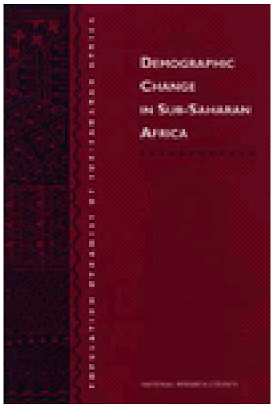

Demographic Change in Sub-Saharan Africa

Karen A. Foote, Kenneth H. Hill, and Linda G. Martin, Editors; Panel on the Population Dynamics of Sub-Saharan Africa, National Research Council

ISBN: 0-309-56432-8, 396 pages, 6 x 9, (1993)

POPULATION DYNAMICS OF SUB-SAHARAN AFRICA

DEMOGRAPHIC CHANGE IN SUB-SAHARAN AFRICA
DEMOGRAPHIC EFFECTS OF ECONOMIC REVERSALS IN SUB-SAHARAN AFRICA
EFFECTS OF HEALTH PROGRAMS ON CHILD MORTALITY IN SUB-SAHARAN AFRICA
FACTORS AFFECTING CONTRACEPTIVE USE IN SUB-SAHARAN AFRICA
POPULATION DYNAMICS OF KENYA
POPULATION DYNAMICS OF SENEGAL
SOCIAL DYNAMICS OF ADOLESCENT FERTILITY IN SUB-SAHARAN AFRICA

NOTE: This map, which has been prepared solely for the convenience of readers, does not purport to express political boundaries or relationships. The scale is a composite of several forms of projection.

DEMOGRAPHIC CHANGE IN SUB-SAHARAN AFRICA

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Karen A.Foote, Kenneth H.Hill, and Linda G.Martin, Editors

Panel on the Population Dynamics of Sub-Saharan Africa
Committee on Population
Commission on Behavioral and Social Sciences and Education
National Research Council

NATIONAL ACADEMY PRESS
Washington, D.C. 1993

NATIONAL ACADEMY PRESS 2101 Constitution Avenue, N.W. Washington, D.C. 20418

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Library of Congress Catalog Card No. 93–85568

International Standard Book Number 0-309-04942-3

Additional copies of this report are available from: National Academy Press, 2101 Constitution Avenue, N.W., Box 285, Washington, D.C. 20418. Call 800–624–6242 or 202–334–3313 (in the Washington Metropolitan Area).

B166

Printed in the United States of America

PANEL ON THE POPULATION DYNAMICS OF SUB-SAHARAN AFRICA

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Preface

This report is one in a series of studies that have been carried out under the auspices of the Panel on the Population Dynamics of Sub-Saharan Africa of the National Research Council (NRC) Committee on Population. The Research Council has a long history of examining population issues in developing countries. In 1971 it issued the report *Rapid Population Growth: Consequences and Policy Implications*. In 1977, the predecessor Committee on Population and Demography began a major study of levels and trends of fertility and mortality in the developing world that resulted in 13 country reports and 6 reports on demographic methods. Then, in the early 1980s, it undertook a study of the determinants of fertility in the developing world, which resulted in 10 reports. In the mid- and late-1980s, the Committee on Population assessed the economic consequences of population growth and the health consequences of contraceptive use and controlled fertility, among many other activities.

No publication on the demography of sub-Saharan Africa emerged from the early work of the committee, largely because of the paucity of data and the poor quality of what was available. However, censuses, ethnographic studies, and surveys of recent years, such as those under the auspices of the World Fertility Survey and the Demographic and Health Survey programs, have made available data on the demography of sub-Saharan Africa. The data collection has no doubt been stimulated by the increasing interest of both scholars and policymakers in the demographic development of Africa and the relations between demographic change and socioeconomic developments. In response to this interest, the Committee on Population held a meeting in 1989 to ascertain the feasibility and desirability of a major study of the demography of Africa, and decided to set up a Panel on the Population Dynamics of Sub-Saharan Africa.

The panel, which is chaired by Kenneth Hill and includes members from Africa, Europe, and the United States, met for the first time in February 1990 in Washington, D.C. At that meeting the panel decided to set up six working groups, composed of its own members and other experts on the demography of Africa, to carry out specific studies. Four working groups focused on cross-national studies of substantive issues: the social dynamics of adolescent fertility, factors affecting contraceptive use, the effects on mortality of child survival and general health programs, and the demographic effects of economic reversals. The two other working groups were charged with in-depth studies of Kenya and Senegal, with the objective of studying linkages between demographic variables and between those variables and socioeconomic changes.

The panel also decided to publish a volume of papers reviewing levels and trends of fertility, the proximate determinants of fertility, nuptiality, child mortality, adult mortality, internal migration, and international migration, as well as the demographic consequences of the AIDS epidemic. This volume comprises those eight papers.

As is the case for all of the panel's work, this report would not have been possible without the cooperation and assistance of the Demographic and Health Survey (DHS) program of the Institute for Resource Development/Macro Systems. We are grateful to the DHS staff for responding to our inquiries and facilitating our early access to the survey data.

We are also grateful to the organizations that provided financial support for the work of the panel: the Office of Population and the Africa Bureau of the Agency for International Development, the Andrew W.Mellon Foundation, the William and Flora Hewlett Foundation, and the Rockefeller Foundation. Besides providing funding, the representatives of these organizations were a source of information and advice in the development of the panel's overall work plan.

The editors would also like to express their gratitude to all of the authors. In addition to writing the papers, the authors were exceedingly gracious in responding to the many questions that were asked of them throughout the preparation of this volume. They would also like to recognize the efforts of Dominique Meekers in coordinating the early work on this volume and of Janet Ewing for providing bibliographic assistance. Finally,

special thanks are also due Paula Melville for superb administrative support, Florence Poillon for skillful copyediting of the volume, Elaine McGarraugh for meticulous production assistance, and Eugenia Grohman for ably coordinating the review and editing process.

SAMUEL H.PRESTON, *Chair*
Committee on Population

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1

Introduction

Linda G.Martin, Kenneth H.Hill, and Karen A.Foote

The first systematic attempt to describe the population dynamics of sub-Saharan Africa dates back to Kuczynski's *Demographic Survey of the British Colonial Empire,* published in two volumes in 1948 and 1949.[1] Despite its wealth of fascinating anecdotal information, Kuczynski's broad conclusion was that very little of a substantive nature could be said with confidence on the basis of the data then available. By the early 1960s, and the next attempt at a broad review, both data bases and methodological procedures had improved substantially. The Office of Population Research at Princeton University was able to compile estimates of demographic parameters for national and subnational populations encompassing more than half the population of the region (Brass et al., 1968).

The most striking feature of the demographic estimates published by the Princeton project was the wide variation in rates within and between countries. Coale (1968), in a paper prepared for the First African Population Conference, reported birth rate estimates that ranged from 30 to 60 births per 1,000 population, and total fertility estimates ranging from 3.5 to more than 8.0 children per woman. Mortality estimates were regarded as

[1]Unless otherwise specified, "Africa" refers to sub-Saharan Africa throughout this volume.

Linda G.Martin is director and Karen A.Foote is a research associate for the Committee on Population at the National Research Council. Kenneth H.Hill is professor in the Department of Population Dynamics at Johns Hopkins University.

less well founded, but the crude death rate was estimated to range from 15 to 40 deaths per 1,000, the infant mortality rate from less than 100 to more than 300 deaths per 1,000 live births, and the expectation of life at birth from less than 30 to more than 45 years.

These early analyses of African data were able to draw approximate conclusions about levels of fertility and mortality, but the nature of the data and methods available precluded anything more concrete than speculation about changes over time. However, Caldwell (1968:11) wrote that "the conviction is widespread that death rates are falling, perhaps rapidly," though also noting "that as yet no major fall in fertility has been experienced…" (p. 14). Coale (1968:186) speculated that "tropical Africa is in the early phase of rapidly accelerating population growth."

We now know that Caldwell and Coale were correct with respect to both mortality decline and rapidly accelerating population growth. In 1960, Harold MacMillan, the British prime minister who presided over dismantling the British colonial empire in Africa, described the "wind of change" of national political consciousness that was blowing through the continent. A wind of demographic change was also beginning to blow. However, it was not until the late 1970s that good-quality demographic data became available to quantify trends. Until that time, censuses were few, far between, and of limited content, and surveys were usually neither nationally representative nor comparable across countries.

The World Fertility Survey (WFS) Program, which included surveys in nine sub-Saharan African countries in the late 1970s and early 1980s, in combination with the 1970 and 1980 rounds of censuses, provided much needed new information to policymakers and stimulated new research (see, for example, International Union for the Scientific Study of Population, 1988; van de Walle et al., 1988). However, that new research, combined with reversals of economic progress in many parts of Africa in the 1980s, generally did not offer much hope for rapid change in the underlying parameters of the population dynamics of sub-Saharan Africa.

In 1989, the World Bank (1989:40) concluded:

> Significant improvement in living standards cannot be achieved over the long term unless population growth is slowed. On current trends Africa will increasingly be unable to feed its children or find jobs for its school leavers.

Estimates and projections made by the United Nations (1991) indicate that the population of the region increased from about 225 million in 1960 to 527 million in 1990. Over the past 30 years, fertility appears to have changed little, the birth rate remaining stable at 47 to 49 per 1,000. Mortality fell, though not as fast as in some other areas of the world: The crude death rate fell from about 24 per 1,000 in the early 1960s to 16 per 1,000 in the late 1980s, with infant mortality falling from 164 per 1,000 live births to 109, and life expectancy at birth increasing from 41 to 53 years. The age distribution has remained youthful: About 45 percent of the population was under the age of 15, and 3 percent was aged 65 or over during 1960 to 1990.

The United Nations' medium projection indicates that the population of the region will increase enormously, to 1.4 billion by 2025, with no substantial change in the youthful age structure until after 2015. By comparison, between 1990 and 2025, the population in Latin America is projected to increase from 448 to 757 million and that in Asia from 3.1 to 4.9 billion.

The African population projection assumes that fertility decline will begin and mortality decline will continue in the coming decades. However, until the late 1980s there was little evidence of any change in fertility. Since then, many changes have occurred in sub-Saharan Africa. Although population growth rates remain high, signs of reductions in fertility are appearing in several populations once regarded as having little or no prospect of lower levels of reproduction in the short term. Child mortality continues to decline in many areas, but the decline may have stagnated or even reversed in some countries, and the AIDS epidemic threatens to increase mortality among young adults in some African countries. Cities are growing rapidly, and flows of refugees due to war and political instability have been great.

At the same time, the quantity, quality, and availability of data on demographic processes in Africa have improved. This improvement has resulted from the Demographic and Health Survey (DHS) Program, which included surveys in 13 sub-Saharan African populations as of 1991, as well as from the release of additional results from the 1980 round of censuses and early results from the censuses of the 1990 round. National survey programs have often added useful information as well. Moreover, analytical procedures for dealing with incomplete or inaccurate data improved in both flexibility and scope during the 1980s, and there has been a growth in the number of African demographers and research institutions.

Accordingly, the Committee on Population of the National Research Council in 1989 established a Panel on the Population Dynamics of Sub-Saharan Africa with the charge of describing and explaining demographic changes in the region. The panel decided to conduct six formal studies, two in-depth studies of population and socioeconomic change in individual countries—Kenya and Senegal—and four analyses and cross-national comparisons of substantive population issues of particular concern in sub-Saharan Africa. The topics selected for these substantive studies were the social dynamics of adolescent fertility, factors affecting contraceptive use, demographic effects of economic reversals, and mortality effects of child survival and general health programs. The panel formed a working group of experts to carry out each of the substantive and country studies.

The panel also thought that it would be useful to both scholars and policymakers to have an up-to-date review of the levels and trends of demographic phenomena that would serve as a backdrop for the studies by the working groups. The topics selected for the review were fertility, the proximate determinants of fertility, nuptiality, child mortality, adult mortality, population distribution and internal migration, and international migration. Given the growing importance of AIDS, the panel also decided to include a review of models that have been designed to estimate the demographic implications of AIDS. A series of papers on the above topics were commissioned from experts, who were asked not to try to explain the changes, because explanation was the focus of the six working groups; rather they were asked to document actual levels, trends, and differentials to the degree that the data would allow. The eight papers appear as Chapters 2–9 in this volume.[2]

In Chapter 2, Barney Cohen reviews levels, differentials, and trends in fertility for more than 30 countries from 1960 to 1992. He finds evidence of fertility decline in Botswana, Kenya, and Zimbabwe, confirming the basic results of the DHS. What is new here though is his finding that the fertility decline appears to have occurred across cohorts of women at all parities, rather than just among women at middle and higher parities, as might have been expected on the basis of experience in other parts of the world. He also presents evidence that fertility may have begun to fall in parts of Nigeria and possibly in Senegal.

In Chapter 3, Carole Jolly and Jay Gribble use the proximate determinants framework and DHS data for 12 sub-Saharan African populations to estimate the contributions to fertility limitation of marriage patterns, contraceptive use, postpartum infecundability, and primary sterility. Besides analyzing national patterns, they also investigate patterns by age, education, and residence, and analyze how the roles of proximate determinants changed between the dates of the WFS and the DHS for the four countries that participated in both programs. Postpartum infecundability continues to play the most important role in reducing fertility. Marriage patterns also reduce fertility substantially, especially in urban areas and among women with more education. Contraceptive use remains low, except in Botswana, Kenya, and Zimbabwe. A comparison of the proximate determinants based on

[2]In an attempt to standardize the countries considered in this volume, the authors were each asked to include countries that are located on the continent of Africa below the Sahara and that have populations of more than one million. The only exception to this general rule is the possible inclusion of Madagascar. Some authors also included Sudan, which, according to the United Nations, is not part of sub-Saharan Africa. When the data for Sudan refer to only the northern part of the country, they are referred to as regional, rather than national.

WFS and DHS data indicates that the fertility decline in Kenya has been due primarily to a change in contraceptive use.

Etienne van de Walle tackles the challenge of teasing out trends in marriage in Chapter 4. Different data collection strategies in surveys and censuses, combined with the processual nature of union formation in sub-Saharan Africa, make it difficult to document trends with the data at hand. Van de Walle concludes that age at marriage appears to have been increasing, with women in countries in eastern and southern Africa generally having average ages of marriage of 20 years or higher, but women in western and middle Africa having relatively low ages at marriage. He also reviews the evidence for a connection between changes in marriage patterns and fertility patterns, and finds that the direct effect of later marriage on fertility may be diluted in some African populations by the incidence of premarital sexual activity.

In Chapter 5, Althea Hill uses data from surveys and censuses to estimate the trends in child mortality in the 1970s and 1980s. The news is generally good, with earlier declines continuing into the 1980s, although there are unhappy exceptions especially in countries that have suffered from political instability. In the past, mortality tended to be higher in the northern and western parts of sub-Saharan Africa, as opposed to the southern and eastern parts, but as of the late-1980s, this differential appears to have weakened.

Ian Timæus describes levels, trends, and patterns of adult mortality in Chapter 6. Once again, the results are mixed. Adult mortality in sub-Saharan Africa remains high by world standards, but the evidence suggests that there was considerable decline during the 1960s and 1970s, especially in western Africa. He notes that in the countries that have been most successful in reducing overall mortality, adults have tended to benefit more than one would have expected on the basis of mortality declines in other parts of the world. Furthermore, the limited data available suggest that there are considerable differentials in adult mortality within African populations by area, urban and rural residence, and socioeconomic status.

In Chapter 7, John Oucho and William Gould review patterns of internal migration, urbanization, and population distribution in sub-Saharan Africa. They find that rural-to-rural migration remains more important than rural-to-urban migration, although urbanization is occurring. It is expected that by the year 2000, one-third or more of the population will live in urban areas in all the subregions except East Africa.

Sharon Russell highlights in Chapter 8 the fact that the number of migrants in sub-Saharan Africa is much larger than might be expected on the basis of population size alone. She finds that movements of refugees have been most important in East Africa, whereas migration for employ ment has dominated elsewhere. Overall, West Africa has the highest concentration of international migrants.

Finally, in Chapter 9, Mike Stoto reviews models of the demographic effect of AIDS in Africa and finds that the predicted effects range from minor to substantial. Despite this variability, he is able to conclude that the most likely effects will be on mortality of children and young adults. However, little effect on broad population age distributions is expected. Less certain are the overall implications for population growth; growth rates are likely to be lower as a result of AIDS, but it is not clear how large the effects will be over the next few decades.

Together, these eight chapters document considerable change in the population dynamics of sub-Saharan Africa. Much remains uncertain about the future, especially given the spread of AIDS. Continuing emphasis on data collection, particularly on the conduct of regular censuses and sample surveys on specific topics, is essential. Data from the latter tend to be especially useful in explaining demographic change. Continuing support for data analysis and for demographic research centers in the region must also be given high priority. There is little doubt that a second “wind of demographic change,” the second stage of the demographic transition, is starting in some countries of Africa where fertility is beginning to fall. This process needs to be monitored and data and analyses provided to policy makers. We believe that the six reports of the working groups of the Panel on the Population Dynamics of Sub-Saharan Africa, along with the chapters in this volume, represent a useful step forward, but it is only one among the many necessary steps needed for substantial progress in understanding population change in Africa.

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2

Fertility Levels, Differentials, and Trends

Barney Cohen

INTRODUCTION

Fertility rates are higher in sub-Saharan Africa (Africa) than in any other major region of the world, and considerable controversy surrounds the likelihood of these rates declining in the near future. Although mortality and fertility rates fell substantially in Latin America and Asia between 1965 and 1985, only mortality declined in Africa; fertility remained relatively stable, well above a level required to replace the population. Consequently, the region experienced extremely rapid population growth, with rates for some populations considerably above 3 percent per year (United Nations, 1991; Freedman and Blanc, 1992). A few countries, most notably Kenya, Botswana, and Zimbabwe, have begun the transition toward lower fertility, but smaller declines in fertility have been observed recently in many other countries. Nevertheless, fertility rates generally remain above six children per woman, and the question of whether Africa is more resistant to fertility change than other regions of the world is a topic of considerable debate

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Barney Cohen is a research associate for the Committee on Population, National Research Council. He thanks Anouch Chahnazarian, James Gribble, Carole Jolly, and the editors for helpful comments on an earlier draft. The author is also grateful to George Bicego, Bill Chu, Timothy Fowler, Ronald Freedman, Bill House, Vasantha Kandiah, Tim Miller, Sidney Moore, and Pat Rowe for their help in providing some of the data used in this report. Anne Scott assisted with the computer programming of the B_{60}s.

(Boserup, 1985; World Bank, 1986; Caldwell and Caldwell, 1987, 1988, 1990; Lesthaeghe, 1989; van de Walle and Foster, 1990; Caldwell et al., 1992).

The level of fertility in sub-Saharan Africa, as measured by the total fertility rate (TFR),[1] is approximately 6.0–6.5 births per woman. This figure masks considerable variation between regions and between individual countries. For example, the most recent estimate of the total fertility rate in Rwanda (8.5 births per woman in 1983) is almost double the most recent estimate for the population of black South Africa (4.6 births per woman in 1987–1989). More generally, fertility rates in East and West Africa are greater than those in Central Africa, in part because of the historically high prevalence of sexually transmitted diseases (STDs) in certain areas of Central Africa (Frank, 1983; Tambashe, 1992). The prevalence of STDs is associated with unusually high rates of infecundability in the region especially prior to the 1970s. Fertility was probably higher in East Africa than in West Africa during the 1970s and 1980s, although the difference appears to have lessened in the more recent past. Reported fertility rates rose in certain parts of Africa in the late 1960s and 1970s; however, it is not clear what proportion of the increase was the result of improvements in data accuracy.

In addition to the regional and national variation in fertility rates, there is often considerable variation in fertility within countries. Repeatedly, fertility surveys have recorded substantial differences in rates among ethnic, geographic, and socioeconomic groups. For example, fertility rates are consistently lower among women who live in urban areas, women who have more than primary school education, and women who work in the formal labor market. In Africa, the number of women in each of these socioeconomic groups has, at least until recently, been small, and the groups overlap considerably. Consequently, lower fertility among these women has a minimal effect on national-level TFRs.

The objective of this chapter is to summarize existing knowledge on levels, trends, and differentials in achieved fertility in sub-Saharan Africa. Although there have been several comprehensive reviews of fertility levels in Africa in the past (see, for example, Brass et al., 1968; Page and Coale, 1972; United Nations, 1987), new sources of data make it possible to update

[1]There is no single, readily agreed upon best measure of fertility. The total fertility rate is a synthetic measure that expresses the total number of children a hypothetical woman would have if she survived to the end of her reproductive years (taken to be 49) and if she experienced the same level and pattern of fertility throughout her reproductive life as women at the time the data are collected. An advantage of using the TFR over other measures of fertility, such as the crude birth rate, is that it is independent of the age structure of the population.

the analysis to the early 1990s. By employing a wide variety of data sources, including some that have not been readily accessible in the past, estimates of fertility rates are presented for virtually all countries in sub-Saharan Africa.

True understanding of fertility trends in Africa is clouded by the extremely variable quality of demographic data in the region. Close examination of much of the data reveals gross inconsistencies that are the result of misreporting of ages and omitting or systematically displacing vital events. In an attempt to correct for obvious data errors, a mixture of direct and indirect estimation techniques is used to determine fertility rates. The indirect techniques are based on the examination of inconsistences within the reported data or on comparisons of observed data to values expected from various demographic models.

The chapter is organized as follows: Issues of data availability and quality are discussed in the following section. In the third section, four methods for estimating TFRs are presented. Characteristics of African fertility are presented in the fourth section. Next, recent data from the Demographic and Health Surveys are used to examine the possible evidence for declining fertility levels in Africa. The penultimate section compares recent fertility trends in Africa to those in other developing areas of the world. Finally, there is a summary and some concluding observations.

SOURCES AND QUALITY OF DEMOGRAPHIC DATA IN AFRICA

The state of demographic data collection in Africa has recently been reviewed by de Graft-Johnson (1988). Despite dramatic improvements since the 1960s, our knowledge and understanding of fertility levels and trends in Africa are still surprisingly weak. Until 1960, virtually no sub-Saharan African country had conducted a complete census. Consequently, little was known about the size or structure of the region's population. In the few countries where censuses were undertaken, they were often unreliable and of very limited content. A fundamental problem facing researchers in Africa was that a large percentage of the adult population was unable to report its age accurately. Further, many early censuses did not include questions related to the number of children ever born and childhood mortality. In addition, vital registration data were virtually nonexistent throughout the region and, when available, were of questionable quality.

Fortunately, demographic data collection in Africa has improved considerably over the last 30 years. Although vital registration is still rare, most countries have conducted one and in many cases several censuses, though quality has been uneven. In addition, many countries have supplemented efforts to collect reliable demographic data with various *ad hoc* national and subnational household demographic surveys. Some of the most accurate information comes from these large-scale demographic surveys. In particular, the World Fertility Surveys (WFS), an international data collection effort undertaken from the mid-1970s to the early 1980s, and the ongoing Demographic and Health Surveys (DHS) begun in the mid-1980s, have generated a reasonably accurate data base for calculating fertility levels and differentials for countries in sub-Saharan Africa. The WFS carried out surveys in nine sub-Saharan African countries: To date, the DHS has published demographic reports for 13 sub-Saharan African countries and issued preliminary results for 4 others. Reports for 4 additional African countries are scheduled for release by the end of 1993. Special attention is given in this chapter to the DHS because it is the source of most of the recent demographic data on Africa.

The quality of DHS data was recently analyzed by DHS staff and found to be generally acceptable. But, in cases where data problems were identified, they were determined to be most severe in sub-Saharan Africa in comparison to other regions of the developing world (Institute for Resource Development, 1990:2). For example, Arnold (1990) identified errors in the coverage and timing of births, including (1) systematic displacement of children's birth dates, (2) disproportionate numbers of women's ages heaped on digits ending in 0 and 5, and (3) missing or incomplete information in some birth histories. These problems were determined to be most severe in Botswana, Burundi, Liberia, Mali, and Togo. Problems in the first category arose, in part, because some interviewers appear to have deliberately altered the ages of children under 5 to avoid asking an extensive series of questions on the health and well-being of young children. A second assessment of the quality of DHS data focused on women's age at first birth and judged that response problems were most severe in African countries, especially Mali and Liberia (Blanc and Rutenberg, 1990). The African data suggest that some women omit information about early births or displace the dates of low-parity births forward in time, making children appear younger than they really are. Finally, Rutstein and Bicego (1990) report that less than 80 percent of women interviewed in Africa provide accurate birth dates for their children.

Fortunately, the effect of displacement problems on fertility levels is relatively minor. For example, Arnold and Blanc (1990) calculate that without any displacement, the total fertility rate in Liberia, the country with the most displacement, would have been 6.5 instead of 6.3 births per woman between 1983 and 1988. Nevertheless, it is important to acknowledge that there is always the danger of drawing incorrect conclusions from data collected in areas where vital events go unrecorded. Consequently, a single point estimate of fertility from Africa should be interpreted with some caution.

In this chapter, DHS and WFS data are supplemented by data collected in censuses and other national demographic surveys. Where no other information was available these data are augmented with findings from large-scale subnational studies. Data from small-scale studies conducted at the district or provincial level have not been used due to concerns regarding their generalizability.

Naturally, censuses and surveys are carried out in different countries at different times. But, unlike the estimates presented by several organizations (including the United Nations and the U.S. Bureau of the Census), the estimates presented here are not standardized on a specific year. Rather, the current goal is to present the reader with the original data from which standardized estimates are derived.

METHODS FOR ESTIMATING TOTAL FERTILITY RATES

Four distinct strategies are used here to obtain independent estimates of fertility. The first strategy is to calculate fertility directly, without adjusting for any apparent inconsistencies in the data. This method requires information on the number of women of childbearing age, their ages, and the number of births to these women during a given time period, typically five years. Direct estimates of fertility are reported only when the quality of the data was thought to be adequate, for example, as in all the WFS and the DHS. In these cases, fertility estimates are derived by using retrospective birth histories.

Experience has shown, however, that response errors in census and survey data can often lead to biased or inaccurate estimates of the fertility rate. Response errors in birth history data arise mainly from age misreporting and the omission or systematic displacement of vital events. For example, many women incorrectly report their own age or the ages of their children. Similarly, in the absence of written records, women often forget births that occurred in the distant past and make systematic errors when estimating the timing and spacing of events (Potter, 1977). Older women, women with little education, women who were not in sanctioned unions at the time of their first birth, and women whose children have moved away or died are particularly likely to make these types of errors. Obvious errors, such as birth intervals of less than 6 months or first births to women under 10 years of age, can often be detected by the interviewer or the researcher and perhaps corrected by cross-referencing birth dates with well-known historical events. Errors resulting from omitted births are much harder to correct.

Demographers have developed alternative methods designed to improve their ability to make “indirect” inferences about fertility from poor or incomplete data (Brass et al., 1968; United Nations, 1983). Most of these methods involve the identification of internal inconsistencies in the reported data or the comparison of observed data to model fertility schedules. In cases where the direct and indirect estimates of fertility are substantially different, the indirect estimates are usually preferred. Three of the four strategies used in this chapter employ indirect techniques.

One strategy is based on the principle of comparing reported births in a given time period with women's responses to questions regarding the number of children ever born. A full description of this method (commonly called the method of P/F ratios) can be found in United Nations (1983). The data requirements for this method are identical to those for direct estimation except that they include information about the number of children ever born. Where the data allowed, this technique was used to check and, if necessary, to adjust the survey or census estimates for apparent misreporting. Unfortunately, because this method relies on equating current and past experiences, it has the potential for producing biased estimates of the total fertility rate when fertility has recently declined (United Nations, 1983:32). Nonetheless, at least for the earlier time periods, this method arguably produces the most accurate estimates possible.

Because early censuses often did not include specific questions on fertility, the age structure of the population may be the only information available to estimate the total fertility rate. In these cases, fertility estimates are inferred by using stable population theory, which is based on assumptions of constant fertility and mortality. The only data requirements for these estimates are the age structure of the population, the growth rate, and an estimate of the level and pattern of mortality. Because results from this estimation method are not particularly robust and are quite sensitive to different mortality assumptions, it is used only in the absence of other alternatives. In an attempt to check the robustness of these approximations, similar estimates are also derived by using a method developed by Coale (1981) and later extended by Venkatacharya (1990). This method, labeled the Coale method, also relies on stable population theory and requires an estimate of the population growth rate, the proportion of both sexes under the age of 15, and an estimate of mortality for children up to age 5. Assuming constant fertility rates for the population under consideration, Coale (1981) suggested that his method would yield reasonable estimates of the total fertility rate for 7.5 years prior to the census date, even if the census or survey was characterized by severe age misreporting.[2]

[2]Another indirect method, the "variable-r" technique suggested by Preston (1983), was dropped after it was ascertained that age structure data in the earlier African censuses were not of sufficiently high quality to provide accurate independent estimates of the fertility rate.

CHARACTERISTICS OF AFRICAN FERTILITY

Estimates of Total Fertility Rates

Table 2–1 provides estimates of the TFR for 38 African countries for which data were available at some point during 1960–1992. For ease of comparison, all estimates were converted into point estimates of the total fertility rate. In reality, a particular figure may be the midpoint of a range of plausible estimates. Table 2–1 highlights the paucity of demographic data in many African countries. Despite considerable improvements in the availability of data during the past 10 years, 12 countries still have fewer than four data points since 1960. In other cases, although data exist, they are of extremely variable quality. Consequently, fertility trends over time may appear more erratic than they truly are. For example, in Ethiopia, the data imply a substantial increase in fertility during the 1970s followed by a rapid decline in the 1980s. Both trends are almost certainly exaggerated.

Although the data are often sketchy, several important conclusions may still be drawn about fertility in Africa. Few countries in Africa have TFRs less than 6.0, and nowhere is fertility currently less than 4.0 births per women, a rate well above that required for replacement. Africans have a strong preference for large families. Children are prized not only as the means of preserving family lines, but as positive economic assets that provide labor, wealth, risk insurance, and old-age security to their parents.

In the past, high fertility in Africa resulted from early and near universal marriage,[3] and extremely low rates of efficient contraception. Fertility has been controlled (outside geographic areas of pathological sterility) by social pressures against premarital sex, the practice of postpartum sexual abstinence, and long breastfeeding periods that lead to lengthy lactational amenorrhea (see Chapter 3; also Caldwell and Caldwell, 1977, 1987; Page and Lesthaeghe, 1981). Bongaarts et al. (1990) recently estimated that fertility in Africa would increase by 72 percent if the fertility-inhibiting effects of breastfeeding and postpartum abstinence were removed. These fertility-reducing practices have probably evolved principally to ensure exceptionally long birth intervals in an effort to combat high rates of infant mortality. Recently there are signs that some of these cornerstones of African fertility may be weakening (see Chapter 3; also Schoenmaeckers et al., 1981; Caldwell et al., 1992; Westoff, 1992).

[3]Divorce is common in Africa but so is remarriage, particularly if the woman is still in her reproductive years, so the total time lost to exposure to the risk of childbearing may be small (Smith et al., 1984). Several institutions, including polygamy and the levirate, a practice whereby a widow automatically remarries a close relative of the deceased (often his brother), facilitate quick remarriage following widowhood.

TABLE 2-1 Fertility Estimates for Various Sub-Saharan African Countries, 1960-1992

Country	Date of Estimate	TFR[a,b]	Data and Methodology[c]	Reference
Western				
Benin	1961	6.9	Demographic Survey, Dahomey	Benin (1988)
	1965	7.1	World Fertility Survey, 1981-1982	Cochrane and Farid (1989)
	1970	7.0	World Fertility Survey, 1981-1982	Cochrane and Farid (1989)
	1975	7.0	World Fertility Survey, 1981-1982	Cochrane and Farid (1989)
	1979	7.3	Census; stable population theory	United Nations (1984)[d]
	1980	7.1	World Fertility Survey, 1981-1982	Cochrane and Farid (1989)
Burkina Faso	1960-1961	6.2	National demographic survey	Burkina Faso (n.d.)[e]
	1960	6.6	Census; stable population theory	United Nations (1979)[d]
	1969	6.4	1975 census (Coale method)	United Nations (1984)[d]
	1973-1974	7.2	Subnational survey	U.S. Department of Commerce (1979)
	1976	6.7	Postenumeration survey	Burkina Faso (n.d.)[e]
	1985	7.2	Census	Burkina Faso (n.d.)[e]
Côte d'Ivoire	1963	7.5	World Fertility Survey, 1980-1981	Cochrane and Farid (1989)
	1962-1964	6.4	National demographic survey	U.S. Department of Commerce (1979)
	1968	7.5	World Fertility Survey, 1980	Cochrane and Farid (1989)
	1973	7.9	World Fertility Survey, 1980-1981	Cochrane and Farid (1989)
	1975	6.9	Census; stable population theory	United Nations (1990)[d]
	1978	7.7	World Fertility Survey, 1980-1981	Cochrane and Farid (1989)
	1978-1979	6.9	National survey; P/F ratios	Ahonzo et al. (1984)
	1981	7.4	1988 census; Coale method	Lopez-Ecartin (1992e)[d]
	1988	6.8	Census; method of estimation not stated	Lopez-Escartin (1992e)[f]
The Gambia	1973	6.4	Census; P/F ratios	The Gambia (1976)
	1983	6.9	Census; stable population theory	United Nations (1990)
	1983	6.4	Census; P/F ratios	The Gambia (1987)
Ghana	1960	7.2	Postenumeration survey	U.S. Department of Commerce (1979)
	1960-1964	7.2	World Fertility Survey, 1979-1980	Singh et al. (1985)

Country	Date of Estimate	TFR[a,b]	Data and Methodology[c]	Reference
Ghana	1965-1969	7.0	World Fertility Survey, 1979-1980	Singh et al. (1985)
	1968-1969	7.1	National demographic survey, second round	U.S. Department of Commerce (1979)[f]
	1970	7.3	Census; stable population theory	United Nations (1979)
	1970-1974	6.9	World Fertility Survey, 1979-1980	Singh et al. (1985)
	1978	6.2	1984 census; Coale method	Ghana (n.d.)[e]
	1975-1979	6.5	World Fertility Survey, 1979-1980	Singh et al. (1985)
	1982-1984	6.6	Demographic and Health Survey, 1988	Ghana (1989)
	1985-1988	6.4	Demographic and Health Survey, 1988	Ghana (1989)
Liberia	1967	6.8	1974 census; Coale method	United Nations (1984)[d]
	1970-1971	6.3	Liberian population growth survey	U.S. Department of Commerce (1979)
	1974	6.2[g]	Census	Chieh-Johnson et al. (1988)
	1977	6.6	1984 census; Coale method	Liberia (n.d.)[d,e]
	1980-1982	7.0	Demographic and Health Survey, 1986	Chieh-Johnson et al. (1988)
	1983-1986	6.8	Demographic and Health Survey, 1986	Chieh-Johnson et al. (1988)
Mali	1960-1961	7.4	Demographic survey	Traoré et al. (1989)
	1976	6.3	Census; stable population theory	United Nations (1984)[d]
	1981-1983	7.1[g]	Demographic and Health Survey, 1987	Traoré et al. (1989)
	1984-1986	6.9	Demographic and Health Survey, 1987	Traoré et al. (1989)
	1987	6.8	Census; method of estimation not stated	Lopez-Escartin (1992a)[f]
Mauritania	1964-1965	5.7	Demographic survey	U.S. Department of Commerce (1979)
	1962-1966	6.5	World Fertility Survey, 1981	Cochrane and Farid (1989)
	1967-1971	6.9	World Fertility Survey, 1981	Cochrane and Farid (1989)
	1972-1976	7.2	World Fertility Survey, 1981	Cochrane and Farid (1989)
	1977	7.0	Census; stable population theory	United Nations (1990)[d]
	1977-1981	6.3	World Fertility Survey, 1981	Cochrane and Farid (1989)
	1988	6.3	Census; stable population theory	Lopez-Escartin (1992b)[d]
Niger	1960	6.9	Demographic survey; P/F ratios	U.S. Department of Commerce (1979)[f]

	1977	7.0	Census; stable population theory	United Nations (1984)[d]
	1988	7.1	Census; P/F ratios	Niger (1992a)[e]
	1992	7.4	Demographic and Health Survey, 1992 (preliminary)	Niger (1992b)
Nigeria	1965	6.6	World Fertility Survey, 1981-1982	Cochrane and Farid (1989)
	1970	6.5	World Fertility Survey, 1981-1982	Cochrane and Farid (1989)
	1971-1973	7.3	National fertility survey; P/F ratios	U.S. Department of Commerce (1979)[f]
	1975	7.0	World Fertility Survey, 1981-1982	Cochrane and Farid (1989)
	1980	6.3	World Fertility Survey, 1981-1982	Cochrane and Farid (1989)
	1990	6.2	Demographic and Health Survey II, 1990	Nigeria (1992)
Senegal	1960	5.4	Demographic Survey	U.S. Department of Commerce (1979)
	1959-1963	7.8	World Fertility Survey, 1978	Cochrane and Farid (1989)
	1964-1968	7.7	World Fertility Survey, 1978	Cochrane and Farid (1989)
	1969-1973	7.5	World Fertility Survey, 1978	Cochrane and Farid (1989)
	1970-1971	6.4	National demographic survey	U.S. Department of Commerce (1979)
	1976	7.0	Census; stable population theory	United Nations (1984)
	1974-1978	7.2	World Fertility Survey, 1978	Cochrane and Farid (1989)
	1981	7.3	Provisional 1988 census; Coale method	Senegal (1988)
	1986	6.6	Demographic and Health Survey, 1986	Ndiaye et al. (1988)
	1988	6.3	Census (preliminary estimate based on a 10 percent sample)	Senegal (1992)
Sierra Leone	1967	7.2	1974 census; Coale method	United Nations (1979)
	1973	6.4	Pilot census; P/F ratios	U.S. Department of Commerce (1979)[f]
Togo	1961	7.0	Demographic survey	U.S. Department of Commerce (1979)
	1971	6.6	Census; method of estimation not stated	Lopez-Escartin (1991d)
	1981	6.0	Census	Agounké et al. (1989)
	1982-1984	6.9[g]	Demographic and Health Survey, 1988	Agounké et al. (1989)
	1985-1987	6.5[g]	Demographic and Health Survey, 1988	Agounké et al. (1989)
Middle				
Angola	1960	6.4	Census; stable population theory	United Nations (1979)[d]
	1970	6.7	Census; stable population theory	Lopez-Escartin (1992d)[d]
	1983-1985	8.0	Census; P/F ratios	Angola (n.d.)[e,f]

Country	Date of Estimate	TFR[a,b]	Data and Methodology[c]	Reference
Cameroon	1961	5.3	World Fertility Survey, 1978	Cochrane and Farid (1989)
	1960-1962	4.6	Demographic survey	U.S. Department of Commerce (1979)
	1964	4.9	Subnational demographic survey	Cameroon (1983)
	1966	5.7	World Fertility Survey, 1978	Cochrane and Farid (1989)
	1969	6.4	1976 census; Coale method	United Nations (1983)[d]
	1971	6.5	World Fertility Survey, 1978	Cochrane and Farid (1989)
	1974-1978	6.4	World Fertility Survey, 1978	Cochrane and Farid (1989)
	1976	6.0	Census; P/F ratios	Cameroon (1983)[f]
	1980	6.3	1987 census; Coale method	Lopez-Escartin (1991a)[d]
	1987	5.7	Census; method of estimation not stated	Lopez-Escartin (1991a)[f]
	1991	5.8	Demographic and Health Survey, 1991	Cameroon (1992)
Central African Republic	1959-1960	4.9	National demographic survey	Central African Republic (1964)
	1975	5.7	Census	Central African Republic (1987)
	1988	6.1	Census	Lopez-Escartin (1992c)
Chad	1964	5.4	Subnational sample; P/F ratios	U.S. Department of Commerce (1979)[f]
Congo	1960-1961	4.9	Survey; P/F ratios	Congo (1965)[f]
	1974	5.5	Census	Congo (1978)
	1977	6.5	1984 census; Coale method	Lopez-Escartin (1991e)[d]
	1984	6.6	Census; P/F ratios	Congo (1987)[d]
Equatorial Guinea	1983	5.6	Census	Equitorial Guinea (1991)
Gabon	1960-1961	4.1	Census and demographic survey	Gabon (1965)
	1969-1970	4.5	Census; stable population theory	Lopez-Escartin (1991c)[d]
Zaire	1955-1957	5.1	National demographic survey	Lopez-Escartin (1992f)
	1978	6.2	Census; Coale method	Zaire (1991)[d]
	1984	6.7	Census; method of estimation not stated	Zaire (1991)

Eastern				
Burundi	1964-1965	7.1	National demographic survey	Burundi (1966)
	1970-1971	6.1	National demographic survey; P/F ratios	Burundi (1972)[d]
	1978	6.5	Pilot survey, precensus	Barampanze (1991)
	1979	6.4	Census	Barampanze (1991)
	1981-1983	7.6	Demographic and Health Survey, 1987	Segamba et al. (1988)
	1984-1986	6.9	Demographic and Health Survey, 1987	Segamba et al. (1988)
	1990	7.0	Census; P/F ratios	Thibon (1993)[f]
Ethiopia	1963	7.1	1970 Subnational demographic survey; Coale method	Kidane (1990)[d]
	1964-1967	6.7	National sample survey, first round; stable population theory	Ethiopia (1971)[d]
	1968-1971	5.8	National sample survey, second round; P/F ratios	Ethiopia (1974)[d]
	1970	7.2	Subnational demographic survey; P/F ratios	Kidane (1990)[f]
	1974	7.6	1981 demographic survey; Coale method	Kidane (1990)[d]
	1981	8.8	Demographic survey; P/F ratios	Kidane (1990)[f]
	1984	7.9	Census; P/F ratios	Ethiopia (1991a)[d]
	1990	6.6	Family and fertility survey (preliminary)	Ethiopia (1991b)
Kenya	1962	6.8	Census; authors' assessment from a range of methods	Blacker et al. (1979)[f]
	1969	7.6	Census; authors' assessment from a range of methods	Blacker et al. (1979)[f]
	1972-1973	7.7	Subnational demographic baseline survey	U.S. Department of Commerce (1979)
	1977	8.0	National demographic survey	Kenya (1989)
	1977-1978	7.9	World Fertility Survey, 1977-1978	Kenya (1980)
	1979	7.9	Census; P/F ratios	Kenya (1989)[f]
	1984	7.7	Contraceptive prevalence survey, 1984	Kenya (1984)
	1983-1985	6.8	Demographic and Health Survey, 1988-1989	Kenya (1989)
	1986-1989	6.7	Demographic and Health Survey, 1988-1989	Kenya (1989)

Country	Date of Estimate	TFR[a,b]	Data and Methodology[c]	Reference
Madagascar	1962	6.6	Rural household sample survey	Lopez-Escartin (1991b)
	1966	6.6	National demographic survey	Lopez-Escartin (1991b)
	1968	6.8	1975 census; Coale method	Lopez-Escartin (1991b)[d]
	1975	6.4	Census	Lopez-Escartin (1991b)
Malawi	1966	7.3	Census; stable population theory	United Nations (1979)[d]
	1970	8.1	1977 census; Coale method	Malawi (1980)[d]
	1970-1972	8.0	Population change survey; method of estimation not stated	U.S. Department of Commerce (1979)
	1977	7.6	Census; P/F ratios	Malawi (1980)[f]
	1980	7.5	1987 census; Coale method	Malawi (n.d.)[d,e]
	1982	7.6	National demographic survey	Malawi (1987a)
	1984	7.5	Family formation survey; P/F ratios	Malawi (1987b)[f]
	1987	8.0	Census; P/F ratios	Malawi (1991); Malawi, National Statistical Office, personal communication (1992)[d]
	1992	6.7	Demographic and Health Surveys (preliminary)	Malawi (1993)
Mozambique	1963	6.9	1970 census; Coale method	United Nations (1979)[d]
	1970	6.6	Census; P/F ratios	U.S. Department of Commerce (1979)[f]
	1980	7.0	Census; stable population theory	United Nations (1990)[d]
Rwanda	1970	7.8	National demographic survey; P/F ratios	Rwanda (1973)[f]
	1978	8.7	Census	Rwanda (1984)
	1983	8.5	National demographic survey	Rwanda (n.d.)[e]
Somalia	1975	6.9	Census; P/F ratios	Somalia (1984)[f]
	1980	7.4	National population survey; P/F ratios	Somalia (n.d.)[e,f]
	1983	6.8	Sample survey of five cities	Somalia (1985)

Tanzania	1967	7.2	Census; P/F ratios	Tanzania (n.d.)[e,f]
	1971	7.0	1978 census; Coale method	United Nations (1990)[d]
	1973	6.3	National sample survey; author's assessment from a range of methods	Ewbank (1979)[f]
	1978	6.9	Census; P/F ratios	Tanzania (1983)[f]
	1988	6.5	Census	Tanzania (1990)
	1991-1992	6.3	Demographic and Health Survey, 1981-1982 (preliminary)	Tanzania (1992)
Uganda	1969	6.8	Census; P/F ratios	Uganda (1973)[d]
	1982-1984	7.4	Demographic and Health Surveys, 1988-1989	Kaijuka et al. (1989)
	1985-1988	7.4	Demographic and Health Surveys, 1988-1989	Kaijuka et al. (1989)
Zambia	1967	7.1	1974 sample census; Coale method	United Nations (1979)[d]
	1969	6.9	Census; P/F ratios	Zambia (1985a)[f]
	1973	7.3	1980 census; Coale method	United Nations (1990)[d]
	1974	6.7	Sample census; P/F ratios	Hill (1985)[f]
	1980	7.4	Census; P/F ratios	Zambia (1985b)[f]
	1989-1992	6.5	Demographic and Health Survey, 1992	Gaisie et al. (1993)
Zimbabwe	1962	6.7	1969 census; Coale method	United Nations (1979)[d]
	1969	8.2	Census; P/F ratios	Thomas and Muvandi (1992)[f]
	1975	7.0	1982 census; Coale method	United Nations (1990)[d]
	1982	7.1	Census; P/F ratios	Thomas and Muvandi (1992)[f]
	1984	6.5	Reproductive health survey	Zimbabwe (1989)
	1982-1984	6.7	Demographic and Health Survey, 1988-1989	Zimbabwe (1989)
	1987	5.1	Intercensal demographic survey	Zimbabwe (1989)
	1985-1988	5.5	Demographic and Health Survey, 1988-1989	Zimbabwe (1989)
Southern				
Botswana	1971	6.6	Census; stable population theory	U.S. Department of Commerce (1979)[f]
	1974	6.7	1981 census; Coale method	United Nations (1990)[d]
	1981	7.1	Census	Manyeneng et al. (1985)
	1982-1984	5.9	Demographic and Health Survey, 1988	Lesetedi et al. (1989)
	1984	6.5	Contraceptive prevalence survey	Manyeneng et al. (1985)
	1985-1988	4.9	Demographic and Health Survey, 1988	Lesetedi et al. (1989)

Country	Date of Estimate	TFR[a,b]	Data and Methodology[c]	Reference
Lesotho	1961	5.6	World Fertility Survey, 1977	Cochrane and Farid (1989)
	1966	5.8	World Fertility Survey, 1977	Cochrane and Farid (1989)
	1971	5.5	World Fertility Survey, 1977	Cochrane and Farid (1989)
	1976	5.8	World Fertility Survey, 1977	Cochrane and Farid (1989)
	1976	5.3	Census; stable population theory	United Nations (1990)[d]
	1986	5.2	Census; P/F ratios	Lesotho (1991)[d]
Namibia	1992	5.6	Demographic and Health Survey, 1992 (preliminary)	Namibia (1992)
South Africa (black population only)	1960	6.6	Source and method of estimation not stated	Chimere-Dan (1993)
	1970	5.8	Source and method of estimation not stated	Chimere-Dan (1993)
	1980	5.4	Source and method of estimation not stated	Chimere-Dan (1993)
	1987-1989	4.6	South African Demographic and Health Survey	Mostert (1990)
Swaziland	1966	6.9	Census; method of estimation not stated	U.S. Department of Commerce (1979)
	1976	5.7	Census; stable population theory	United Nations (1984)[d]
	1986	5.1	Census	Warren et al. (1992)
	1988	5.0	Family health survey	Warren et al. (1992)

[a]The TFRs have not always been calculated by using similar recall periods since, in a number of instances, theoretical purity was outweighted by data limitations.

[b]Estimate refers to women aged 15-49 unless marked otherwise.

[c]Where no method is noted, direct estimation was used.

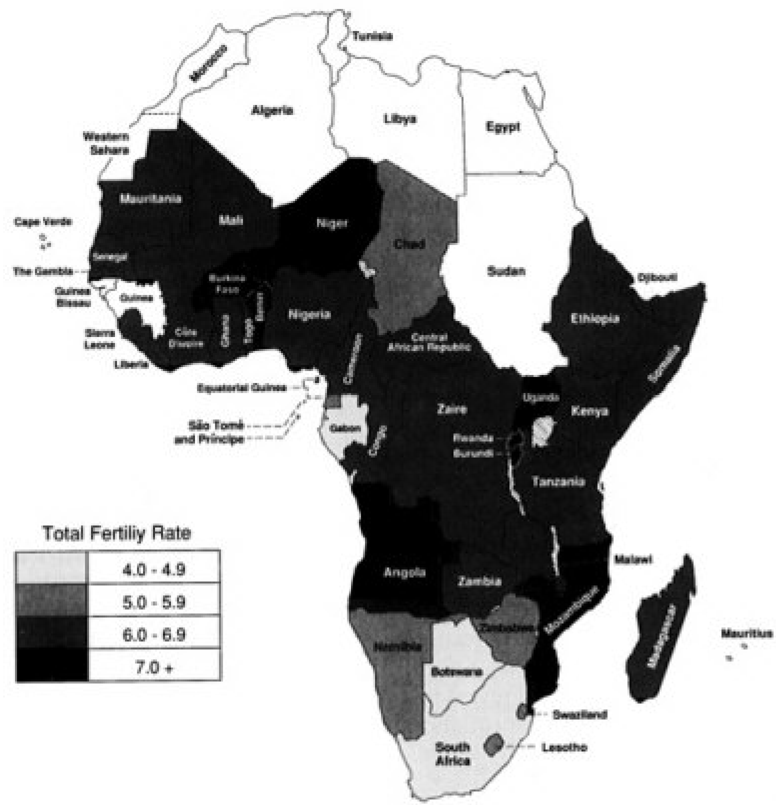
[d]Indirect estimate based on the author's calculations.

[e]n.d. = no date.

[f]Indirect estimate provided in reference.

[g]TFR for women aged 15-44.

Most recent estimates of the TFR in each country are shown in the map (the data for the map are from Table 2–1). African fertility rates are not homogeneous across the continent, and close investigation of demographic data reveals considerable diversity. In the 13 West African countries in Table 2–1, the estimated TFRs lie within a narrow range between 6.2 and 7.4 births per woman. Fertility in West Africa is highest in Niger, where the TFR was estimated to be 7.4 children per woman in 1992, and lowest in Nigeria, where the TFR was estimated to be 6.2 children per woman in 1990. For the 12 East African countries discussed in this chapter, fertility ranges from 5.5 children per woman in Zimbabwe to 8.5 children per woman



Total fertility rates in sub-Saharan Africa. SOURCE: See Table 2–1; estimates are the most recent available.

in Rwanda. In the majority of East African countries the TFR is between 6.4 and 7.0 children per woman.

Average fertility in Central Africa is somewhat lower than it is in either East or West Africa. Fertility in Central Africa was lower during the 1960s and 1970s than elsewhere in Africa because of high levels of infertility and subfecundity. In all probability, the most common cause of infertility in sub-Saharan Africa was a high prevalence of gonorrhea (Frank, 1983). Childlessness is a good indicator of overall infertility, and a rate of childlessness of 3 percent is what one might expect to see in a developing country (Frank, 1983). In Central Africa, the proportion of women aged 45 and over who have not had a live birth ranges from 11 percent in Chad and Angola to more than 20 percent in Congo, Gabon, and Zaire (Frank, 1983).

Fertility estimates are included for five countries in southern Africa: Botswana, Lesotho, Namibia, South Africa, and Swaziland. Most recent estimates for Botswana, South Africa, and Swaziland indicate that the TFR in these three countries lies between 4.5 and 5.0 children per woman. Fertility is slightly higher in Namibia and Lesotho, although the latest estimate of the TFR in Lesotho (5.2 children per woman in 1986) is now quite dated.

The black population of South Africa experienced a decline in fertility before any country of sub-Saharan Africa (Caldwell and Caldwell, 1993). This fact has been poorly documented for two reasons. First, a long period of international political isolation has meant that little has been written about the demographic situation in South Africa over the last 30 or so years. Second, the South African government has been reluctant to provide open access to demographic data. In addition, the primary means of collecting demographic data—the registration of births and deaths—has not been complete because black South Africans have not felt sufficiently vested in ensuring its accuracy (Caldwell and Caldwell, 1993).

Fortunately, the situation has improved recently. The country has entered a period of political, social, and economic reform, and new data have emerged from a DHS-type household survey conducted in 1987–1989 under the auspices of the Human Sciences Research Council of South Africa. There were some initial concerns about the general lack of documentation of the sampling and methodological strategies that were employed to collect these data (see, for example, Freedman, 1992; Caldwell and Caldwell, 1993), but these issues have now been rectified (R.Freedman, personal communication, 1993). These data reveal that the black population of South Africa currently has lower rates of childbearing and higher rates of modern contraceptive use than any country in sub-Saharan Africa. However, there will probably be a great deal of debate about the extent to which comparisons should be drawn between the South African experience and the experiences of other countries in the region.

Undoubtedly, African fertility has varied over time. The longstanding belief that African fertility levels have remained the same for long periods is probably a result of the absence of reliable time-series data (Page, 1988). The seemingly regular occurrence of catastrophic events certainly creates substantial short-run variations in demographic rates that often go unrecorded. However, the subject of short-term fluctuations in fertility lies beyond the scope of this chapter.[4] The only changes in fertility rates discussed below are the more permanent ones that have occurred over longer periods of time.

There is some evidence to suggest that fertility rates rose in several African countries during the 1960s and 1970s. As stated earlier, it is unclear what proportion of the change is genuine and what proportion is attributable to improvements in data collection. A popular example of a country in which fertility rates may have increased is Kenya. Historical fertility estimates for Kenya are available from the 1962 Post-Enumeration Sample Census, the 1969 census, and the 1977 National Demographic Survey. At face value, the data from these sources indicate that fertility rose dramatically from 5.3 births per woman in 1962 to 6.6 in 1969 and to 8.0 in 1977. Extensive manipulation resulted in official estimates being revised to 6.8 for 1962 and 7.6 for 1969. However, it is now apparent that the shapes of the age-specific fertility distribution derived from both the 1962 and the 1969 censuses were almost certainly biased (Blacker et al., 1979). Despite the extensive official data manipulation, TFR estimates for 1962 and 1969 are probably still too low. Fertility probably increased in Kenya between 1962 and 1977, but the true extent of the increase is unknown.

An increase in fertility in recent decades appears more certain in Cameroon and certain other Central African countries. Of the eight Central African nations included here, only in Cameroon and Angola was fertility higher than 5.5 births per women before 1975. Currently, fertility is estimated to be above this level in all six countries for which data are available after 1975. This increase in fertility has been attributed largely to a reduction in the historically high incidence of pathological sterility in Central Africa resulting from widespread STDs (Frank, 1983; Tambashe, 1992).

Recent indications exist that fertility may be falling in several sub-Saharan African countries, a topic that is taken up in more detail below. Table 2–1 shows fertility falling in 26 countries. In most cases, however, the declines in fertility are quite small, less than one birth per woman. The observed declines could be a function of using alternative strategies to estimate fertility at different points in time or the result of using unreliable

[4]See Working Group on Demographic Effects of Economic and Social Reversals (1993) for a recent investigation of the short-run effects of economic and social reversals on demographic rates.

data. Evidence of declining fertility is strongest in Kenya, Botswana, and Zimbabwe. Apart from Ethiopia and Malawi, where the data are too unreliable to detect the magnitude of a decline with any measure of certainty, these are the only countries that show a recent fertility decline of more than 1.0 birth per woman. Recent data from various DHS surveys indicate that fertility may be falling in other countries as well, including Senegal, Zambia, and parts of Nigeria. However, in these and other cases, the changes in fertility are smaller and less definite. Further observation is required to confirm these trends.

Detecting the start of a decline in fertility is not always easy. The number of children a woman bears is the outcome of a series of complex interactions among biological, social, economic, and other factors. These factors can be conveniently divided into the proximate (biological and behavioral) determinants that directly influence fertility, and all other social and economic factors that affect fertility only indirectly through the proximate determinants (Bongaarts and Potter, 1983). Early detection of fertility decline through behavioral changes affecting the proximate determinants is made difficult because certain aspects of socioeconomic development can have competing effects on the proximate determinants that cancel each other at low levels of development (Lesthaeghe et al., 1981). Hence, early detection of fertility decline would be considerably easier if we had more precise measures of each of the proximate determinants and a clearer understanding of how these variables relate to one another. (See Chapter 3 for a more indepth discussion of proximate determinants in sub-Saharan Africa.) Finally, fertility and nuptiality patterns may be affected by the recent implementation of structural adjustment programs by several African governments in response to worsening economic conditions. It is unclear whether any crisis-induced reductions in fertility would be sustainable for long periods of time. It is worth noting, however, that economic conditions in Kenya, Botswana, and Zimbabwe have been better than average for the region during the past 10 years (van de Walle and Foster, 1990).

Shape of the Fertility Distribution

A great deal can be learned about the timing and intensity of childbearing from a simple examination of the shape of the fertility schedule by age. However, construction of fertility schedules requires reasonably accurate data because the omission or misplacement of vital events can lead to serious errors. Recent estimates of age-specific fertility rates (ASFRs) are presented in Figures 2–1 to 2–4. The data for these figures are provided in Table 2–2. The data reveal a remarkable degree of similarity among estimates across countries, particularly given the many difficulties associated with collecting accurate demographic data in an area where significant per centages of the population are unable to recall either their own or their children's dates of birth. Below, first births and the timing of subsequent births are discussed.

First Births

The age at which a woman gives birth for the first time has important implications for the health and well-being of the mother and her child (Haaga, 1989). Compared to older women, teenage mothers face greater risks of pregnancy- and delivery- related complications, maternal morbidity and mortality, and having premature or low-birthweight babies. Significant educational and economic consequences also result from having children at a very young age. The most publicized examples of these consequences relate to lost educational opportunities (Working Group on the Social Dynamics of Adolescent Fertility, 1993). Under a natural fertility regime, with little or no use of modern contraception, the mother's age at first birth is also an important determinant of completed family size.

In general, African countries have relatively high rates of adolescent fertility, and the median age of women at first birth in sub-Saharan Africa is approximately two years younger than it is in North Africa, Asia, or Latin America (Arnold and Blanc, 1990). Table 2–2 reveals that the largest differences between age-specific fertility schedules for a subset of countries in sub-Saharan Africa occur among women aged 15–19. This finding is largely attributable to differences in the average age of marriage in these countries. For example, teenage fertility is highest in Mali, where the mean age of 15.7 at first marriage is among the lowest in Africa (Traore et al., 1989). Similarly, adolescent fertility is low in Burundi where the mean age at first marriage is relatively high, 19.5 years (Segamba et al., 1988).

In the past, the vast majority of childbearing in Africa probably took place within the institution of marriage. However, recent survey data have identified a weakening of the link between the age at which a woman first marries and the age at which a woman first gives birth. What appears to be occurring in several countries is that the age at first marriage is increasing while the age at first birth is remaining constant. Consequently, several countries have recorded an increase in births among unmarried adolescents. In Kenya and Botswana, more than 70 percent of teenagers who give birth either are unmarried or become pregnant before they marry (Population Reference Bureau, 1992; see Chapter 4, for a discussion of marriage trends and the relation of marriage and fertility.)

TABLE 2–2 Age-Specific Fertility and Total Fertility Rates for Selected Sub-Saharan Africa Countries

		Age		
Areas and Countries	Year of Survey	15–19	20–24	25–29
Western				
Burkina Faso	1985	0.152	0.328	0.321
Ghana	1988	0.130	0.258	0.279
Liberia	1986	0.188	0.289	0.275
Mali	1987	0.209	0.288	0.293
Niger	1992	0.230	0.327	0.317
Nigeria	1990	0.144	0.267	0.274
Senegal	1986	0.161	0.274	0.274
Togo	1988	0.129	0.269	0.277
Middle				
Cameroon	1991	0.164	0.282	0.260
Congo	1984	0.152	0.287	0.294
Eastern				
Burundi	1987	0.052	0.268	0.321
Ethiopia	1990	0.102	0.293	0.287
Kenya	1988–1989	0.153	0.315	0.295
Malawi	1992	0.161	0.287	0.269
Tanzania	1991–1992	0.144	0.278	0.268
Uganda	1988–1989	0.186	0.325	0.322
Zambia	1993	0.156	0.294	0.271
Zimbabwe	1988–1989	0.103	0.247	0.246
Southern				
Botswana	1988	0.127	0.213	0.203
Lesotho	1986	0.091	0.250	0.239
Namibia	1992	0.108	0.208	0.249
South Africa[b]	1987–1989	0.124	0.223	0.196
Swaziland	1988	0.129	0.224	0.211
All countries (unweighted average)		0.137	0.262	0.260

NOTE: Estimates from DHS birth-history data are based on 3- or 4-year recall periods instead of the conventional 5-year period in order to avoid the problem of displacement of births identified by Arnold (1990).

[a]TFRs do not match those in Table 2–1 because of different recall periods.

[b]Black population only.

30–34	35–39	40–44	45–49	Total Fertility Rate
0.279	0.215	0.104	0.038	7.2
0.243	0.187	0.116	0.059	6.4
0.226	0.185	0.115	0.062	6.7[a]
0.265	0.199	0.114	0.040	7.0[a]
0.258	0.196	0.106	0.042	7.4
0.222	0.162	0.095	0.067	6.2
0.265	0.200	0.100	0.050	6.6
0.244	0.215	0.111	0.073	6.6[a]
0.228	0.149	0.062	0.020	5.8
0.263	0.195	0.102	0.032	6.6
0.290	0.241	0.129	0.084	6.9
0.274	0.210	0.101	0.058	6.6
0.246	0.183	0.099	0.034	6.6[a]
0.254	0.197	0.120	0.058	6.7
0.228	0.184	0.108	0.040	6.3
0.275	0.231	0.098	0.034	7.4
0.242	0.194	0.105	0.031	6.5
0.222	0.160	0.085	0.036	5.5
0.187	0.146	0.082	0.037	5.0[a]
0.198	0.159	0.082	0.025	5.2
0.219	0.175	0.115	0.044	5.6
0.164	0.125	0.060	0.023	4.6
0.198	0.129	0.067	0.033	5.0
0.229	0.176	0.094	0.042	6.0

SOURCES: Burkina Faso (no date); Cameroon (1992); Congo (1987); Ethiopia (1991b); Lesotho (1991); Malawi (1993); Mosert (1990); Namibia (1992); Niger (1992b); Tanzania (1992); Warren et al. (1992); Zambia (1993), and calculations from Demographic and Health Surveys standard recode files.

Timing of Subsequent Births

Figures 2–1 to 2–4 illustrate another essential feature of fertility in Africa: Unlike Western populations, childbearing continues throughout a woman's reproductive years with no obvious "stopping" behavior. The peak of childbearing occurs between 20 and 29 and falls slowly, indicating little parity-specific limitation. In societies that practice family limitation, fertility rates depart from a natural fertility schedule as women age, because women use efficient methods of contraception to prevent pregnancy once they have achieved their desired family size. There is little evidence of a stopping pattern in any of the fertility schedules for sub-Saharan Africa, despite the reported practice of terminal abstinence in some societies.

It is important to note, however, that there is some debate about the path that fertility decline in Africa is likely to take and, consequently, the effect of a decline in fertility on the shape of the age-specific fertility distribution. Caldwell et al. (1992) argue that the nature of fertility decline in Africa is likely to be very different from that observed in Asia or Latin America. The reasons are related to differences in constraints on premarital and extramarital sexuality, and different emphases on the need and reasons for birth spacing. In Africa, efficient contraception may be used to space children more efficiently rather than as a means to lower completed family

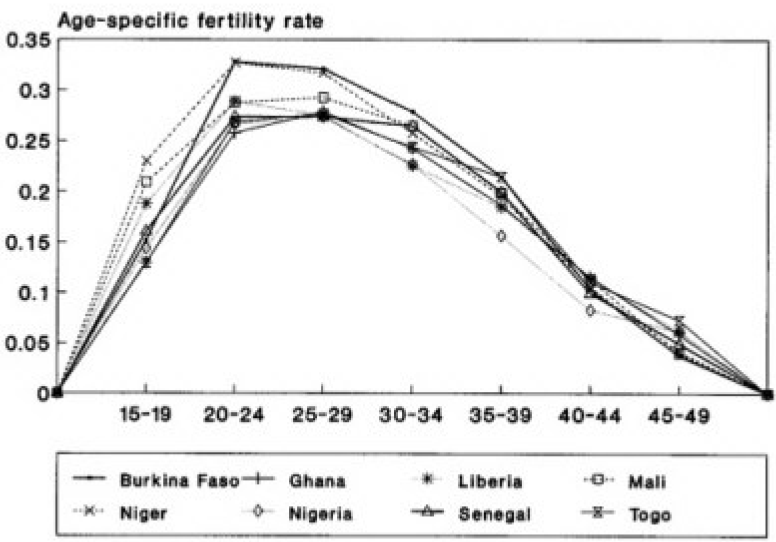


FIGURE 2–1 Age-specific fertility rates: western Africa.

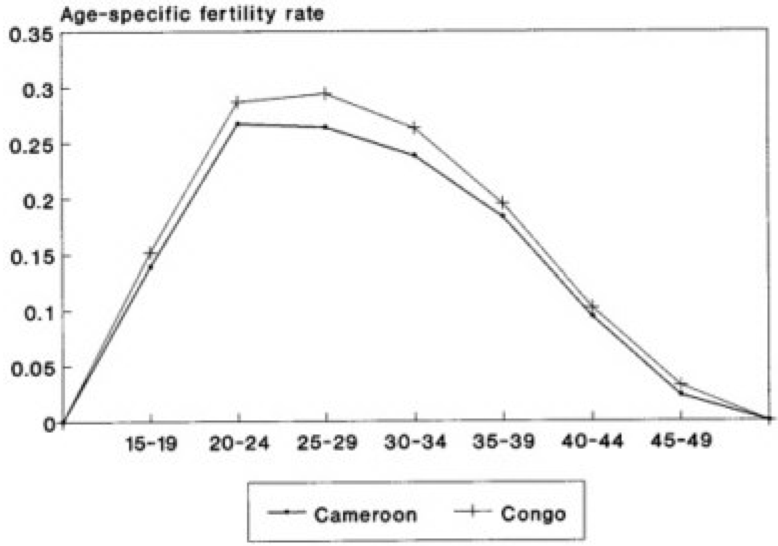


FIGURE 2–2 Age-specific fertility rates: middle Africa.

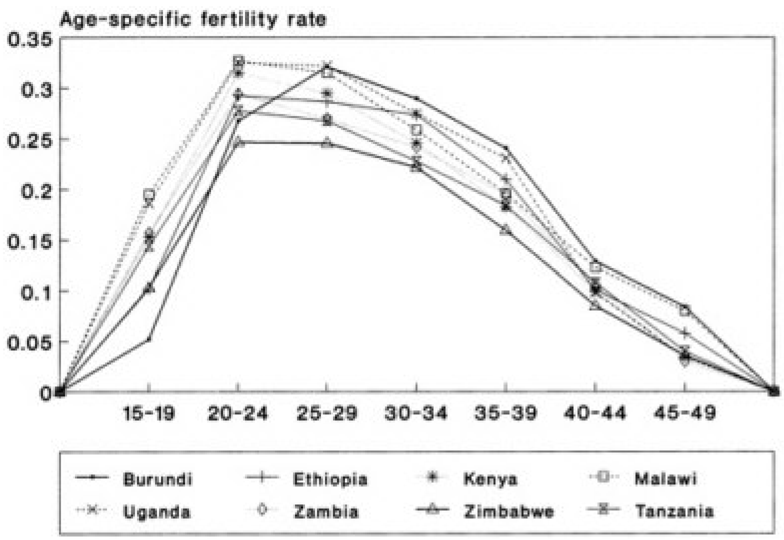


FIGURE 2–3 Age-specific fertility rates: eastern Africa.

size. There may also be a growing demand for efficient contraceptives among unmarried women who want to delay the onset of marriage and childbearing. Consequently, Caldwell et al. predict that fertility decline in Africa is likely to involve a simultaneous uptake in contraceptive use at all ages.

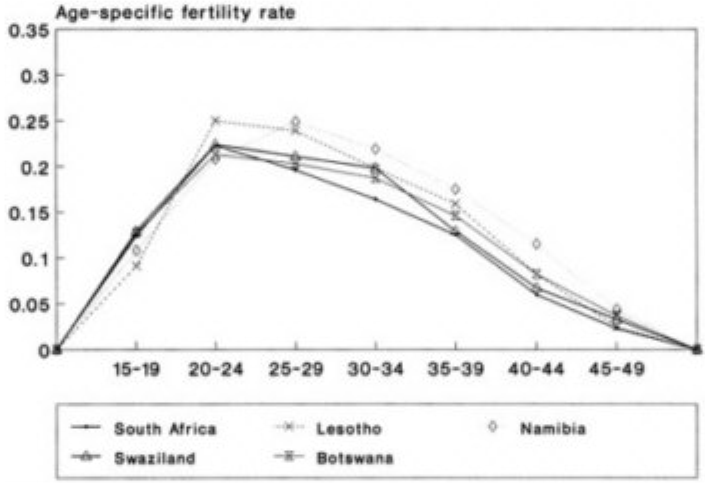


FIGURE 2–4 Age-specific fertility rates: southern Africa.

Socioeconomic Differentials in Achieved Family Size

The relationship between various indicators of socioeconomic development and family size is an important topic that is of direct relevance to planners and policymakers attempting to integrate population variables into development planning. Place of residence and education are examined here because they are usually two of the most efficient predictors of fertility decline.

Place of Residence

Previous studies have consistently observed that women living in urban areas have fewer children than their rural counterparts. The explanation for this difference is often that women in urban areas tend to have more education and are more likely to participate in the formal labor market. Conse quently, these women are more likely to appreciate the advantages of having a smaller family. At the same time, urban women are assumed to have better knowledge of, and access to, modern contraception than women in rural areas.

Age-specific fertility rates by place of residence are shown in Table 2–3 for selected countries that participated in the DHS. The data confirm our *a priori* expectations: Rural fertility is substantially higher than urban fertility in every country even in those countries where national-level fertility estimates do not indicate a recent decline in childbearing (for example, Mali, Togo, and Uganda). The average difference in total fertility is 1.8 births per woman; however, the difference ranges from less than 1.1 births per woman in Cameroon and Liberia to more than 2.5 births per woman in Ethiopia, Tanzania, and Togo. The urban-rural differential is usually highest among those aged 15–19 and 45–49, reflecting differences in age at marriage and limitation of family size, respectively.

Level of Education

Fertility has also been closely associated with female educational levels, although identifying the direction of any causal relationship between fertility and education is complex (Cochrane, 1979). Lower levels of fertility are associated usually with higher levels of education. Typically, the explanation for this association revolves around the fact that more educated women are more likely to delay marriage and to work for paid employment in the formal labor market after leaving school. Consequently, the demand for children may be inversely related to educational level. Literacy skills may improve women's ability to practice efficient contraception and may empower them with more decision-making authority in the household. However, it could be that the initiation of childbearing is a factor in the termination of education.

Several studies have found that low levels of education as opposed to no education may actually be associated with relatively higher fertility. Small amounts of education may break down birth-spacing practices, including long breastfeeding intervals and postpartum abstinence, without lowering fertility desires or increasing age at marriage. On the other hand, higher levels of education are almost always associated with the lowest fertility.

Age-specific fertility rates by level of education for countries participating in the DHS are presented in Table 2–4. The essential point to take from this table is that fertility does not appear very responsive to small amounts of education. The average TFR for women with no education, 7.0 (as shown at the bottom of the table), is identical to that for women with 1 to 4 years of education. In five countries, Burundi, Kenya, Liberia, Mali, and Nigeria, fertility rises with a small amount of education. (Fertility may

TABLE 2–3 Age-Specific Fertility and Total Fertility Rates by Current Residence

Country and Residence	Age	Total Fertility Rate					
	15–19		20–24	25–29	30–34	35–39	40–44	45–49
Western Ghana								
Urban	0.153	0.204	0.262	0.209	0.137	0.104	0.044	5.3
Rural	0.091	0.284	0.287	0.259	0.213	0.122	0.066	6.9
Liberia								
Urban	0.173	0.270	0.261	0.206	0.187	0.087	0.039	6.1
Rural	0.202	0.306	0.286	0.241	0.184	0.126	0.073	7.1
Mali								
Urban	0.172	0.256	0.284	0.253	0.169	0.083	0.020	6.2
Rural	0.224	0.300	0.296	0.270	0.209	0.122	0.042	7.3
Niger								
Niamey	0.118	0.259	0.266	0.246	0.180	0.070	0.034	5.9
Rural	0.242	0.333	0.324	0.261	0.196	0.105	0.042	7.5
Nigeria								
Urban	0.091	0.211	0.267	0.227	0.138	0.056	0.038	5.1
Rural	0.164	0.287	0.276	0.227	0.163	0.089	0.068	6.4
Senegal								
Urban	0.098	0.242	0.249	0.241	0.189	0.067	0.027	5.6
Rural	0.212	0.297	0.291	0.282	0.206	0.117	0.051	7.3
Togo								
Urban	0.072	0.211	0.226	0.209	0.150	0.079	0.035	4.9
Rural	0.169	0.304	0.305	0.261	0.238	0.122	0.085	7.4
Middle Cameroon								
Urban	0.130	0.273	0.250	0.189	0.130	0.049	0.013	5.2
Rural	0.189	0.290	0.268	0.261	0.160	0.067	0.023	6.3
Eastern Burundi								

Urban	0.130	0.261	0.265	0.227	0.092	0.025	0.000	5.0
Rural	0.048	0.269	0.323	0.291	0.245	0.133	0.086	7.0
Ethiopia								
Urban	0.028	0.167	0.200	0.176	0.112	0.065	0.012	3.8
Rural	0.122	0.314	0.301	0.288	0.228	0.106	0.065	7.1
Kenya								
Urban	0.130	0.250	0.220	0.176	0.107	0.016	0.043	4.7
Rural	0.159	0.334	0.312	0.259	0.192	0.107	0.034	7.0
Malawi								
Urban	0.135	0.268	0.242	0.210	0.149	0.086	0.012	5.5
Rural	0.165	0.291	0.273	0.261	0.202	0.123	0.062	6.9
Tanzania								
Dar es Salaam	0.083	0.214	0.202	0.180	0.101	0.022	0.000	4.0
Rural	0.148	0.296	0.285	0.240	0.192	0.115	0.045	6.6
Uganda								
Urban	0.139	0.304	0.298	0.170	0.152	0.060	0.000	5.6
Rural	0.194	0.329	0.325	0.285	0.239	0.100	0.036	7.5
Zambia								
Urban	0.133	0.263	0.265	0.222	0.171	0.078	0.028	5.8
Rural	0.184	0.328	0.276	0.264	0.221	0.121	0.032	7.1
Zimbabwe								
Urban	0.083	0.190	0.199	0.149	0.097	0.047	0.006	3.9
Rural	0.113	0.283	0.271	0.259	0.188	0.099	0.045	6.3
Southern Botswana								
Urban	0.115	0.171	0.161	0.150	0.123	0.045	0.026	4.0
Rural	0.134	0.235	0.222	0.190	0.155	0.090	0.038	5.3
All countries (crude average)								
Urban	0.113	0.234	0.242	0.202	0.140	0.061	0.022	5.1
Rural	0.166	0.299	0.290	0.259	0.202	0.110	0.053	6.9

SOURCES: Cameroon (1992); Ethiopia (1991b); Malawi (1993); Niger (1992); Tanzania (1992); Zambia (1993), and calculations from Demographic and Health Surveys standard recode files.

TABLE 2–4 Age-Specific Fertility and Total Fertility Rates by Level of Education

Country and Years School	Age 15–19	Total Fertility Rate	20–24	25–29	30–34	35–39	40–44	45–49
Western								
Ghana								
0	0.163	0.281	0.305	0.236	0.187	0.132	0.060	6.8
1–4	0.163	0.280	0.267	0.233	0.202	0.074	0.100	6.6
5–7	0.157	0.284	0.306	0.198	0.150	0.085	0.023	6.0
8+	0.099	0.232	0.253	0.217	0.193	0.085	0.028	5.5
Liberia								
0	0.188	0.298	0.286	0.236	0.193	0.117	0.065	6.9
1–4	0.194	0.338	0.342	0.252	0.152	0.179	0.082	7.7
5–7	0.204	0.333	0.302	0.239	0.141	0.096	0.108	7.1
8+	0.165	0.233	0.185	0.143	0.142	0.051	0.000	4.6
Mali								
0	0.233	0.289	0.293	0.267	0.203	0.115	0.037	7.2
1–4	0.198	0.312	0.294	0.209	0.133	0.098	0.305	7.8
5–7	0.218	0.317	0.279	0.206	0.148	0.140	0.000	6.5
8+	0.084	0.227	0.291	0.349	0.121	0.000	0.000	5.4
Nigeria								
0	0.210	0.283	0.269	0.220	0.166	0.091	0.062	6.5
1–4	0.178	0.353	0.332	0.255	0.198	0.090	0.090	7.5
5–7	0.134	0.309	0.308	0.255	0.123	0.036	0.032	6.0
8+	0.059	0.185	0.232	0.203	0.109	0.015	0.091	4.5
Senegal								
0	0.197	0.289	0.285	0.276	0.207	0.104	0.041	7.0
1–4	0.088	0.274	0.307	0.199	0.182	0.000	0.090	5.7
5–7	0.112	0.252	0.237	0.269	0.114	0.028	0.000	5.1
8+	0.045	0.169	0.204	0.168	0.167	0.000	0.000	3.8
Togo								
0	0.168	0.307	0.299	0.254	0.225	0.111	0.074	7.2
1–4	0.131	0.287	0.253	0.305	0.238	0.101	0.115	7.2
5–7	0.107	0.244	0.268	0.180	0.155	0.071	0.000	5.1
8+	0.048	0.151	0.186	0.164	0.124	0.212	0.000	4.4
Eastern								
Burundi								
0	0.051	0.267	0.318	0.287	0.239	0.123	0.091	6.9
1–4	0.066	0.285	0.315	0.335	0.253	0.169	0.000	7.1
5–7	0.043	0.262	0.364	0.266	0.294	0.163	0.062	7.3
8+	0.062	0.244	0.298	0.258	0.154	0.151	0.000	5.8
Kenya								
0	0.231	0.306	0.303	0.275	0.193	0.105	0.034	7.2
1–4	0.284	0.353	0.311	0.268	0.176	0.098	0.041	7.7
5–7	0.188	0.338	0.307	0.229	0.197	0.112	0.059	7.2
8+	0.097	0.280	0.257	0.180	0.111	0.049	0.016	5.0

Country and Years School	Age 15–19	Total Fertility Rate	20–24	25–29	30–34	35–39	40–44	45–49
Uganda								
0	0.243	0.341	0.326	0.290	0.246	0.107	0.032	7.9
1–4	0.185	0.324	0.307	0.273	0.231	0.085	0.048	7.3
5–7	0.187	0.321	0.352	0.243	0.189	0.083	0.030	7.0
8+	0.087	0.291	0.272	0.272	0.221	0.000	0.000	5.7
Zimbabwe								
0	0.203	0.294	0.270	0.289	0.180	0.122	0.077	7.2
1–4	0.211	0.311	0.280	0.261	0.174	0.077	0.015	6.7
5–7	0.125	0.272	0.238	0.208	0.154	0.082	0.020	5.5
8+	0.072	0.179	0.216	0.141	0.116	0.011	0.000	3.7
Southern								
Botswana								
0	0.118	0.242	0.218	0.216	0.188	0.107	0.062	5.8
1–4	0.178	0.235	0.223	0.228	0.137	0.071	0.018	5.5
5–7	0.143	0.225	0.205	0.162	0.133	0.067	0.000	4.7
8+	0.096	0.174	0.167	0.113	0.082	0.046	0.000	3.4
All countries (crude average)								
0	0.182	0.291	0.288	0.259	0.202	0.112	0.058	7.0
1–4	0.171	0.305	0.294	0.256	0.189	0.095	0.082	7.0
5–7	0.147	0.287	0.288	0.223	0.163	0.088	0.030	6.1
8+	0.083	0.215	0.233	0.201	0.140	0.056	0.012	4.7

SOURCE: Calculated from Demographic and Health Surveys standard recode files.

rise with small amounts of education in other countries as well, but the increase may be masked by the way the education categories were formed.) Even with 5–7 years of education, the average TFR remains high at 6.1 births per women. This figure represents a modest reduction in fertility of less than one child per woman, compared to women who have never attended school.

Fertility is considerably more responsive at higher levels of education. Women with eight or more years of education have many fewer children than women with no education. The difference ranges from 1.3 children per woman in Ghana to 3.5 children per woman in Zimbabwe. One explanation is that secondary education has a large positive and significant effect on the average age at first marriage and the average age at first birth (Westoff, 1992).

RECENT EVIDENCE OF A FERTILITY DECLINE IN COUNTRIES PARTICIPATING IN THE DHS

Sub-Saharan Africa is the only major region of the developing world that has not yet undergone a general decline in fertility. So the question of when fertility is likely to decline is a pressing one. The possibility that fertility may already be declining in several African countries was mentioned in an earlier discussion of TFRs. The evidence presented in Table 2–1 indicates that many sub-Saharan African countries are experiencing minor declines in fertility. However, small declines in fertility could be artificial—the product of using different strategies to estimate fertility at different points in time, or the product of unreliable data. Consequently, more detailed analysis is required to confirm whether small observed declines in fertility are genuine.

This section provides corroborating evidence for fertility declines in the sub-Saharan African countries that are participating in the DHS, when it exists. Two strategies are used to judge the veracity of recent trends in TFRs for DHS countries. The first strategy is based on a simple fact: It is easier to accept a change in fertility as genuine if it is accompanied by a change in one of the proximate determinants of fertility that would account for it (e.g., an increase in age at marriage or in the use of contraceptives). Consequently, changes in fertility are compared with changes in marriage patterns, changes in acceptance and mix of contraceptive methods, and changes in family size preferences. The second strategy is to conduct an independent, in-depth analysis of birth histories by using life table techniques.

Table 2–5 presents direct estimates of the total fertility rate for each of the 11 African countries for which detailed DHS information were available. The surveys were conducted over a 5-year period, 1986–1990. The fertility estimates do not all refer to the same date. They have been calculated by using recall periods of 0–3 years and 4–7 years prior to the date each country was surveyed.

Fertility appears to have fallen in 10 of the 11 countries included in Table 2–5. The average decline in fertility is slightly less than 1 child per woman, with a range of 1.2 children per woman in Zimbabwe to 0.4 in Ghana. In eight countries, the declines in fertility are statistically significant at the 5 percent level. Uganda is the only country that shows no evidence of a decline.

In reality, the eight cases with statistically significant declines can be split into two groups. Group A includes Kenya, Botswana, and Zimbabwe, where declines in fertility appear to be reasonably certain. The decline in fertility rates in all three countries has been accompanied by an increase in the proportion of women using modern contraception. (See Table 2–6 for current levels of modern contraceptive use.) DHS data in Table 2–5 show that the group B countries, Burundi, Mali, Nigeria, Senegal, and Togo, also experienced statistically significant declines in fertility; however, these declines have not been accompanied by substantial increases in the median age at marriage, the percentage of women using modern methods of contraception, or a substantial decrease in ideal family size, which might explain the decline in fertility. (See Table 2–6 for most recent estimates.)

TABLE 2–5 Total Fertility Rate for Women Aged 15–44; Selected Demographic and Health Surveys, 1986–1990

		Total Fertility Rate[a]			
Region and Country	Year of Survey	0–3 Years Prior to Survey	4–7 Years Prior to Survey	Change Absolute	Change Percentage
Western					
Ghana	1988	6.1	6.4	–0.3	–5.8
Liberia	1986	6.4	6.8	–0.4	–5.9
Mali	1987	6.8	7.7	–0	–11.2
Nigeria	1990	5.9	6.9	–1.0[b]	–18.1
Senegal	1986	6.4	7.6	–1.2[b]	–15.6
Togo	1988	6.2	7.2	–1.0[b]	–13.3
Eastern					
Burundi	1987	6.5	7.4	–0.9[b]	–12.4
Kenya	1988–1989	6.5	7.1	–0.6[b]	–8.9
Uganda	1988–1989	7.2	7.1	+0.1	+1.0
Zimbabwe	1988–1989	5.3	6.6	–1.3[b]	–18.9
Southern					
Botswana	1988	4.8	5.6	–0.8[b]	–14.0

[a]To minimize problems caused by the displacement of births, estimates of the total fertility rate have been calculated on the basis of 4-year periods instead of conventional 5-year periods. Because only women aged 15–49 were surveyed, the total fertility rates are restricted to women aged 15–44 to avoid problems of truncation in the period 4–7 years prior to the survey.
[b]Rates for the two periods are significantly different at the 5 percent level.
SOURCES: Freedman and Blanc (1992); Nigeria (1992).

Group A: Countries in Which Fertility Declines Have Occurred

Fertility decline has been most dramatic in Kenya, Botswana, and Zimbabwe. In Kenya, fertility rates fell by slightly more than 0.5 child per woman between 1987 and 1989 and by 1.2 children per woman between 1979 and 1989. Overall, the Kenyan DHS results not only indicate that the transition to lower fertility is already under way, but also suggest that it

TABLE 2–6 Key Features of African Fertility: Selected DHS Countries

	Fertility Preference[a]		Modern Contraceptive Use (%)[a]	Median Age at First Marriage (women aged 25–49)
Region and Country	Ideal Family Size[b] (number of children)	Want No More Children (%)		
Western				
Ghana	5.5	23	4.7	18.3[c]
Liberia	6.5	17	7.0	17.5
Mali	6.9	17	1.2	15.7[c]
Nigeria	6.2	15	3.8	16.9
Senegal	7.2	19	2.6	16.6[c]
Togo	5.6	25	3.4	18.4
Eastern				
Burundi	5.5	24	1.0	19.5
Kenya	4.8	49	14.7	18.5[c]
Uganda	6.8	19	2.7	17.5[c]
Zimbabw	5.4	33	27.2	18.6
Southern				
Botswana	5.4	33	28.9	17.3[c,d]

[a]Currently married women aged 15–49.
[b]Excludes non-numeric responses.
[c]Ages 20–49.
[d]Age at first sexual intercourse.
SOURCE: Demographic and Health Surveys First Country Reports.

may accelerate in the future (Cross et al., 1991). Fertility decline has been even more dramatic in Zimbabwe where the DHS-based estimate implies that fertility fell by 1.2 children per woman between 1982–1984 and 1985– 1988. The rate of decline in Zimbabwe is even greater if one accepts the results from the Intercensal Demographic Survey, which yield an estimated TFR of 5.1 for 1987, instead of the DHS estimate of 5.5 for 1985–1988. In Botswana, the DHS-based fertility estimates are 5.9 in 1982–1984 and 4.9 children per woman in 1985–1988. Other sources have yielded considerably higher fertility estimates in Botswana in the recent past: 6.5 in the 1984 Family Health Survey (FHS) and 7.1 in the 1981 census. Comparing the results from the various surveys is difficult, however, because different questions and methods of estimation were used. Furthermore, close comparisons of the DHS and the FHS revealed that the two samples differed appreciably in composition (Thomas and Muvandi, 1992) and that the number of children ever born was inconsistent between surveys, at least for older women (United Nations, 1992). Finally, the estimate of the TFR based on the 1981 census was probably too high, tending to exaggerate the extent of the decline in fertility over the last 10 years (Rutenberg and Diamond, 1993). Nevertheless, the difference in fertility rates between the various sources is too great to be attributable solely to problems of sampling or estimation.

Countries in group A are distinguished from countries in group B by the fact that recorded decreases in fertility have been accompanied by changes in other fertility-related variables. As discussed above, collecting accurate demographic data in sub-Saharan Africa is difficult. Hence, for countries that have a low TFR, it is reassuring to find a low average desire for children, a high use of efficient contraception, and a high median age at first marriage. Table 2–6 summarizes the data on these key indicators. Two crude measures of fertility preference are presented: the mean ideal family size and the proportion of all women who want no more children. Of the women in the 11 populations, only women in Kenya, Botswana, and Zimbabwe considered the mean ideal family size to be fewer than 5 children.[5] Among all women in Kenya, the mean ideal number of children fell dramatically from 5.8 in 1984 to 4.4 in 1989 (Kenya, 1989). Also of note is the age pattern of preference in 1989, with women aged 40–44 preferring 5.5 children, women aged 25–29 preferring 4.4, and women aged 15–19

[5]Interestingly, the recent decline in fertility in Botswana may have occurred without a substantial fall in ideal family size. The 1988 DHS estimate of the ideal number of children is slightly lower than that recorded in a 1984 survey, but the difference is not statistically significant and may be attributable to differences in the wording of the questionnaires (Lesetedi et al., 1989).

preferring 3.7. Furthermore, compared to women in other countries, women in these three countries were more likely to indicate at the time of the DHS that they did not want additional children. In Kenya, nearly half the married women in the DHS sample reported that they wanted no more children. In Zimbabwe and Botswana, the proportion was closer to one-third.

Another important indicator of women's fertility intentions is use of contraception. In group A countries, more than 14 percent of married women used some type of modern contraceptive at the time of the DHS. In Botswana, the increase in the number of women using modern contraceptives since 1984 is large enough to account for the observed decline in fertility (van de Walle and Foster, 1990). The level of contraceptive use among married women is even higher in Zimbabwe: Almost all women who were interviewed knew of at least one method of contraception; 93 percent of married women had used contraception at one time; and 36 percent of married women were currently using a modern method. Contraceptive prevalence in Kenya has also increased sharply: 27 percent of married women reported using some method of contraception in 1989, a fourfold increase in use from 1977–1978 levels (Kenya, 1989). Part of the increase in the demand for contraceptives may be the result of women wanting to space children more efficiently rather than wanting to limit family size (van de Walle and Foster, 1990; Caldwell et al., 1992).

Additional information on the nature of the fertility decline in Kenya, Botswana, and Zimbabwe can be obtained from an analysis of birth histories. These histories allow us to describe the family formation process in greater detail. For example, rather than just observing that a woman has had a birth in the last 12 months, birth histories can tell us birth order and the timing between pregnancies. Consequently birth histories enable the researcher to identify changes in fertility behavior that are specific to parity. Because the vast majority of women in Africa marry and have children, changes in fertility behavior between cohorts are most likely to occur after women have had several children. Consequently, a parity-specific investigation of fertility behavior can be a useful way to detect small changes in fertility for a country at the beginning of a transition toward lower fertility (Brass and Juarez, 1983).

Life table techniques provide the best way to analyze birth history data. This approach views the family formation process as a series of steps in which women pass successively through marriage to first births to second births and so on, until they achieve their completed family size. When data are available for a cohort of women who have completed their fertility, parity progression ratios (PPRs) can be calculated directly. For each age cohort, these ratios measure the proportion of women who have had n children and proceed to have an additional child. Because the majority of women included in cross-sectional data sets have not completed their fertil ity, it is inappropriate to calculate PPRs. Another measure, analogous to the PPR, is suggested by Rodriguez and Hobcraft (1980). It measures the proportion of women in an age cohort who, having attained an *n*th birth, go on to an (*n*+1)th birth within 60 months. This measure is usually called a censored parity progression ratio (CPPR). One advantage of CPPRs over TFRs is that they are robust with respect to the problem of misreported dates of births. As long as the index birth is reported as having occurred within 60 months of the preceding one, the CPPR is unaffected.

Unfortunately, Rodriguez and Hobcraft's measure is biased because it systematically excludes women with long birth intervals (Brass and Juarez, 1983). A simple adjustment to correct this limitation has been proposed by Brass and Juarez (1983). This variant of the CPPR is reported below and denoted B_{60}. Because no formula exists to calculate the standard errors associated with the B_{60}s, inferences about changes in fertility trends may be drawn only by examining general patterns in the data.

Table 2–7 presents the B_{60}s for Botswana, Kenya, and Zimbabwe. To simplify the table, neighboring parity progression ratios for the same cohort have been combined by multiplying consecutive indices together. The summary measures represent the combined probability of having two additional births, that is, the probability of moving from the *n*th to the (*n*+1)th parity within 60 months multiplied by the probability of moving from the (*n*+1)th to the (*n*+2)th parity within 60 months of the previous birth.

The B_{60}s reveal the pattern of fertility decline that has occurred in these countries. The most important finding is that there appears to have been a general reduction in fertility across cohorts of women at all parities in the probability of having additional births. In Kenya, the largest decline across cohorts appears to have been among women with seven children. Fewer women who have given birth to seven children now continue to have an eighth and a ninth child. In Botswana, the B_{60}s imply that important reductions in fertility have also occurred at low-order parities (first to third and third to fifth births). In Zimbabwe, the greatest reductions have occurred in the middle-order parities (third to fifth and fifth to seventh parities).

Group B: Countries in Which Fertility May be Declining

Evidence in favor of a fertility decline is not as strong in the other countries exhibiting a decline in Table 2–5, namely, Burundi, Mali, Nigeria, Senegal, and Togo. As shown in Table 2–6, in all five countries the demand for children, as measured by mean ideal family size, remains high; and few married women are currently using modern methods of contraception.

Of the countries in group B, Senegal is the country likeliest to be on the verge of undergoing a decline in fertility. The total fertility rate in Senegal was 7.1 births per woman in 1978, according to WFS data. According to the DHS, fertility fell to 6.6 by 1986, and provisional analysis of the recent census suggests it fell further to 6.3 in 1988 (Senegal, 1992). It is important to note, however, that the census and the DHS estimates are based on different kinds of data and different methodologies. The DHS collected detailed birth histories from all women. The census only asked women about the number of births they had in the last 12 months. Unfortunately, the latter approach is particularly susceptible to reporting bias because women tend to omit systematically children that have died or moved away. It has been established that the number of births in the 12 months preceding the census was underestimated (Senegal, 1992). Consequently, part of the difference between the fertility estimates from the DHS and those from the census may be attributable to flaws in the census data. Nevertheless, both the DHS and the census estimates are at least half a child per woman lower than the WFS estimates.

TABLE 2–7 Cumulated Cohort Parity Progression Ratios: Group A Countries

	Censored Parity Progression Ratios (B_{60}s) by Age Group			
Country and Women's Age	1–3	3–5	5–7	7–9
Botswana				
20–24	.308			
25–29	.487	.312		
30–34	.604	.446	.395	
35–39	.652	.549	.379	.356
40–44	.678	.571	.480	.388
45–49	.644	.615	.495	.505
Kenya				
20–24	.704			
25–29	.761	.675	.626	
30–34	.771	.734	.547	.408
35–39	.794	.759	.616	.504
40–44	.797	.772	.652	.553
45–49	.813	.811	.650	.596
Zimbabwe				
20–24	.622			
25–29	.664	.500	.237	
30–34	.682	.598	.518	.481
35–39	.741	.666	.559	.504
40–44	.733	.689	.616	.560
45–49	.765	.709	.605	.518

SOURCE: Calculations based on data from the Demographic and Health Surveys.

Some support for a decline in fertility in Senegal comes from apparent changes in contraceptive use and marriage patterns. The percentage of women currently using any method of contraception rose from 3.9 in 1978 to 11.4 in 1986. At the same time, there appears to have been an increase in the average age at first marriage among Senegalese women. DHS data indicate that the median age at marriage for women aged 40–44 at the time of the survey was 16.1 years in comparison to 17.2 years for women 20–24, and provisional results from the 1988 census indicate that the average age at first marriage is continuing to rise (Senegal, 1992). Westoff (1992) argues that this change in marriage patterns is sufficient to account for the slight drop in fertility. However, if the decrease in fertility is the result of an increase in the age at first marriage and first birth, then the greatest declines in fertility should have occurred among women in the youngest age groups. A simple comparison of age-specific fertility rates between data from the WFS and the DHS would suggest that changes in fertility have occurred in the youngest ages. The age-specific fertility rates for the two youngest age groups are between 8 and 16 percent lower in the DHS than they were in the WFS, but are virtually identical for the older four age groups. However, this pattern is not confirmed by a detailed internal analysis of the DHS data. These data suggest that fertility levels fell for all cohorts. A comparison of ASFRs for 0–3 and 4–7 years prior to the survey shows that the largest reductions in fertility occurred among women in the older age groups (Arnold and Blanc, 1990). Moreover, inspection of the B_{60}s for Senegal in Table 2– 8 indicates that fertility has fallen most consistently for parities three and higher. These discrepancies prevent Senegal from being placed in group A among countries in which declining fertility is confirmed. Even so, it is probable that at least some part of the observed fertility decline in Senegal is genuine, particularly the portion that results from an increasing age at first marriage.

In Nigeria, the DHS data indicate a decline in fertility of 1.3 children per woman, the largest absolute decline reported for any African country for which DHS data are available. Although some proportion of the decline is certainly genuine, other evidence does not support a decline of this magnitude. First, the use of contraception is extremely limited among Nigerian women. As shown in Table 2–6, only 6.0 percent of married women used any method of contraception in 1990, and only 3.5 percent used modern methods. Furthermore, the proportions of Nigerian women that are married by age 17 and that become mothers by age 20 appear to be stable across cohorts (Nigeria, 1992). On the other hand, the pattern in B_{60}s in the lower parities is consistent with a fertility decline. However, there is evidence to suggest that the number of births in the 5 years preceding the survey was underestimated (Nigeria, 1992).

More detailed analysis of data from Nigeria shows that the national

TABLE 2–8 Cumulated Cohort Parity Progression Ratios: Group B Countries

	Censored Parity Progression Ratios (B_{60}s) by Age Group			
Country and Women's Age	1–3	3–5	5–7	7–9
Burundi				
20–24	.826	.594		
25–29	.874	.782		
30–34	.825	.889	.673	.687
35–39	.848	.786	.673	.611
40–44	.793	.795	.655	.476
45–49	.789	.822	.664	.559
Mali				
20–24	.755	.580		
25–29	.760	.642	.676	
30–34	.761	.716	.633	.525
35–39	.726	.695	.657	.536
40–44	.768	.706	.701	.568
45–49	.670	.680	.625	.643
Nigeria				
20–24	.606			
25–29	.683	.612		
30–34	.730	.640	.532	.517
35–39	.748	.671	.608	.454
40–44	.757	.705	.624	.440
45–49	.776	.746	.672	.573
Senegal				
20–24	.733			
25–29	.785	.646		
30–34	.822	.771	.731	.438
35–39	.804	.753	.665	.482
40–44	.781	.755	.675	.546
45–49	.787	.797	.631	.555
Togo				
20–24	.699			
25–29	.714	.716		
30–34	.771	.662	.524	
35–39	.770	.728	.545	.544
40–44	.775	.730	.600	.519
45–49	.821	.744	.689	.514

SOURCE: Calculations based on data from the Demographic and Health Surveys.

averages mask very important regional differences in fertility patterns. Table 2–9 highlights the extent of these differences. In southwest and southeast Nigeria, the TFR is less than it is in the northeast and northwest regions, by one child per woman. Furthermore, there is enormous variation in the average age at first marriage and the level of contraceptive use among the regions. In the northeast and the northwest regions, almost half of all women are married by age 15. Marriage occurs later in southeast and southwest Nigeria, where the median age at first marriage is closer to 18 and 20, respectively. Current use of family planning is also much higher in southwest Nigeria, where 15 percent of currently married women were using some method of contraception at the time of the survey, compared with 9 percent in southeast Nigeria and 2 percent or less elsewhere. The contrast in rates of modern contraceptive use between regions is even greater. Therefore, upon closer examination of fertility in Nigeria, it appears that a fertility transition is limited to the southwest (and possibly the southeast) region(s) of the country and is not a country-wide phenomenon. Nonetheless, this transition is significant because this part of Nigeria has a larger total population than most African countries.

The small declines in fertility recorded in Mali, Burundi, and Togo probably should not be interpreted as heralding the onset of a major fertility transition in those countries. A comparison of the total fertility rates in the two reference periods shows fertility falling by less than 1.0 birth per woman in each of these three countries. At the same time, there were considerable problems in the DHS for all three countries with the displacement of births (Arnold, 1990). The most likely explanation for the observed decline in fertility is that the data are flawed in some way.

Mali has an extremely low mean age at first marriage, and more than half of all women report that they were married by age 16, as shown in Table 2–6. The desire for children is greater in Mali than in any of the other countries in sub-Saharan Africa covered by the DHS, and relatively few women want no more children. Only 1.2 percent of currently married women are using efficient contraception. Moreover, there is little evidence of parity-specific reductions in fertility in the B_{60}s. These conditions are inconsistent with the reported decline in fertility. It is not surprising, therefore, to find evidence of a serious displacement of births in Mali. The problem appears particularly acute for children that died and for children whose exact month of birth was not known (Arnold and Blanc, 1990).

Fertility does appear to have fallen in Bamako, the capital of Mali. More than 16 percent of currently married women in Bamako are using some means of contraception, and 6 percent are using a modern method. Elsewhere in Mali, only 4 percent of married women are using any method of contraception, with less than 1 percent using a modern method. It is probably significant that in Bamako, the total fertility rate—an indication of

TABLE 2–9 Fertility and Related Measures in Nigeria, by Region, 1990

	Region				
Measure	Northeast	Northwest	Southeast	Southwest	Total
Age-specific fertility rates					
15–19	0.224	0.194	0.106	0.074	0.146
20–24	0.280	0.281	0.256	0.210	0.258
25–29	0.237	0.274	0.268	0.270	0.263
30–34	0.221	0.229	0.220	0.211	0.220
35–39	0.140	0.256	0.162	0.176	0.159
40–44	0.129	0.134	0.053	0.078	0.092
45–49	0.075	0.061	0.050	0.073	0.064
Total fertility rate (1990)	6.5	6.6	5.6	5.5	6.0
Total fertility rate (1981–1982)[a]	6.0	6.4	5.7	6.3	5.9
Difference	+0.5	+0.2	−0.1	−0.8	−0.1
Currently married women using any method of contraception (%)	2.0	1.2	8.8	15.0	6.0
Using modern method (%)	1.3	0.7	3.9	10.5	3.5
Median age at first marriage (women 25–49)	15.2	15.4	18.3	19.7	16.9
Median age at first birth (women 25–49)	18.8	19.5	19.6	20.5	19.7

[a] From World Fertility Survey.

SOURCE: Nigeria (1992:23, 43, 61).

fertility at the time of the survey—was considerably lower than the number of children ever born to women aged 40 to 49—an indicator of cumulative fertility in the past (Traoré et al., 1989). However, because of migration, the lifetime fertility of women aged 40–49 does not necessarily reflect cumulative fertility in Bamako.

In Burundi, age at first birth is relatively stable across age cohorts, though quite high by sub-Saharan African standards (Segamba et al., 1988). The DHS recorded very low use of modern contraceptives with only 1 percent of currently married women using a modern method of contraception. The B_{60}s for Burundi provide a final check for any signs of a reduction in fertility that is parity specific, but provide no clear indication of parity-specific reductions in fertility. Hence, the recorded decline in fertility is suspect.

In Togo, the decline in fertility is likely to have been exaggerated by poor data, although a number of indications are consistent with fertility decline. Specifically, contraceptive use, primarily abstinence, is very high; contraceptive awareness is virtually universal (93.5 percent); family planning receives widespread approval (68.9 percent); and recently, there has been a 10 percent decline in the number of women marrying by age 20. However, there is little evidence of a parity-specific reduction in fertility in the B_{60}s for Togo.

Finally, Group B should also include the most recently surveyed DHS countries for which data are not yet completely available. These include Cameroon and Zambia, for which first country reports have been published, and Malawi, Namibia, Niger, and Tanzania, for which only preliminary reports have been released. Because standard recode files are currently unavailable, the interpretation of recent fertility trends for these countries are based solely on the relevant DHS publications. None of these countries is included in Table 2–5 because the relevant DHS publications do not report age-specific fertility rates for 0–3 years and 4–7 years prior to the survey, the intervals indicated for the other populations. Neither do any of the reports discuss the reliability of birth history data. For example, none discusses the extent of misreporting of childrens' dates of births that in earlier surveys resulted in the appearance of declines in fertility.

The Cameroon report indicates a modest decline in fertility, from 6.4 births per woman in 1978 to 5.8 births per woman in 1991. This latter estimate is very close to the 1987 census estimate of 5.7 births per woman derived using P/F ratios. Nationally, the use of modern contraceptives is very limited (around 4.3 percent among currently married women) and not supportive of a sustained decline in fertility. However, in Douala and Yaoundé, the two largest cities in Cameroon, use of modern contraceptives is much higher (12.1 percent of currently married woman), and the total fertility rate for these two cities is 4.4 births per woman.

In Zambia, the DHS reports that the TFR of 6.5 children per woman is down approximately 10 percent from the (heavily adjusted) figure obtained from the 1980 census. Contraceptive prevalence stands at approximately 9 percent nationally, 15 percent in urban areas, and 3 percent in rural areas. At least part of the observed decline in fertility may be the result of a trend towards later age at first marriage among younger women (Zambia, 1993:60), but comparisons of age-specific fertility rates between the DHS and the census figures show that most of the decline in fertility appears to have occurred for women aged 25–39 and not in the age group 15–19 as might be expected. Hence, the conclusion that fertility is falling in Zambia is tentative and further assessment of these newest data is warranted when they become available.

Recent data from the Malawi DHS proved the most difficult to interpret. Until 1984, estimates of the TFR in Malawi were thought to be fairly reliable. Fertility rates appear to have changed little in the late 1970s and early 1980s in Malawi, and three independent sources—the 1977 census, the 1982 Demographic Survey, and the 1984 Family Formation Survey— were all in close agreement that the TFR stood between 7.6 and 7.7 births per woman (Malawi, 1980, 1987a,b).

Data from the 1987 census, however, showed an unadjusted TFR of 5.7 births per woman (National Statistical Office, Zomba, personal communication, 1992). This is almost certainly a gross underestimate, perhaps because the information was not necessarily supplied by the woman who bore the children. By applying a P/F adjustment, the TFR was revised to 8.0 births per woman (Table 2–1), a considerable difference from the unadjusted figure but not out of line with some expectations (see for example, House and Zimalirana, 1992:144). Consequently, the DHS preliminary estimate of the TFR, 6.7 children per woman, is a surprise, being substantially lower than the adjusted census figure and even below the mean number of children ever born to women aged 40–49 in both the 1987 census and the 1992 DHS. (When fertility is not changing, the number of children ever born is generally lower than the unadjusted total fertility rate because older women tend to systematically omit certain births.) However, 1990 and 1992 were drought years, which may have affected behavior over the short term. And the recent massive AIDS-prevention campaign may have achieved lower fertility through increased use of condoms, especially outside of sanctioned unions.

If all these estimates are correct, then the conclusion would be that fertility has fallen only in the last 3 or 4 years. Two qualifications apply. First, as stated above, adjusting the period fertility rates from the 1987 census on the basis of a comparison of P/F ratios is only valid if fertility has been approximately constant over the recent past. If fertility declined before 1987, then cumulated period rates cannot be expected to equal lifetime fertility, and the P/F ratios method would produce biased estimates of the true period rates.

Second, it should be possible to verify a recent decline in fertility rates by comparing mean numbers of children ever born by age groups across recent data sources. By imagining that the data were obtained from a single hypothetical cohort of women rather than from two independent samples, one can obtain an indirect estimate of the level of fertility. For example, if two surveys are exactly 5 years apart, women aged 15–19 in the first survey would be aged 20–24 in the second survey, and the incremental change in children ever born between these two groups would provide an estimate of the level of fertility between the two surveys. Applying this method to the recent data from Malawi produces an estimate of TFR of 6.8 births per woman for the intersurvey period. On the surface this estimate is quite consistent with the DHS figure, but actually the two methods yield quite different age-specific fertility schedules. Fertility probably fell in Malawi over the period 1987–1992, but more work will be needed to reconcile the various data sources when the DHS data are finally released.

Namibia gained its independence from South Africa in 1990, and conducted a national census in 1991 and a DHS in 1992. Unfortunately, results from the 1991 census are not yet available, but preliminary results from the DHS suggest that the national fertility rate for the years 1989–1992 was 5.6 births per woman. As with Nigeria, there are large differences in fertility levels across regions, from 6.4 children per woman in the Northwest region to 4.1 children per woman in the more urbanized Central/South region, which contains the capital, Windhoek. Differences in the use of modern contraceptives are also striking across regions, from 7 percent in the Northwest to 45 percent in the Central/South region.

In Niger, preliminary results indicate that there has been little or no change in fertility between the 1992 DHS and the 1988 census. Contraceptive prevalence rates are also extremely low. Despite reasonable levels of contraceptive awareness, only 4 percent of currently married women reported that they were currently using either a modern or a traditional method of contraception. Only in the capital, Niamey, are there any signs of a fertility reduction. In Niamey, the TFR was estimated to be 5.9 births per woman, compared with 7.2 births per woman for other urban areas and 7.5 births per woman for rural areas.

Preliminary data from the DHS in Tanzania indicate that the TFR stands at approximately 6.3 births per woman. This figure represents a slight decline from the 1988 census estimate of 6.5 children per woman. There also appear to be large urban-rural differences in fertility rates: for example, in the capital of Dar es Salaam, fertility is 4.0 children per woman, and 25 percent of currently married women are using modern means of contraception. More generally, however, the percentage of women using modern methods of contraception remains low. Perhaps the most intriguing finding is that modern contraceptive use is highest in Kilimanjaro and Arusha, two districts that border on Kenya. Here, 25 and 12 percent, respectively, of currently married women are using a modern method of contraception. These figures are higher than for Dar es Salaam (11 percent) and quite comparable to some districts in Kenya in 1989. These two regions of Tanzania are more densely populated and more economically developed than most of the rest of the country. Consequently, one explanation for the relatively high levels of contraceptive use is that the special socioeconomic and demographic characteristics of the area make it more amenable to the introduction of modern family planning. Alternatively, the proximity of these two regions to the Kenyan border perhaps suggests that there is a diffusion of ideas about ideal family size spreading from the north.

COMPARISON OF RECENT FERTILITY TRENDS IN AFRICA AND OTHER DEVELOPING REGIONS

Fertility patterns in most African and Asian countries were very similar in the 1960s.[6] As shown in Table 2–10, the total fertility rate in sub-Saharan Africa in 1965 was estimated to be 6.6 children per woman, only slightly higher than average for low- and middle-income countries. By 1989, fertility levels in developing countries varied markedly, but almost all regions had experienced some fertility decline. In East Asia, fertility fell by more than 50 percent, from 6.2 in 1965 to 2.7 in 1989. In Latin America, a decline in fertility probably began in the mid-1960s and resulted in a 40 percent decline by 1989. In South Asia, the decline was approximately 30 percent, from 6.3 to 4.4 births per woman.

Sub-Saharan Africa is the only major region of the developing world that has not yet undergone a general decline in fertility. The question arises: Is Africa more resistant to a change in fertility than elsewhere? This question is of enormous concern to population planners and policymakers, and has sparked a considerable amount of debate and controversy. Two distinct positions have emerged. In the past, Caldwell and Caldwell (1987, 1988) argued that even if Africa were to achieve levels of general development that exist elsewhere, the decline in fertility would continue to lag. This argument stresses the importance of both cultural and economic factors as determinants of fertility (Caldwell and Caldwell, 1987:416–417):[7]

[6]The figures used in this section are taken from the World Bank (1991). Although, some of the specifics are likely to be imperfect, the general trends are well established.

[7]See also Caldwell et al. (1989, 1992), Frank (1987), Mhloyi (1988), van de Walle and Omideyi (1988), and Lesthaeghe (1989) for a more complete explanation of the various cultural influences in place.

> High fertility (and a considerable number of surviving children) is associated with joy, the right life, divine approval, and approbation by both living and dead ancestors…. African parents almost certainly receive larger and more certain rewards from reproduction than do parents in any other society, and these upward wealth flows are guaranteed by interwoven social and religious sanctions.

Alternatively, the World Bank (1986:12–13) argues that the high fertility rates observed in Africa are not entirely unexpected because much of the rest of the world is relatively more developed:

> The strength of traditional pronatalist attitudes in much of sub-Saharan Africa raises the question of whether they are unique to Africa or parts of Africa. The answer is, probably not. First, incomes are generally lower than in other countries, levels of education and health levels are poorer, and urbanization is less extensive…Second, much of the progress that has occurred in Africa…is so recent that old attitudes have had little time to change. Third, although traditional beliefs—for example, that having children allows ancestors to be "reborn" —reinforce pronatalist attitudes in much of Africa, such beliefs are not unique to Africa.

Is the fertility decline observed in Africa in line with other countries' experience, or is Africa more resistant to fertility change? The 1986 World Bank report identifies several key areas in which sub-Saharan Africa lags behind the rest of the world. These include slower progress in the areas of education and health care, and lower rates of urbanization and industrialization. Table 2–10 presents various summary statistics demonstrating the progress that sub-Saharan Africa and other regions have made in these areas over the past 25 years.

In the past 25 years, the percentage increase in the proportion of children enrolled in school has been larger in sub-Saharan Africa than in any other region of the world. The proportion of females enrolled in primary education rose 94 percent, while the proportion enrolled in secondary education rose a staggering 600 percent.[8] In absolute terms, however, the level of primary education in sub-Saharan Africa in 1989 is roughly equal to the levels in most other regions of the world in 1965. Although fertility in sub-Saharan Africa may appear less responsive to changes in enrollment in primary and secondary education than elsewhere (van de Walle and Foster, 1990; Adamchak and Ntseane, 1992), it is important to remember that fertility is likely to respond to changing levels of education only after a lag,

[8]There has been some concern that the extremely rapid increase in enrollments has resulted in a major decline in the quality of education received (see, for example, World Bank, 1988, for some frightening evidence of declining quality in African schools).

TABLE 2–10 Summary Indicators of Socioeconomic Development

Indicator	Low- and Middle-Income Countries	Sub-Saharan Africa	East Asia	South Asia	Latin America and Caribbean
Total fertility rate					
1965	6.1	6.6	6.2	6.3	5.8
1989	3.9	6.6	2.7	4.4	3.5
Change (%)	–36	0	–56	–30	–40
Percentage of age group enrolled in primary education (females only)					
1965	63	31	–	52	96
1988	97	60	123	76	108
Change (%)	+54	+94	–	+46	+13
Percentage of age group enrolled in secondary education (females only)					
1965	14	2	–	12	19
1988	36	14	41	26	55
Change (%)	+157	+600	–	+117	+189
GNP per capita					
1965[a]	439	316	155	208	1,236
1989	800	340	540	320	1,950
Change (%)	+82	+8	+248	+54	+58
Infant mortality rate					
1965	117	157	95	147	94
1989	65	107	35	95	50
Change (%)	–44	–32	–63	–35	–47

Urban population (% of total)					
1965	24	14	19	18	53
1989	42	28	47	26	71
Change (%)	+58	+100	+147	+44	+34
Distribution of gross domestic product in agriculture (%)					
1965	30	41	42	44	16
1989	19	32	24	32	–
Change (%)	–37	–22	–43	–27	–

NOTE: —: no data.

[a]Imputed from 1989 rates and reported growth rates 1965–1989.

SOURCE: World Bank (1991).

and declines in fertility outside Africa did not occur at the levels of education currently found in Africa.

Table 2–10 also shows that the infant mortality rate (IMR) in 1965 was higher in sub-Saharan Africa than in any of the other broad regions represented in the table. Furthermore, the decline in the IMR was slowest in Africa. By 1989, the level of infant mortality in Africa was comparable to levels experienced by other regions in the mid-1960s. In Africa, fertility has not responded to the decline in mortality, perhaps because it is too recent and parents are not aware of it or are not convinced it is sustainable.

Finally, there was virtually no increase in gross national product (GNP) per capita in sub-Saharan Africa during 1965–1989. Following a brief period of economic growth in the 1970s, most African economies have experienced a gradual deterioration. The World Bank (1989) identified three distinct economic periods in contemporary African history: 1961–1972, a period of growth in per capita income; 1973–1980, a period of general stagnation; and 1981–1987, a period of general decline. There are exceptions to this generalization, most notably in Botswana and, to a lesser extent, in Cameroon, Congo, and Lesotho, where per capita incomes have risen consistently over the past 25 years. For the most part, however, African economies have faltered. Poor industrial and agricultural performance, falling commodity prices, declining exports, mounting debt, and increasing environmental degradation have all contributed to a deepening crisis (World Bank, 1989).

Figure 2–5 shows the relationship between the total fertility rate and GNP per capita. The figure includes data pooled from 1965 and 1989 so there are two points for each country. The figure includes data from each of the low- and middle-income countries (i.e., countries with a level of GNP per capita of less than $5,350 in 1989) for which data are available, with data points both for countries in Africa and for other developing countries.

Ordinary least squares regression methods were used to estimate two separate lines, one for African data points and the other for all other regions combined. The slope of the African line is less than the slope of the line representing the other countries. A formal statistical test was used to determine that there is a significant difference between the slopes of the two lines. Although cross-sectional data of this sort are not well suited to modeling change, the more gradual slope of the African line suggests that fertility in Africa may be less responsive to changes in GNP per capita than it is in other developing countries. Therefore, the graph provides some support for the Caldwells' assertion that African fertility is more resistant to change. On the other hand, sub-Saharan Africa is only now approaching the development levels of the other regions in 1965, and sophisticated econometric techniques are required to control simultaneously for variations in GNP per capita, infant mortality rates, and primary and secondary school enrolment rates across countries. Once these controls are introduced, Africa no longer exhibits a slower fertility response to changes in GNP per capita (Working Group on Factors Affecting Contraceptive Use, 1993). Overall, it is probably too early to tell whether a major decline in fertility is likely to occur more or less slowly in Africa than elsewhere.

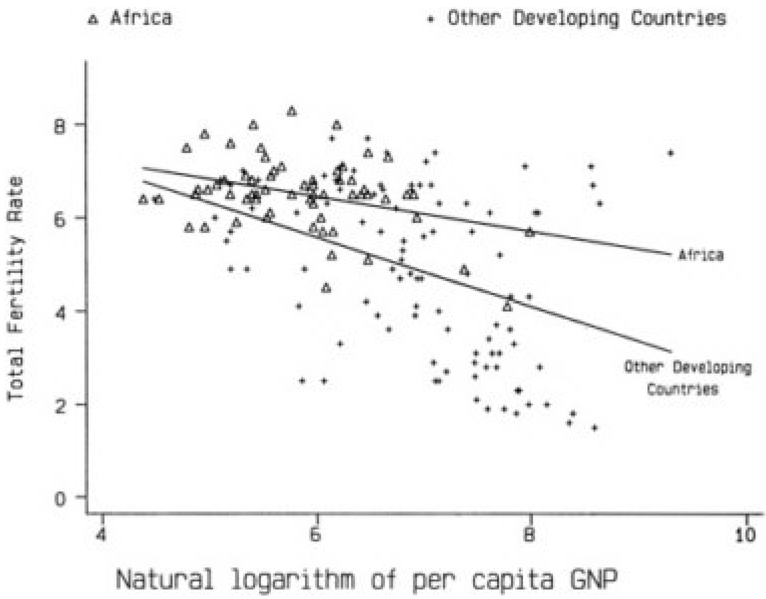


FIGURE 2–5 Total fertility rates (TFR) by gross national product (GNP) per capita.
NOTE: Δ: African countries; +: other developing countries.

CONCLUSIONS

This chapter has presented a descriptive picture of childbearing in sub-Saharan Africa. It is clear that most countries in Africa began to experience a decline in mortality in the 1950s and 1960s (see Chapter 5), but the region has yet to experience a similar general decline in fertility. Consequently, the population growth rate is high, with the population of sub-Saharan Africa expected to double within the next 22–23 years.[9] One overriding ques

[9]This statement is true regardless of whether there is an immediate and sustainable drop in fertility because the young age structure of sub-Saharan African populations ensures that large numbers of potential parents will shortly enter their childbearing years. Consequently, “demographic momentum” is built into the current age structure of the population (Keyfitz, 1977).

tion now faces African demographers: When and through what mechanisms is a general decline in fertility likely to occur?

Together, the Demographic and Health Surveys represent the biggest single data collection effort ever to be undertaken in sub-Saharan Africa, and birth histories have already been collected from more than 90,000 women. Attempting to identify the start of an African fertility transition has been one of the most important contributions of the DHS. At face value, DHS data imply that fertility is declining across much of Africa. However, this conclusion is not always supported by other related patterns of behavior (i.e., later marriage, increased contraceptive use, and lower fertility preferences) or by in-depth analysis of birth histories. Kenya, Botswana, Zimbabwe, parts of Nigeria, and, possibly, Senegal comprise the vanguard of the decline. In none of the above cases has fertility fallen to a level that would imply a zero rate of population growth (that is, a level that would just replace the existing population). Nonetheless, the reductions in fertility rates are important and may herald the onset of the fertility transition that at some point will stretch across the entire continent. What is particularly intriguing about these fertility declines, however, is not only that they are the first to have taken place, but also that they have arisen through changes in different proximate determinants. In the first four cases, fertility decline appears to be associated with an increase in the use of contraception. In Senegal, the decline appears associated with a trend toward later marriage.

DHS data also indicate that there are substantial differences in fertility by urban-rural residence and level of education even in countries whose national-level statistics do not indicate that a substantial decline in fertility has occurred. However, the absolute level of fertility in urban areas and among more educated women often remains high. There is also considerable overlap between the two groups so that the total contribution to fertility decline, so far, is small.

Despite the increase in information available from sample surveys and censuses, there is still a shortage of reliable data on fertility rates for many countries in Africa. There is no tradition of accurate data collection in the region, and vital registration statistics are unavailable. Given the resource constraints facing most governments, the instability of political regimes in the region, and the large-scale movements of many refugees across the continent as a result of drought, famine, or low-intensity warfare, the immediate prospects for accurate data collection are extremely poor. Censuses have provided the majority of the information on fertility rates, but censuses have been plagued frequently by problems that have resulted in incomplete or inaccurate coverage. In other cases, census counts were not published because they were politically unacceptable (the 1983 Guinea Census), too unreliable (the census of Nigeria in 1973), or simply lost due to conflict (Uganda in 1980, Liberia in 1984, and Somalia in 1986). Survey data from the region are thought to be reasonably reliable; yet despite WFS and DHS efforts to ensure data quality, careful analysis has revealed significant inaccuracies. In addition, many countries in Africa have not been surveyed recently. The need for accurate and timely demographic data on fertility levels and trends for many African countries is still urgent.

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3

The Proximate Determinants of Fertility

Carole L.Jolly and James N.Gribble

INTRODUCTION

Fertility levels in sub-Saharan Africa are among the highest in the world. As a result, recent fertility declines in a few countries have gained the attention of researchers and policy makers, and have renewed interest in the factors affecting fertility. As first outlined by Davis and Blake (1956), the factors affecting fertility can be classified into two groups: background variables and intermediate or proximate variables. The former includes cultural, psychological, economic, social, health, and environmental factors. The proximate determinants are those factors that have a direct effect on fertility. The background factors operate through the proximate determinants to influence fertility; they do not influence fertility directly.

Drawing on data from the Demographic and Health Surveys (DHS) and World Fertility Surveys (WFS), this chapter examines the relative effects of four proximate determinants on fertility: marriage patterns, contraceptive use, postpartum infecundability, and primary sterility. Using the Bongaarts model of proximate determinants of fertility, we examine how these four factors influence the levels of fertility and illustrate different effects of each

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Carole L.Jolly and James N.Gribble are program officers for the Committee on Population, National Research Council. They thank Kenneth Hill for his assistance in estimating the measure of the degree of childbearing outside marriage and are also grateful for his help in the computations.

factor with country examples. We also examine differentials across countries for each of the determinants and compare the changes over time by comparing results from the WFS and the DHS for those countries that conducted surveys under the auspices of both programs.

DATA

The data sources for this analysis are the 12 DHS of women conducted in sub-Saharan Africa during the 1980s and the WFS conducted during the 1970s in Ghana, Kenya, Senegal, and northern Sudan. Only four WFS countries are examined—those for which there was a subsequent DHS. The DHS core instrument gathered data on the socioeconomic status and reproductive history of women and the health of their children, as well as their experiences in using health services. The WFS also systematically gathered comparable data on fertility and mortality in nine sub-Saharan African countries, including northern Sudan.[1]

Although Sudan is included in our analysis, it is important to note that the survey was conducted in northern Sudan, a region that is primarily Arab/Muslim and quite distinct from the black African/Christian or animist south, which is more similar to the rest of sub-Saharan Africa. Table 3–1 provides information on the sample sizes, criteria for being included in the sample, and dates of fieldwork for the surveys.

FRAMEWORK

Bongaarts et al. (1984) enumerate nine major proximate determinants of fertility at the societal level:

1. marriage or union patterns,
2. contraception,
3. lactational amenorrhea,
4. postpartum abstinence,
5. pathological sterility,
6. induced abortion,
7. frequency of sexual intercourse,
8. spontaneous intrauterine mortality, and
9. natural sterility.

[1]Although this analysis generally used data from the core questionnaires of the DHS and the WFS, in some cases a variation of a core question was asked or a core question was eliminated. In these cases, it was necessary to obtain the information from another question or to use an imputation procedure. See Technical Notes at the end of this chapter for details.

TABLE 3–1 Data Sets Used in the Analysis

Country	Abbreviation	Time of Fieldwork	Respondents	Sample Size
Demographic and Health Surveys				
Botswana	BWA	August-December 1988	All women 15–49	4,368
Burundi	BDI	April-July 1987	All women 15–49	3,970
Ghana	GHA	February-May 1988	All women 15–49	4,488
Kenya	KEN	December-May 1988–1989	All women 15–49	7,150
Liberia	LBR	February-July 1986	All women 15–49	5,239
Mali	MLI	March-August 1987	All women 15–49	3,200
Ondo State, Nigeria		September-January 1986–1987	All women 15–49	4,213
Senegal	SEN	April-July 1986	All women 15–49	4,415
Sudan[a]	SDN	November-May 1989–1990	Ever-married women 15–49	5,860
Togo	TGO	June-November 1988	All women 15–49	3,360
Uganda	UGA	September-February 1988–1989	All women 15–49	4,730
Zimbabwe	ZWE	September-January 1988–1989	All women 15–49	4,201
World Fertility Surveys				
Ghana	GHA	February-March 1979–1980	All women 15–49	6,125
Kenya	KEN	August-May 1987–1988	All women 15–50	8,100
Senegal	SEN	May-October 1978	All women 15–49	3,985
Sudan[a]	SDN	December-April 1978–1979	Ever-married women age 50 or under	3,115

[a]WFS and DHS data for Sudan refer only to northern Sudan.

Bongaarts and Potter (1983) developed a model to quantify the effects of the six proximate determinants that in their analysis had the most important influences on fertility levels: union patterns, contraception, lactational amenorrhea and postpartum abstinence, pathological sterility, and abortion (Bongaarts, 1982; Bongaarts et al., 1984). The analysis in this chapter is based on the Bongaarts and Potter model, but does not include abortion because reliable and comparable estimates are not available for sub-Saharan Africa.

The model relates total fertility to total potential fertility reduced by a series of indices, each of which reflects the fertility-reducing effect of a proximate determinant. An index, which has a range between 0 and 1 for most of the proximate determinants, is estimated (lactational amenorrhea and postpartum abstinence are joined into one index). An index value of 0 has the strongest effect of reducing fertility (fertility equals zero); a value of 1 has the weakest effect on fertility (the proximate determinant has no fertility-limiting effect). The lower the index, the more influential the proximate determinant is in reducing the total fecundity rate (TF), the level of fertility that would occur in the absence of all of the proximate determinants. Thus, the proximate determinants can be thought of as inhibitors of fertility. For example, delayed entry into marriage, use of family planning methods, and prolonged breastfeeding or postpartum abstinence are factors that reduce fertility to levels lower than those that would occur in the absence of these proximate determinants. Below is a description of the proximate determinants used in this analysis, the way these factors influence fertility through inhibiting TF, and the computational procedure used to estimate the indices. (Equations for deriving these indices are given in the appendix to this chapter.)

Marriage or Union Patterns[2]

Because entry into marriage is a process and not a single event in many parts of sub-Saharan Africa (see Chapter 4), this analysis looks at the effect of the proportions of women in sexual union, rather than marriage per se, on fertility. The proportion of women in a sexual union in a society indicates the degree to which women of reproductive age are exposed to the risk of becoming pregnant (if one assumes that all sexual intercourse occurs within union). In populations where women marry early and there is little divorce or separation, exposure to pregnancy is very high. In many parts of sub-

[2] In the context of this analysis, the term "marriage" refers to being married or living in a fairly stable union.

Saharan Africa, women marry young; median age at first union among women ages 25–49 at the time of the DHS surveys ranges from 15.7 in Mali to 19.7 in Ondo State, Nigeria. Although union dissolution is relatively common, most women remarry quickly, which results in a large proportion of ever-married women who are actually in a union (Mhloyi, 1988). Such behavior can be expected to result in high levels of fertility.

In the Bongaarts model, the index of the proportion in marriage or union, C_m, is intended to measure the effect on fertility of the proportion of women in a sexual union. The effect of marriage or union patterns on fertility is captured as the ratio of the average number of children a woman bears throughout her life (total fertility rate or TFR) to the number she would bear if she first entered a union at age 15 and stayed in that union until age 50 (total marital fertility rate or TMFR). C_m has the value of 1 when all women of reproductive age are in union and is equal to 0 when none are in union.

This formulation assumes that all fertility occurs within marriage or union. This assumption does not hold in many parts of sub-Saharan Africa, where substantial proportions of births are reported by women who describe themselves as single or never married, which may result in the calculated C_m being greater than 1. Anthropological studies indicate that the Western concept of marriage is not necessarily the appropriate paradigm to be applied to all of sub-Saharan Africa. Union formation may be an extended process, and births do occur outside of union (see Chapter 4; and Working Group on the Social Dynamics of Adolescent Fertility, 1993).

The fact that nonmarital births occur raises a problem for the Bongaarts model (which Bongaarts recognized). If births to unmarried women are excluded from the analysis, the TFR is underestimated, but the TMFR is estimated accurately. If, on the other hand, these births are included in both, the TFR is calculated accurately, but the estimated TMFR is inflated, giving the impression that marriage patterns reduce fertility by a much greater fraction than is actually the case.

To circumvent this problem and to maintain a consistent definition for other variables in the Bongaarts' model using women currently in union only, we have added a variable to the model. This variable, M_o, captures the effect on total fertility of births outside union. M_o relates total fertility calculated by using all births to total fertility from using births only to women in union. C'_m, a modified version of C_m, captures the effect on total fertility of the specific observed union pattern, under the assumption that no births occur outside unions. The product of M_o and C'_m is C_m, the usual definition of the effects of marriage patterns on fertility used in the Bongaarts model.

To summarize, in our model, M_o can be thought of as the effect of births outside union on total fertility (thus a value of M_o of 1.43 indicates that the TFR is approximately 43 percent higher than it would have been if all fertility occurred in unions). C'_m can be thought of as the effect of reported union patterns on fertility if births occur only in unions, and C_m is the combined result of the fertility-inhibiting effect of union pattern and the fertility-promoting effect of sexual relations outside union. The two new indices are related because, if all women were in unions from age 15 to age 50, there would be no births to women not married, and M_o would be equal to 1 (i.e., there would be no effect on fertility) and C'_m would equal C_m. It is important to note that M_o is not a fertility-reducing parameter of the model, but rather a device to maintain comparability across cultures in the interpretation of other parameters of the model. C_m, C'_m, and M_o are reported in the tables; only C_m is shown in the figures.

Contraception

The proportion of women using contraception to space or limit births and the effectiveness of the contraception they use directly affect a society's fertility level. In sub-Saharan Africa, contraceptive prevalence rates are generally low in comparison with other regions of the world (Rutenberg et al., 1991). There is also substantial use of traditional methods, which are not as effective in preventing pregnancy as modern methods.

The index of contraception, C_c, measures the effect of actions intentionally taken to reduce the risk of conception. C_c equals 1 if no form of contraception is used and 0 if all fecund exposed women use modern methods that are 100 percent effective.

Postpartum Infecundability

There are several practices women can follow after the birth of a child that delay a subsequent pregnancy. A woman is unable to conceive after a pregnancy until her normal pattern of ovulation returns. When she is breastfeeding, the length of lactational amenorrhea is determined primarily by the duration, intensity, and pattern of breastfeeding. Moreover, in a number of societies, sexual relations are not permitted while women breastfeed their newborn children, which further reduces the chances of conception.

In much of sub-Saharan Africa, women breastfeed for long periods and refrain from sexual relations after the birth of a child. Both of these practices are seen as necessary to preserve the health of the child and mother (van de Walle and van de Walle, 1988). In most of the sub-Saharan African countries analyzed here, the duration of breastfeeding was much longer than postpartum abstinence (see Table 3–2). However, substantial variation in both practices exists within the region.

The index of postpartum infecundability, C_i, estimates the effect of

TABLE 3–2 Mean Duration (months) of Postpartum Variables for Women Currently Married

Country	Breastfeeding	Amenorrheic	Abstaining	Nonsusceptible[a]	Weighted No. of Births
Botswana	19.2	11.7	8.9	13.3	932
Burundi	23.9	19.4	2.4	19.6	2,306
Ghana	20.9	14.6	12.9	17.7	2,314
Kenya	20.1	11.2	3.9	11.7	3,667
Liberia	17.5	11.7	13.1	15.5	2,554
Mali	21.5	15.7	7.0	17.0	2,101
Ondo State	18.8	14.2	22.7	23.9	1,847
Senegal	19.2	15.8	6.8	17.6	2,433
Sudan[b]	19.7	14.1	4.6	14.9	3,885
Togo	23.0	14.6	17.2	20.1	1,804
Uganda	19.1	13.1	3.0	13.4	2,654
Zimbabwe	18.2	11.4	4.1	11.9	1,760

NOTE: Data are national-level DHS.

[a] See Technical Notes (at end of this chapter) on derivation of indices for a discusssion of nonsusceptible period.

[b] DHS data for Sudan refer only to northern Sudan.

postpartum amenorrhea and abstinence on fertility. When there is no lactation or postpartum abstinence, C_i equals 1; when infecundability is permanent, C_i equals 0.

Pathological or Primary Sterility

Several studies of infecundity in sub-Saharan Africa have indicated relatively high levels, particularly in Central Africa (Frank, 1983a; Bongaarts et al., 1984; Farley and Besley, 1988). Bongaarts et al. (1984) found that at least 20 percent of women in much of Central Africa are childless at the end of their reproductive years. In parts of Central and East Africa, between 12 and 20 percent of women ages 45 to 49 are childless. Lower levels generally exist in West Africa. Clearly, such high levels of infecundity inhibit the level of fertility achieved in many African societies.

Although infertility increases naturally as a woman ages (natural sterility), much of the primary sterility (inability to have any children at all) in sub-Saharan Africa is caused by sexually transmitted diseases (STDs) (Caldwell and Caldwell, 1983; Frank, 1983a). It is generally thought that gonorrhea is the most prevalent STD affecting African populations.

I_p, the index of sterility, takes into account only primary sterility and not secondary sterility, which is the inability to bear a second or subsequent child. Calculation of I_p is based on a 3 percent standard rate of childlessness in developing countries (Frank, 1983a; Bongaarts et al., 1984). If the rate of childlessness exceeds 3 percent, I_p will have a value less than 1, indicating that it reduces fertility. However, if less than 3 percent of women aged 40 to 49 are childless, then I_p has a value greater than 1, which indicates that levels of primary sterility are lower than would be expected in a developing country. It is difficult to interpret such a result in the context of a proximate determinants analysis because it suggests that low levels of primary infecundity increase fertility. When calculating I_p with the data used here, most of the indices were greater than 1. As a result, the index was omitted from many of the figures (see further discussion below).

Summary of Model

Each index outlined above (except M_o) acts as an inhibitor to fertility. The observed fertility rate (TFR) is equal to total fecundity rate (TF) multiplied (generally reduced) by each index:

$$\text{TFR}=\text{TF}\bullet C_m\bullet C_c\bullet C_i\bullet I_p.$$

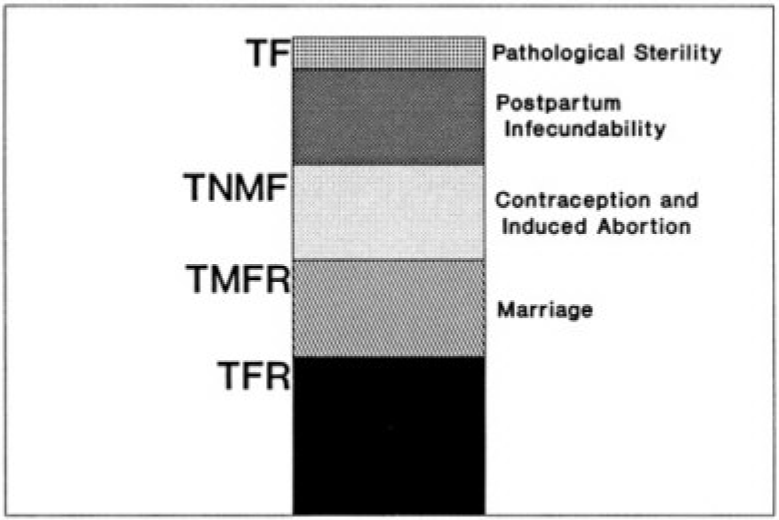

FIGURE 3–1 Relationship between the fertility-inhibiting effects of the proximate determinants and various measures of fertility.

	Proximate Determinant Indices
C_m:	index of marriage
M_o:	effect of births outside unions on total fertility
C'_m:	adjusted index of marriage
C_c:	index of contraception
C_i:	index of postpartum infecundability
I_p:	index of sterility

The model can also be shown graphically, as in Figure 3–1. The column, which represents TF, is divided into five segments. The solid base at the bottom indicates the observed total fertility rate based on the reported number of births occurring in the four years prior to the survey. Moving upward, the height of the next segment indicates the level fertility would be if all women were in a union during the whole of their reproductive years (the TMFR). If no women in union practiced contraception, observed fertility would rise to the top of the next segment. This height represents the total natural marital fertility rate (TNMF). The top two segments of the column indicate the effects of postpartum infecundability and sterility. The height of the column indicates the fertility level one would observe if none of the proximate determinants was exerting a fertility-reducing effect (i.e., if all the indices were equal to 1).

EMPIRICAL RESULTS

National-Level Results for DHS Countries

The national-level results of the proximate determinants analysis for the DHS countries are illustrated in Figure 3–2. The index of primary sterility is not included in the graph because many of the values are greater than 1. (The actual numbers used in the figure are reported in Table 3–3.) The height of the columns estimates the total fecundity rate (TF) of the national population of each country. The columns vary in height, but fall within the range of 12.9 to 16.5, basically within the theoretical range of 13 to 17 suggested by Bongaarts and Potter (1983).

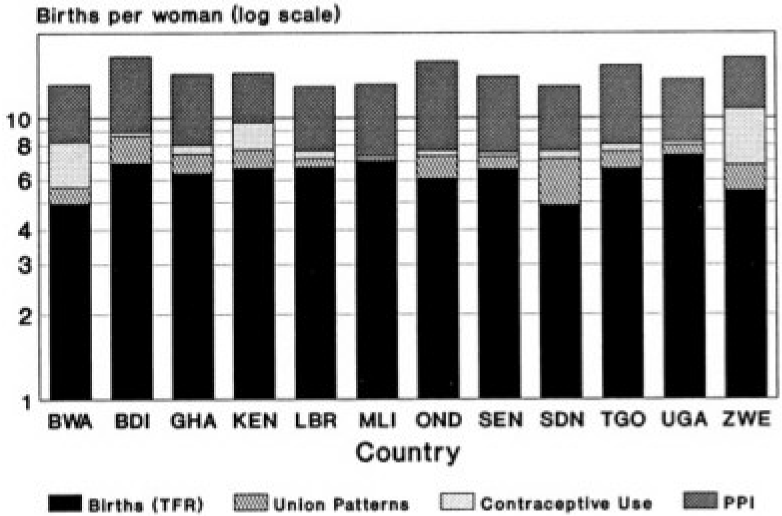

FIGURE 3–2 Relationship between the fertility-inhibiting effects of the proximate determinants and various measures of fertility, by country (for country abbreviations, see Table 3–1). NOTE: PPI: Postpartum infecundability; DHS data for Sudan refer to only northern Sudan.

TABLE 3–3 Proximate Determinants of Fertility

Country	Index of Marriage, C_m	Adjusted Index of Marriage, C'_m	Measure of Births Outside Marriage, M_o	Index of Contraception, C_c	Index of Postpartum Infecundability, C_i	Index of Sterility, I_p	Model Estimate of Total Fecundity Rate, TF	Observed TFR
Botswana	0.87	0.46	1.89	0.70	0.63	1.00	13.0	5.0
Burundi	0.80	0.76	1.06	0.97	0.53	1.03	16.5	6.9
Ghana	0.85	0.77	1.11	0.93	0.55	1.02	14.3	6.4
Kenya	0.86	0.73	1.17	0.80	0.66	1.01	14.4	6.6
Liberia	0.93	0.75	1.24	0.94	0.59	1.00	12.9	6.7
Mali	0.98	0.95	1.02	0.98	0.56	0.99	13.1	7.0
Ondo State	0.83	0.80	1.04	0.96	0.47	1.03	15.8	6.1
Senegal	0.90	0.84	1.07	0.97	0.55	0.98	14.0	6.6
Sudan[a]	0.68	0.66	1.03	0.94	0.60	0.99	12.9	4.9
Togo	0.87	0.82	1.06	0.94	0.52	1.02	15.3	6.6
Uganda	0.92	0.77	1.19	0.97	0.63	0.97	13.6	7.4
Zimbabwe	0.81	0.73	1.12	0.63	0.66	1.01	16.3	5.5

NOTE: Data are national-level DHS.

[a]DHS data for Sudan refer only to northern Sudan.

The data from the DHS in the mid-1980s show that the TFRs range from 4.9 in northern Sudan to 7.4 in Uganda. Botswana also exhibits a relatively low level of fertility, 5.0 births. Mali and Burundi show relative high levels of fertility, 7.0 and 6.9, respectively (see Chapter 2 for further discussion of fertility in sub-Saharan Africa).

Marriage

The first proximate determinant estimated is the effect of union or marriage patterns on fertility (see Chapter 4 for a discussion of marriage data). M_o, which describes the effect on total fertility of births outside union, ranges in these populations from 1.02 in Mali to 1.89 in Botswana. This value indicates that in Mali, very little childbearing occurs outside of union (only 2 percent of the fertility in the TFR occurred outside of union). Botswana, on the other hand, shows a high level of fertility occurring to women not currently in union. If the TFR were estimated by using only births in union, it would be 89 percent lower than the level observed when all births are considered.

In populations where M_o is large, C'_m, which captures the effect of union patterns on fertility under the assumption that no births occur outside of unions, varies substantially in comparison with C_m. In settings where much childbearing occurs outside of union, the inhibiting effect of union pattern alone on fertility is underestimated by C_m (i.e., C_m is higher than it should be). In Botswana, for example, C'_m is 0.46, compared to a C_m value of 0.87. (As explained in the description of the framework, the lower the index, the greater inhibiting effect it has on fertility.) The value of C'_m for Botswana suggests that union patterns (relatively late age at marriage and substantial proportions of women not in union) have a large effect in reducing fertility. In Mali, because most childbearing occurs in union, only a small difference is observed between C'_m and C_m. Sudan also has a very low M_o value, and consequently, the values of C'_m and C_m are very similar. Although part of the low value of the C'_m index for Sudan can be explained by rising age at marriage and increasing proportions of women never married, part of the difference may be explained by the way in which the TFR was calculated (see note 2). Kenya, Liberia, and Uganda have substantially lower C'_m index values, reflecting the effect of union patterns on fertility. These countries also have correspondingly high M_o values—greater than 1.15—indicating that a relatively large amount of the fertility contributing to the TFR is outside of union. By controlling for childbearing outside of marriage, the reductive effect of union patterns is much stronger than indicated solely by C_m (as evidenced by the C'_m values being lower than the C_m values).

Contraception

The second index C_c evaluates the influence of contraceptive use on fertility. This factor quantifies the difference between the TMFR and the TNMF.

In general, contraceptive use in sub-Saharan Africa is low, as reflected in C_c values close to 1. However, the index values for Botswana, Kenya, and Zimbabwe are lower, relative to other countries, indicating that contraception plays a more important role in limiting fertility. In Zimbabwe, for example, the C_c of 0.63 reflects a relatively high contraceptive prevalence rate of 43 percent and a fairly effective method mix, with 31.0 percent of women using pills, 1.1 percent using the IUD, 2.5 percent using sterilization, and 8.4 percent using other (mostly traditional) methods.

Burundi, Mali, Ondo State, Senegal, and Uganda have relatively high C_c values, all greater than 0.95, reflecting very low contraceptive prevalence rates and ineffective method mixes. For example, C_c in Mali is 0.98, based on a contraceptive prevalence of 3.3 percent, with most women using traditional methods. Because the index of contraception is so close to 1, the TMFR and the TNMF are almost identical, indicating that fertility in union is close to the level that would exist in the absence of contraception.

Postpartum Infecundability

Analysis of the mean durations of breastfeeding, amenorrhea, and abstinence among women in union indicates that these postpartum practices last substantially longer than in many parts of the world, although there is considerable regional variation (Mhloyi, 1988; van de Walle and Omideyi, 1988). Mean duration of breastfeeding ranges from 17.5 months in Liberia to 23.9 months in Burundi. Mean duration of abstinence varies from 2.4 months in Burundi to 22.7 months in Ondo State. These durations translate into relatively long periods of nonsusceptibility after childbirth, particularly in West African countries. (See Table 3–2 for national-level estimates.)

The third index C_i demonstrates the effect of such long postpartum nonsusceptible periods on fertility. In Ondo State, C_i had the largest fertility-reducing effect of all the proximate determinants, with a value of 0.47. The index primarily reflects a very long period of postpartum abstinence, 22.7 months (the longest of all the DHS populations considered here), which contributed greatly to an nonsusceptible period of 23.9 months. The effect of this index on fertility is to reduce the average number of births per woman by 8.2; that is, if postpartum breastfeeding and abstinence ceased, the average observed total fertility rate would increase, *ceteris paribus,* by 8.2 births.

Many countries also have low values of C_i (.56 and less): Burundi, Ghana, Mali, Senegal, and Togo. Four countries (Botswana, Kenya, Uganda, and Zimbabwe) have index values greater than 0.60, indicating a less significant influence of postpartum nonsusceptibility on reducing fertility. Three of these countries—Botswana, Kenya, and Zimbabwe—also exhibit relatively high levels of contraceptive use.

Pathological Sterility

The fourth index I_p is the index of involuntary infecundity or pathological sterility. The proportion of ever-married women ages 40 to 49 who are childless ranges from 0.8 percent in Ondo State to 5.2 percent in Uganda. Altogether, fewer than half of the countries exhibit proportions childless of greater than 3 percent, the average expected for a developing country. Given this result, it may be surmised that an average of 3 percent sterility is too high an estimate, contrary to the conclusions of much of the literature on pathological sterility in sub-Saharan Africa. However, Central Africa, where the highest levels of infecundity are reported to exist (Page and Coale, 1972; Frank 1983a,b), is underrepresented in the DHS thus far, and childlessness may be underreported by women who do not want to reveal that they have borne no children (Larsen, 1989).

The average of 3 percent is based on work by Frank (1983a), who uses data sources published in the 1960s and 1970s to determine the prevalence of childlessness among women ages 45–49. Farley and Besley (1988) report that a large part of the infertility in sub-Saharan Africa is the result of infections (sexually transmitted diseases) that can be treated with antibiotics. The availability of antibiotics for the treatment of other infectious diseases may have reduced the prevalence of STDs in the 1950s and 1960s, thus reducing levels of infertility among women ages 40–49 in the late 1980s.

Overall, the effect of the index is small, with the greatest effect observed in Uganda. There, the index was 0.97, indicating that primary sterility reduced fertility by an average of only 0.40 birth per woman.

Interpreting the Results

Using the proximate determinants and data from the WFS and DHS yields national-level TF estimates ranging from 12.1 to 16.5 (see Tables 3–4 and 3–7). Bongaarts and Potter (1983) indicate that estimates for most populations range from 13 to 17, with an average of 15.3. The TF values for the 16 populations examined in this chapter average about 14.1, more than a birth lower on average per woman. This unexplained difference plus some methodological biases inherent in the proximate determinants model point to the danger of taking these estimates too literally.

TABLE 3–4 Proximate Determinants of Fertility by Age of Women

Country and Age	Index of Marriage, C_m	Adjusted Index of Marriage, C'_m	Measure of Births Outside Marriage, M_o	Index of Contraception, C_c	Index of Postpartum Infecundability, C_i	Index of Sterility, I_p	Model Estimate of Total Fecundity Rate, TF	Observed TFR
Botswana National	0.87	0.46	1.89	0.70	0.63	1.00	13.0	5.0
15–24	0.83	0.24	3.40	0.78	0.61	1.00	4.3	1.7
25–34	0.92	0.57	1.63	0.67	0.64	1:00	5.0	2.0
35–49	0.87	0.61	1.42	0.70	0.63	1.00	3.5	1.3
Burundi National	0.80	0.76	1.06	0.97	0.53	1.03	16.5	6.9
15–24	0.56	0.51	1.10	0.98	0.53	1.03	5.4	1.6
25–34	0.95	0.90	1.06	0.97	0.53	1.03	6.1	3.1
35–49	0.88	0.85	1.04	0.97	0.51	1.03	5.1	2.3
Ghana National	0.85	0.77	1.11	0.93	0.55	1.02	14.3	6.4
15–24	0.71	0.60	1.20	0.95	0.53	1.02	5.3	1.9
25–34	0.95	0.89	1.07	0.93	0.57	1.02	5.1	2.6
35–49	0.90	0.84	1.07	0.91	0.54	1.02	4.0	1.8
Kenya National	0.86	0.73	1.17	0.80	0.66	1.01	14.4	6.6
15–24	0.75	0.56	1.35	0.87	0.66	1.01	5.4	2.3
25–34	0.94	0.85	1.11	0.79	0.68	1.01	5.4	2.7
35–49	0.92	0.86	1.08	0.76	0.64	1.01	3.5	1.6

Liberia National	0.93	0.75	1.24	0.94	0.59	1.00	12.9	6.7
15–24	0.91	0.61	1.48	0.96	0.58	1.00	4.7	2.4
25–34	0.95	0.83	1.14	0.93	0.60	1.00	4.7	2.5
35–49	0.95	0.82	1.15	0.94	0.59	1.00	3.5	1.8
Mali National	0.98	0.95	1.02	0.98	0.56	0.99	13.1	7.0
15–24	0.98	0.94	1.04	0.98	0.57	0.99	4.6	2.5
25–34	0.99	0.97	1.02	0.98	0.56	0.99	5.2	2.8
35–49	0.98	0.95	1.02	0.99	0.55	0.99	3.4	1.8
Ondo State Regional	0.83	0.80	1.04	0.96	0.47	1.03	15.8	6.1
15–24	0.56	0.52	1.09	0.98	0.48	1.03	5.6	1.5
25–34	0.99	0.98	1.02	0.95	0.51	1.03	6.0	3.0
35–49	0.96	0.93	1.03	0.96	0.42	1.03	4.0	1.6
Senegal National	0.90	0.84	1.07	0.97	0.55	0.98	14.0	6.6
15–24	0.81	0.71	1.14	0.99	0.54	0.98	5.2	2.2
25–34	0.95	0.91	1.04	0.96	0.57	0.98	3.4	2.7
35–49	0.95	0.92	1.03	0.97	0.55	0.98	5.4	1.7
Sudan Northern	0.68	0.66	1.03	0.94	0.60	0.99	12.9	4.9
15–24	0.44	0.43	1.03	0.96	0.61	0.99	4.8	1.2
25–34	0.81	0.79	1.03	0.93	0.60	0.99	5.3	2.4
35–49	0.87	0.85	1.02	0.93	0.59	0.99	2.7	1.3
Togo National	0.87	0.82	1.06	0.94	0.52	1.02	15.3	6.6
15–24	0.74	0.66	1.11	0.96	0.52	1.02	5.4	2.0
25–34	0.95	0.92	1.04	0.94	0.54	1.02	5.3	2.6
35–49	0.91	0.89	1.03	0.94	0.48	1.02	4.7	2.0

Country and Age	Index of Marriage, C_m	Adjusted Index of Marriage, C'_m	Measure of Births Outside Marriage, M_o	Index of Contraception, C_c	Index of Postpartum Infecundability, C_i	Index of Sterility, I_p	Model Estimate of Total Fecundity Rate, TF	Observed TFR
Uganda National	0.92	0.77	1.19	0.97	0.63	0.97	13.6	7.4
15–24	0.86	0.69	1.25	0.99	0.64	0.97	4.9	2.6
25–34	0.94	0.82	1.16	0.97	0.63	0.97	5.3	3.0
35–49	0.97	0.82	1.18	0.94	0.58	0.97	3.5	1.8
Zimbabwe National	0.81	0.73	1.12	0.63	0.66	1.01	16.3	5.5
15–24	0.69	0.54	1.27	0.62	0.60	1.01	6.8	1.8
25–34	0.90	0.85	1.07	0.56	0.68	1.01	6.9	2.3
35–49	0.86	0.83	1.05	0.71	0.71	1.01	3.2	1.4

NOTE: Data are national-level DHS.

There are several factors at work that could be affecting the reliability of our estimates. One is errors in the WFS and DHS data. Although both of these survey programs were highly professional operations, the data sets for sub-Saharan Africa do contain reporting errors. Statements regarding age at marriage, duration of postpartum abstinence, use of contraception, and current age are often approximate. For example, in more than half of the DHS surveys for sub-Saharan Africa, less than 50 percent of the women interviewed were able to give their date of birth (Institute for Resource Development, 1990). In all the African surveys (WFS and DHS), there was considerable age heaping (Goldman et al., 1985; Institute for Resource Development, 1990).

The second factor to consider is biases within the proximate determinants model. Menken (1984) and Reinis (1992) both find that the model produces very good estimates under the assumption of random use of contraception. However, Reinis finds that with nonrandom use of contraception, which is more likely given that women tend to use contraception depending on their family-building plans, the estimates produced, except for C_i, are less accurate. In particular, the model performs poorly when women use contraception to stop rather than to space births, when there is delayed marriage, and when contraceptive use is most prevalent at the oldest ages (which happens when large families are sought).

In sub-Saharan Africa, one or more of these conditions exist for many countries. For example, parity progression ratios indicate a stopping pattern in Kenya (DHS; see Chapter 2); in some of the countries, particularly those with low contraceptive prevalence rates, contraceptive use is concentrated in the oldest age group; and in some countries, dates of first union are relatively late.

A third factor not accounted for in our application of the model is the incidence of induced abortion. Although reliable and comparable cross-national estimates do not exist for sub-Saharan Africa, there is limited evidence indicating that abortion is substantial in some regions. The failure to incorporate abortion in the model will affect our assessment of the relative importance of the fertility-inhibiting variables and the estimation of TF (which will be underestimated in areas of high abortion rates). Coeytaux (1988), in a review of the literature on abortion, notes that studies conducted in the late 1970s and early 1980s show rising hospital admissions for complications related to abortions. She notes that ethnographic data suggest that a greater number of abortions are performed than originally thought. Data on adolescent unmarried urban women indicate that abortion may be fairly common (Working Group on the Social Dynamics of Adolescent Fertility, 1993). However, some studies indicate that abortion is also practiced by older married rural women. The survey data that do exist probably underestimate the prevalence of abortion because many women who have had an abortion deny it in interviews (Coeytaux, 1988).

Summary

In all of the DHS sub-Saharan African populations included in this analysis, except Zimbabwe, the proximate determinant having the greatest fertility-inhibiting effect is the postpartum nonsusceptible period. At a minimum, observed fertility would increase by 4.8 births in Botswana and, at a maximum, by 8.2 births in Ondo State in the absence of breastfeeding and postpartum abstinence. The practice of spacing children for the health of the child and mother still continues to exhibit a powerful fertility-reducing effect.

The second most powerful proximate determinant in inhibiting fertility is marriage patterns (C_m). For all populations except Botswana, Kenya, Mali, and Zimbabwe, union patterns are more important than contraceptive use in reducing fertility. However, when controlling for the effect of births among women currently not married, the effect of union patterns, C'_m, is even greater except in Zimbabwe. In Mali, the reductive effects of union patterns and contraception are approximately equal and both are very weak. The use of contraception, in the three countries where it has a stronger effect on fertility than union patterns (based on C_m), reduces observed fertility by 2.5 births in Botswana, 1.9 births in Kenya, and 4.0 births in Zimbabwe.

Differentials for DHS Countries

Comparison of the proximate determinants across subpopulations helps illuminate background factors that underlie fertility differentials. For example, observed fertility is generally higher in rural areas than in urban areas, and the proximate determinants provide an understanding of what behavioral or biological factors are associated with this differential. In this section, we examine differentials of the proximate determinants of fertility by age, residence, and education using DHS data.

Age

Age is divided into three groups: 15–24 years (youngest), 25–34 years (middle), and 35–49 years (oldest). Table 3–4 provides estimates across age groups for all the countries studied. In most countries, marriage patterns are the primary factor that distinguishes the youngest group from the middle and oldest groups. C_m and C'_m have the strongest fertility-reducing effect during the younger years due to entry into union. The later the age at marriage and the larger the proportion of never married, the greater is the fertility-inhibiting effect of C_m or C'_m. In the middle and oldest groups, marriage patterns do not inhibit fertility as much as in the youngest ages because most women are married by age 25, and marriage dissolution through widowhood or divorce has little effect.

Interestingly, in five of the populations, contraceptive patterns have their greatest reductive effect in the middle age group, the years when childbearing is at its peak. Contraception has the second greatest effect in the oldest age group. In the countries where use of contraception is highest—Botswana, Kenya, and Zimbabwe—patterns vary across age group. Botswana follows the general pattern just outlined. In Kenya, contraceptive patterns have the greatest fertility-inhibiting effect in the oldest age group, followed by the middle age group. In Zimbabwe, the strongest effect is in the middle age group, followed by the youngest age group.

In most of the countries studied, the index of postpartum infecundability (C_i) varies less across age groups than do the indices of marriage (C_m or C'_m) or contraception (C_c). In seven of the populations, postpartum practices have their greatest effect in reducing fertility in the oldest age group, indicating that younger women are breastfeeding and abstaining for shorter periods than are older women. In five countries, however, postpartum infecundability has its greatest effect in the youngest group.

Two examples, shown in Figure 3–3, illustrate the differentials in fertility across age groups attributable to the proximate determinants.

Ondo State, Nigeria The TFRs by age group in Ondo State are 1.5 in the youngest group, 3.0 in the middle group, and 1.6 in the oldest group (for a total TFR of 6.1 across all age groups). Marriage is almost universal within the middle and oldest groups. Among the youngest group, marriage is far less common and occurs at a relatively late age (the median for those aged 15–24 is 19.7 years).

The index of contraception does little to reduce fertility in Ondo State because contraceptive prevalence in all three age groups is low, ranging from 4.1 percent among the youngest to 7.7 percent among the oldest, and method use-effectiveness is low. In all three age groups, the index of postpartum infecundability has the strongest effect of the indices on reducing TF. Thus, the variation in fertility across age groups in Ondo State is attributable principally to different marriage patterns.

Zimbabwe Fertility levels across age groups in Zimbabwe are similar to those observed in Ondo State, but contraception is the major inhibitor to fertility. Marriage patterns have a smaller fertility-reducing effect in the youngest age group in Zimbabwe than in Ondo State. Even so, marriage patterns in Zimbabwe reduce fertility more in each of the age groups than they do in most of the other DHS populations.

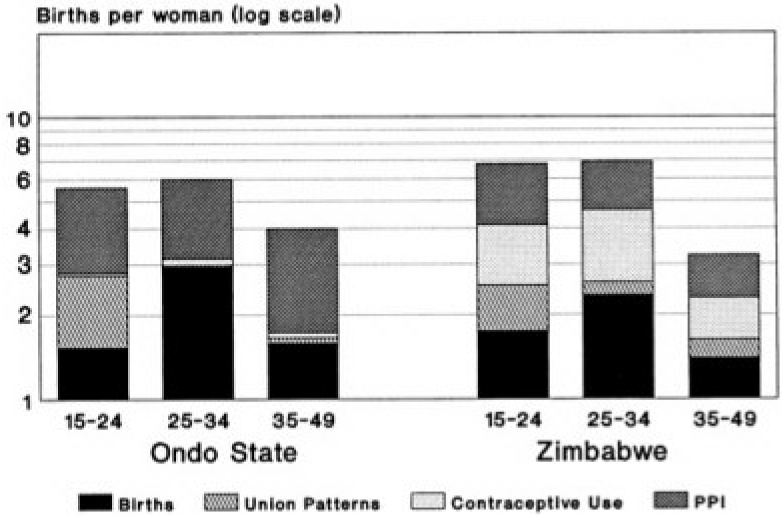

FIGURE 3–3 Relationship between the fertility-inhibiting effects of the proximate determinants and various measures of fertility, by age, for Ondo State, Nigeria and Zimbabwe. NOTE: PPI: Postpartum infecundability.

Contraceptive use is relatively high in Zimbabwe, with prevalences of 41.7 percent in the youngest group, 50.5 percent in the middle group, and 36.1 percent in the oldest group. Consequently, C_c has the greatest effect on inhibiting fertility for each age group of all the proximate determinants.

Finally, C_i has its largest inhibitive effect among the youngest group, corresponding to a nonsusceptible period of 14.7 months. This same pattern was observed in four of our other study populations.

Residence

Fertility tends to be higher in rural areas than in urban areas. Residence may have a strong effect on fertility by influencing a woman's values, how she spends her time, and her view of the world (Zeidenstein, 1979). Women in rural areas may want larger families to ensure that someone will help with domestic and agricultural activities and provide financial security in old age. In urban areas, women may begin to limit their fertility because of the costs associated with childbearing. Living in an urban area may change women's values as they are exposed to the modern health sector, family planning, and more Western attitudes (Acsadi and Johnson-Acsadi, 1990).

Table 3–5 presents results of the analysis of proximate determinants by residence, which are generally consistent with this pattern of differential fertility by residence. In all the populations except Ondo State and Botswana, C_m and C'_m are lower in urban areas than in rural areas, indicating that a larger proportion of rural women are married. Consistent with this pattern is the tendency of M_o to be higher in urban areas than in rural areas, reflecting greater proportions of nonunion births in urban areas.

C_c has a greater effect in inhibiting fertility among urban women due to higher contraceptive prevalence and use of more effective methods. The index of postpartum infecundability C_i is lower among women in rural areas, indicating that either breastfeeding or postpartum abstinence has a stronger fertility-inhibiting effect there. In all the populations except Botswana and Burundi, I_p is lower in urban areas, indicating higher levels of primary sterility. Larsen (1989) has suggested that despite generally better health care in urban areas, the incidence of STDs is likely to be higher there because prostitution is more common.

Education

Education plays an important role in inhibiting fertility, although substantial variation is observed in how fertility is associated with different levels of education, as illustrated in Table 3–6. Two basic patterns describe the association. In the first pattern, which is common particularly in Latin America and observed in seven of the sub-Saharan African populations analyzed here (Botswana, Ghana, Senegal, Sudan, Togo, Uganda, and Zimbabwe), as women's education increases, fertility declines monotonically. In the second pattern, which is observed in five of our populations (Burundi, Kenya, Liberia, Mali, and Ondo State), the relationship follows an inverted U-shape pattern, that is, in comparison to women with no education, women with some education have higher fertility, but those with even greater amounts of education have the lowest fertility of all.

These two patterns have been previously documented by Cochrane (1979, 1983) among others. A common explanation of the finding that women with some education have higher fertility is that increased female education and urbanization are generally correlated with decreases in durations of breastfeeding and postpartum abstinence, which lead to shorter intervals between births and thus higher fertility (Adegbola et al., 1977). Women with some education are also likely to seek modern health care for medical problems, such as STDs, leading to reduced subfecundity (Cochrane, 1979; Romaniuk, 1980). Overall, C_c and C_m show the greatest variation by educa

TABLE 3–5 Proximate Determinants of Fertility by Urban or Rural Residence

Country and Residence	Index of Marriage, C_m	Adjusted Index of Marriage, C'_m	Measure of Births Outside Marriage, M_o	Index of Contraception, C_c	Index of Postpartum Infecundability, C_i	Index of Sterility, I_p	Model Estimate of Total Fecundity Rate, TF	Observed TFR
Botswana								
Urban	0.86	0.48	1.80	0.61	0.68	1.02	11.0	4.0
Rural	0.86	0.45	1.91	0.74	0.61	0.99	13.7	5.3
Burundi								
Urban	0.75	0.60	1.25	0.83	0.70	1.03	11.1	5.0
Rural	0.81	0.76	1.05	0.98	0.52	1.03	16.5	7.0
Ghana								
Urban	0.78	0.70	1.11	0.89	0.60	1.01	12.6	5.3
Rural	0.89	0.80	1.11	0.95	0.54	1.03	15.0	6.9
Kenya								
Urban	0.82	0.66	1.24	0.74	0.70	0.96	11.7	4.7
Rural	0.87	0.75	1.17	0.81	0.66	1.01	14.8	7.0
Liberia								
Urban	0.91	0.68	1.33	0.90	0.62	0.99	12.3	6.1
Rural	0.96	0.80	1.19	0.97	0.58	1.01	13.3	7.1
Mali								
Urban	0.96	0.93	1.03	0.94	0.62	0.96	11.6	6.2
Rural	0.98	0.97	1.02	1.00	0.55	1.00	13.6	7.3
Ondo State								
Urban	0.83	0.80	1.04	0.94	0.50	1.01	15.1	6.0
Rural	0.83	0.80	1.04	0.97	0.45	1.04	16.3	6.1
Senegal								
Urban	0.79	0.71	1.12	0.92	0.63	0.96	12.7	5.6
Rural	0.98	0.93	1.04	0.99	0.53	0.99	14.5	7.3

Sudan[a]								
Urban	0.55	0.53	1.03	0.87	0.65	0.98	12.2	3.7
Rural	0.71	0.70	1.01	0.58	0.98	1.00	13.3	5.2
Togo								
Urban	0.79	0.73	1.08	0.90	0.57	0.99	12.2	4.9
Rural	0.91	0.87	1.05	0.96	0.50	1.03	16.3	7.4
Uganda								
Urban	0.84	0.62	1.36	0.86	0.70	0.93	11.8	5.6
Rural	0.91	0.77	1.18	0.98	0.62	0.97	14.1	7.5
Zimbabwe								
Urban	0.70	0.52	1.36	0.52	0.68	1.00	15.6	3.9
Rural	0.87	0.78	1.11	0.67	0.65	1.01	16.5	6.3

NOTE: Data are national-level DHS.

[a]DHS data for Sudan refer only to northern Sudan.

TABLE 3–6 Proximate Determinants of Fertility by Level of Education

Country and Education Level	Index of Marriage, C_m	Adjusted Index of Marriage, C'_m	Measure of Births Outside Marriage, M_o	Index of Contraception, C_c	Index of Postpartum Infecundability, C_i	Index of Sterility, I_p	Model Estimate of Total Fecundity Rate, TF	Observed TFR
Botswana								
None	0.85	0.50	1.70	0.83	0.61	0.98	13.8	5.8
1–4 years	0.98	0.53	1.87	0.72	0.59	0.99	13.0	5.5
5–7 years	0.84	0.44	1.93	0.67	0.65	1.02	12.5	4.7
8+years	1.02	0.42	2.44	0.50	0.69	1.05	9.1	3.4
Burundi								
None	0.81	0.76	1.06	0.98	0.52	1.03	16.4	6.9
1–4 years	0.77	0.74	1.05	0.96	0.54	1.05	16.9	7.1
5–7 years	0.79	0.72	1.09	0.95	0.57	1.05	16.2	7.3
8+years	0.71	0.64	1.13	0.76	0.67	1.05	15.2	5.8
Ghana								
None	0.88	0.84	1.05	0.95	0.51	1.02	15.7	6.8
1–4 years	0.87	0.78	1.11	0.93	0.54	1.00	15.0	6.6
5–7 years	0.88	0.79	1.11	0.92	0.58	1.05	12.1	6.0
8+years	0.79	0.70	1.13	0.89	0.61	1.03	12.5	5.5
Kenya								
None	0.91	0.85	1.06	0.88	0.61	1.00	14.8	7.2
1–4 years	0.94	0.80	1.18	0.80	0.65	1.02	15.4	7.7
5–7 years	0.88	0.75	1.18	0.78	0.69	1.04	14.6	7.2
8+years	0.82	0.66	1.24	0.70	0.71	1.00	12.2	5.0
Liberia								
None	0.96	0.82	1.17	0.97	0.57	1.00	12.9	6.9
1–4 years	1.12	0.71	1.57	0.96	0.59	1.04	11.8	7.7

5–7 years	0.79	0.62	1.27	0.90	0.65	1.03	14.9	7.1
8+years	0.82	0.53	1.56	0.75	0.68	0.99	11.0	4.6
Mali								
None	0.99	0.96	1.03	0.99	0.56	0.99	13.2	7.2
1–4 years	1.05	0.97	1.08	0.96	0.55	1.05	13.4	7.7
5–7 years	0.97	0.96	1.01	0.95	0.59	1.05	11.5	6.5
8+years	0.98	0.94	1.05	0.77	0.68	1.05	10.1	5.4
Ondo State								
None	0.96	0.92	1.04	0.98	0.43	1.03	16.4	6.8
1–4 years	0.86	0.85	1.02	0.96	0.49	1.05	17.0	7.2
5–7 years	0.89	0.87	1.02	0.96	0.49	1.05	17.4	7.6
8+years	0.77	0.75	1.02	0.90	0.54	0.99	14.3	5.2
Senegal								
None	0.95	0.91	1.05	0.99	0.54	0.97	14.3	7.0
1–4 years	0.87	0.76	1.14	0.98	0.58	1.05	11.2	5.7
5–7 years	0.78	0.62	1.25	0.88	0.68	1.05	10.4	5.1
8+years	0.60	0.53	1.14	0.74	0.71	1.05	11.3	3.7
Sudan[a]								
None	0.78	0.76	1.03	0.98	0.57	0.99	13.4	5.8
Primary	0.69	0.67	1.03	0.91	0.62	0.96	13.0	4.9
Secondary+	0.36	0.35	1.03	0.83	0.69	1.05	15.4	3.3
Togo								
None	0.92	0.89	1.03	0.96	0.50	1.02	16.1	7.2
1–4 years	0.90	0.82	1.09	0.94	0.54	1.05	15.0	7.2
5–7 years	0.78	0.71	1.09	0.91	0.57	0.97	13.2	5.1
8+years	0.75	0.59	1.28	0.81	0.63	1.05	11.0	4.4
Uganda								
None	0.93	0.82	1.13	0.99	0.60	0.96	15.1	7.9
1–4 years	0.91	0.77	1.18	0.97	0.64	0.98	13.0	7.3
5–7 years	0.87	0.70	1.25	0.96	0.65	1.00	13.0	7.0
8+years	0.84	0.60	1.39	0.87	0.70	0.94	12.0	5.7

Country and Education Level	Index of Marriage, C_m	Adjusted Index of Marriage, C'_m	Measure of Births Outside Marriage, M_o	Index of Contraception, C_c	Index of Postpartum Infecundability, C_i	Index of Sterility, I_p	Model Estimate of Total Fecundity Rate, TF	Observed TFR
Zimbabwe								
None	0.93	0.86	1.09	0.73	0.64	1.01	16.2	7.2
1–4 years	0.89	0.80	1.11	0.69	0.65	1.00	16.8	6.7
5–7 years	0.83	0.74	1.13	0.62	0.69	1.01	15.4	5.5
8+years	0.75	0.64	1.17	0.47	0.63	0.98	17.0	3.7

NOTE: Data are national-level DHS.

[a]DHS data for Sudan refer only to northern Sudan.

tion, with the former having a monotonically negative relation to education in all the populations. Greater contraceptive use and use of more effective methods are generally associated with more education. C_m has a similar relation to education in Senegal, Sudan, Togo, Uganda, and Zimbabwe, but for the other populations, the relation is not uniform. However, when C'_m is examined, all but Botswana, Mali, and Ondo State show a monotonically negative effect of union patterns on fertility as education increases.

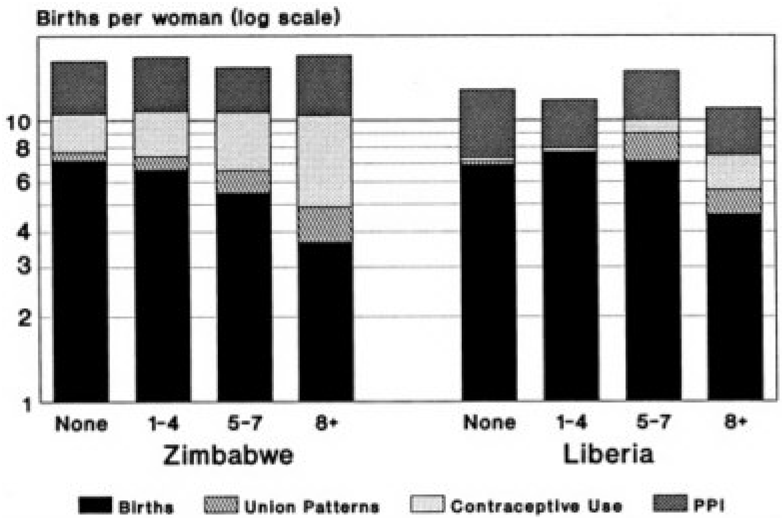

FIGURE 3–4 Relationship between the fertility-inhibiting effects of the proximate determinants and various measures of fertility, by years of education, for Zimbabwe and Liberia. NOTE: PPI: Postpartum infecundability.

The inhibitive effect of postpartum infecundability on fertility decreases with education, except in Botswana, Mali, and Zimbabwe. Women with less education tend to breastfeed their children and abstain from sex after birth for longer durations than more-educated women. Even so, there is relatively little variation in C_i across education groups. I_p also varies little by education.

Two examples, shown in Figure 3–4, illustrate how the proximate determinants inhibit fertility when the relationship between fertility and education follows the two above-mentioned patterns: Zimbabwe, with the monotonically inverse relationship, and Liberia, with the inverted U-shape relationship.

Zimbabwe In Zimbabwe, TFR is 7.2 among women with no educa tion, 6.7 among women with one to four years of schooling, 5.5 among women with five to seven years, and 3.7 among women with eight or more years.

The proximate determinants exhibiting variation across educational groups are C_m (and C'_m) and C_c. Most women with no education are married. C_m is lower among women with eight or more years of school. Among more educated women, union patterns—later age at marriage and smaller proportions of women married—result in lower fertility. C'_m illustrates the same pattern. Generally, the effect of childbearing among women not in union increases with education level, which may imply more marital instability among better-educated women.

Contraceptive practices vary across the four educational groups, although the national prevalence rate is high when compared with most of sub-Saharan Africa. Prevalence is 32.3 percent among women with no education, and 56.6 percent among the most educated group. Eliminating contraceptive use would increase observed fertility by 5.5 births among women with eight or more years of schooling and by 2.9 births among the least-educated group.

The effect of postpartum nonsusceptibility on inhibiting fertility is large, but the index shows little variation across the four education groups.

Liberia Liberia illustrates the inverted U-shape relationship between fertility and education. The TFR is 6.9 among women with no education. It increases to 7.7 among women with one to four years of schooling, but begins dropping to 7.1 among women with five to seven years, and falls to 4.6 among women with eight or more years of formal schooling.

In Liberia, C_m, C'_m, M_o, C_c, and C_i all vary across educational groups and contribute to the observed pattern. C'_m decreases monotonically with education, indicating an increasingly stronger effect of union patterns on fertility. M_o is lowest among women with no education and reaches levels greater than 1.5 for two of the education groups, indicating perhaps a relatively higher level of marital instability among educated women or a higher percentage of births occurring outside of union among this group. (Bongaarts' C_m shows an erratic pattern, reaching a value of 1.12 among women with one to four years of schooling, and contributing to the high level of fertility among this group. In this case, C_m is not interpretable as a fertility-reducing parameter, so our discussion focuses on C'_m. Such a finding illustrates the methodological difficulty mentioned in the appendix.)

Contraceptive use increases with education, although its inhibiting effect on fertility is much higher among women with eight or more years of schooling than among other women. The effect of postpartum infecundability decreases monotonically with education, although C_i is the most important proximate determinant in reducing fertility across all education groups.

Change Over Time: Comparison of WFS and DHS Results

A comparison of how the proximate determinants of fertility have changed over time provides an understanding of the biological and behavioral factors underlying fertility change. Four sub-Saharan African countries—Kenya, Senegal, Sudan, and Ghana—have participated in both the WFS and the DHS programs thus far, which allows an examination of changes in these countries from the 1970s to the 1980s. TFRs from these four countries indicate that the total fertility rate declined between the mid-1970s and mid-1980s in Kenya (8.2 to 6.6), Senegal (7.2 to 6.6), and Sudan (6.0 to 4.9), but remained unchanged in Ghana (6.4), as shown in Figure 3–5 and Table 3–7. Comparative estimates for all subgroups are provided in appendix Tables A–1 through A–3 (see Chapter 2 for a more complete discussion of fertility change in sub-Saharan Africa).

Kenya

Kenya illustrates the potential role of contraceptive practices in reducing fertility, as shown in Figure 3–5. The most important determinant of the change in TFR of 1.5 births was a drop in the index of contraception, from

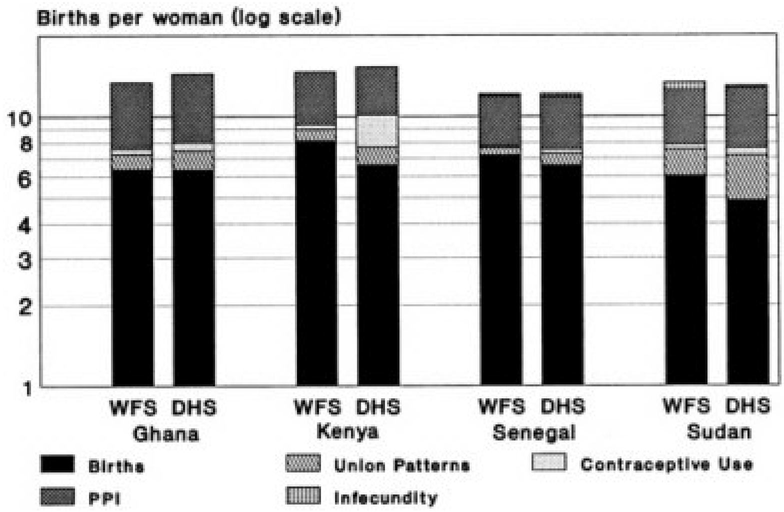

FIGURE 3–5 Comparison of WFS and DHS data of the relationship between the fertility-inhibiting effects of the proximate determinants and various measures of fertility. NOTE: WFS and DHS data for Sudan refer only to northern Sudan.

TABLE 3–7 Proximate Determinants of Fertility

Country and Survey	Index of Marriage, C_m	Adjusted Index of Marriage, C'_m	Measure of Births Outside Marriage, M_o	Index of Contraception, C_c	Index of Postpartum Infecundability, C_i	Index of Sterility, I_p	Model Estimate of Total Fecundity Rate, TF	Observed TFR
Ghana								
WFS	0.88	0.81	1.08	0.95	0.56	1.01	13.4	6.4
DHS	0.85	0.77	1.11	0.93	0.55	1.02	14.3	6.4
Kenya								
WFS	0.91	0.81	1.12	0.96	0.64	1.00	14.7	8.2
DHS	0.86	0.73	1.17	0.80	0.66	1.01	14.4	6.6
Senegal								
WFS	0.94	0.89	1.05	0.99	0.65	0.99	12.1	7.2
DHS	0.90	0.84	1.07	0.97	0.64	0.98	12.1	6.6
Sudan[a]								
WFS	0.80	0.78	1.03	0.96	0.63	0.93	13.3	6.0
DHS	0.68	0.66	1.03	0.94	0.60	0.99	12.9	4.9

NOTE: Data are national-level WFS and DHS.

[a]WFS and DHS data for Sudan refer only to northern Sudan.

0.94 to 0.76. Underlying this decline was a substantial increase in contraceptive prevalence across all subgroups between the two surveys. At the time of the DHS (1988–1989), contraceptive prevalence in Kenya was estimated at 26.8 percent, with 5.2 percent using pills, 3.7 percent using IUDs, 4.7 percent using sterilization, and 13.2 percent using other, mainly traditional, methods. At the time of the WFS (1977–1978), prevalence was 6.7 percent, with 2.0 percent using pills, 0.7 percent using IUDs, 0.9 percent being sterilized, and 3.1 percent using traditional methods. The effect of the increase in contraceptive use on TF was substantial. At the time of the WFS, C_c contributed to a reduction of 0.4 birth in observed fertility, but at the DHS, it contributed to a reduction of 1.9 births. However, even though contraceptive use rose, the use-effectiveness of the method mix did not change.

Over the same period, the inhibiting effects of marriage on fertility increased only slightly, as C_m decreased from 0.91 to 0.86. M_o increased between the surveys, indicating an increase in nonunion fertility. The C_i index changed little over the intervening period. However, at both times, C_i had the largest fertility-inhibiting effect of all the proximate determinants. The increase in the index reflects the decrease in the nonsusceptible period from 12.7 to 11.7 months.

Senegal[3]

Between the WFS and the DHS, the observed TFR in Senegal declined by 0.6 birth from 7.2 to 6.6 (see Table 3–7). The change appears to be attributable principally to a change in marriage patterns. For the WFS, the C_m index was 0.94, which contributed a reduction of 0.5 birth relative to TF. For the DHS, C_m had a value of 0.90, which was associated with a reduction of 0.7 birth. This change probably reflects an increase in the proportion of never-married women from 12.9 percent in the WFS to 18.8 percent in the DHS (Ndiaye et al., 1988). Although marriage patterns appear to have changed, the changes are very small and, therefore, do not give solid evidence of a real change in marriage or fertility. The low values of M_o result in very small differences between C_m and C'_m, indicating that most childbearing occurs within union.

[3]The WFS for Senegal did not ask women whether they were currently amenorrheic, so the nonsusceptible period was imputed by using a formula based on the duration of breastfeeding that was developed by Bongaarts and Potter (1983) (see Technical Notes at the end of the chapter).

To make the analysis based on DHS and WFS data comparable, the DHS C_i used in Figure 3–5 and Table 3–7 was also imputed by using the same formula.

Comparing C_c and I_p reveals only small changes in the calculated values over time. C_c is 0.99 for the WFS and 0.97 for the DHS, indicating insignificant change in contraceptive use or method mix. Contraceptive prevalence was less than 5 percent at the times of both surveys, and the method mixes were heavily dependent on traditional methods.

Sudan

A comparison of the changes in the proximate determinants of fertility of Sudan indicates that the TFR decreased by 1.1 births from 6.0 to 4.9. The index of marriage appears to be the factor that changed most significantly over the intervening period. At the time of the WFS, C_m was 0.80, indicating marriage patterns contributed a reduction of 1.5 births relative to the TF. By the time the DHS was conducted, the C_m was 0.68, resulting in a fertility reduction of 2.3 births. The values of M_o were very low, indicating that almost all childbearing occurs within union.

The DHS reports that almost all Sudanese women marry during their lifetime; by ages 45–49, 99 percent of all women have married (Sudan, 1991). Although the DHS was based on a sample of ever-married women, the household survey associated with DHS indicated that a substantial increase in the average age at marriage had occurred in recent years. The proportion of never-married women had risen by 12 percentage points in the 10 years since the Sudan Fertility Survey.

Postpartum infecundability had a large effect in reducing fertility at both times, but it did not exhibit as much of a decrease between the two periods as C_m. Contraceptive use was low at the time of both surveys (4.5 percent in the WFS and 8.2 percent in the DHS), resulting in an insignificant decline in C_c.

Ghana

The final sub-Saharan African country for which both the DHS and WFS were available at the time of our analysis is Ghana. TFR remained unchanged between the two surveys (6.4), and the proximate determinants inhibited fertility to roughly the same extent for both surveys. The most important factor at both times was postpartum infecundability, with values of 0.56 and 0.55, respectively. C_m was the second most important proximate determinant, with values falling in the mid-range of those observed in the region. M_o was about 1.1 for both surveys, indicating a consistent level of nonunion fertility. In Ghana, contraceptive use made the smallest contribution to limiting fertility of any of the proximate determinants even though the index of contraception is lower in Ghana than in many other sub-Saharan African populations studied; only Zimbabwe, Kenya, and Botswana are lower.

CONCLUSION

The proximate determinants framework illustrates how the underlying factors that determine levels of fertility vary across populations and time. The original model developed by Bongaarts assumes that all childbearing occurs in marriage. In the African setting, where entry into union is a process, this assumption is not necessarily correct. In response to this situation, we developed the measures M_o and C'_m, which further refine the effect of union patterns on fertility.

The index of postpartum infecundability is generally the most significant inhibitor of fertility. Although prolonged breastfeeding and postpartum abstinence are not universal in sub-Saharan Africa, they generally play an important role in spacing births and reducing total fertility.

Marriage patterns also reduce fertility substantially in many populations. The index of marriage C_m tends to be lowest in the youngest age groups, indicating that marriage is less common among women between ages 15 and 24. The index is generally closer to unity among women living in rural areas because marriage is more common and earlier there. Among women with more education, union patterns are less supportive of high fertility.

M_o illustrates the proportion of fertility occurring outside union. In some populations, such as Mali, Ondo State, and northern Sudan, M_o is very low (close to 1) indicating that most fertility occurs in union. However, in some populations, such as Botswana, Liberia, and Uganda, M_o values are higher, suggesting that a substantial proportion of total fertility occurs outside of union. C'_m is substantially lower than C_m in populations where M_o is large, indicating that C_m underestimates the effect of union patterns on fertility in these populations.

Contraceptive use in sub-Saharan Africa is fairly low; notable exceptions are Botswana, Kenya, and Zimbabwe. Generally contraceptive prevalence is higher among women in the middle age group. Younger women may want to bear their children rapidly to demonstrate their value as wives. Once women begin to achieve their desired family size, they may begin to use family planning methods (Mhloyi, 1988). In a few populations, contraception has its most significant effect on inhibiting fertility among the oldest age group, perhaps because these women are trying to end their childbearing. On the other hand, in most of these countries, contraceptive prevalence is still relatively low compared to other parts of the developing world. C_c has a greater fertility-inhibiting effect among women with eight or more years of education than among women with fewer years of schooling, and among women living in urban rather than rural areas.

The index of sterility poses a difficulty in our analysis. Although Frank (1983a) estimates that primary sterility generally affects at least 3 percent of women in developing countries, many of the populations analyzed here show much lower levels. In Botswana, Mali, Senegal, Sudan, and Uganda, the index values were less than 1, indicating that primary sterility was greater than 3 percent. In the remaining countries, less than 3 percent of women between the ages of 40 and 49 had never borne a child, indicating that the calculation for estimating I_p may need to be reconsidered. However, it is also possible that women are underreporting primary sterility by a considerable margin, given the stigma attached to being childless in many parts of sub-Saharan Africa (Larsen, 1989).

The failure to include abortion in our analysis, as a result of a lack of adequate data, is a major shortcoming. It is clear that more data on the incidence of abortion are needed to measure its effect on fertility. This is an important underresearched area, particularly given reports that point to increasing levels of abortion. However, the fact that the total fecundity rates we obtain fall largely within the theoretical range suggested by Bongaarts and Potter may indicate that indeed abortion is not as yet an important fertility-limiting factor in Africa.

Comparing the WFS and DHS for four sub-Saharan African countries illustrates how fertility and its determinants have changed over time. In Kenya, the change in fertility is attributable principally to a change in contraceptive use. In Senegal and Sudan, changing marriage patterns seem to underlie the fertility declines; however, the change in Senegal is too small to provide solid evidence of real changes in marriage patterns or fertility. In Ghana, little change in fertility or its determinants is observed. Although some of the indices changed in importance over time, postpartum infecundability continues to be the greatest fertility-inhibiting proximate determinant for all four populations.

TECHNICAL NOTES

Data Sources

- *DHS Ondo State, Nigeria* A question on whether the survey respondent was currently amenorrheic was not asked, so the question (V215) on the time since the woman's last menstrual period was used to estimate mean months of amenorrhea.
- *DHS Sudan* The survey was conducted only for ever-married women of reproductive age, so the denominators for the total fertility rates (TFRs) were estimated by using a set of weights developed by the Institute for Resource Development/DHS to estimate the total number of never-married and ever-married women. Because these weights were developed only for specific subgroups of the population, education categories for Sudan differ from education categories used for other DHS countries in the analysis.

- *WFS Senegal* A question on whether the survey respondent was currently amenorrheic was not asked, so the postpartum nonsusceptible period was estimated as $1.753e^{(0.1396 \times B - 0.001872 \times B^2)}$ where *B* equals the mean number of months of breastfeeding for the 36 months prior to the survey. Bongaarts and Potter (1983) estimated this regression equation from data on breastfeeding and amenorrhea from about 25 countries.
- *WFS Sudan* This survey, like the DHS, was conducted only for ever-married women of reproductive age. Because the weights developed for the denominators of the TFRs were not included in the WFS Sudan standard recode file, the TFRs used in this analysis are taken from Volume 1 of *The Sudan Fertility Survey 1979, Principal Report,* Vol. 1 (Sudan, 1982).

Derivation of Indices

Index of Marriage

The index of marriage is calculated as

$$C_m = \frac{\text{total fertility rate (TFR)}}{\text{total marital fertility rate (TMFR)}},$$

where

TFR= the average total number of births a woman would have in her lifetime at current age-specific fertility rates (ASFRs), and
TMFR= the average total number of births a woman in union from age 15 to 49 would have at current age-specific marital fertility rates.

Both rates are estimated for the 4 years prior to the survey. Four-year fertility rates are estimated instead of 5-year rates because of the underreporting of births in the fifth year preceding some of the DHS (Institute for Resource Development, 1990). The TMFR was estimated for women currently in union.

Measured Births Outside Marriage and Adjusted Index of Marriage

The measured births outside marriage and the adjusted index of marriage are calculated, respectively, as

$$M_o = \frac{\text{TFR}}{\text{TUFR}},$$

and

$$C'_m = \frac{\text{TUFR}}{\text{TMFR}},$$

where
TUFR is the sum of the age-specific union fertility rates (ASUFRS), and

$$\text{ASUFR} = \frac{\text{marital births at age } i}{\text{midyear population of women aged } i}$$

Because the DHS does not give a complete marriage history, it is impossible to estimate lengths of marital disruption. Therefore, in the estimation of TUFR, it is assumed that there is no marital disruption from the date of first union if the woman is still currently married. If a marital disruption had in fact occurred, unbeknownst to us, we are assuming that it was fairly short, given that most women remarry quickly (Mhloyi, 1988). This assumption results in the classification of births occurring to currently married women during a past period of marital disruption as occurring in union, resulting in an overestimation of the TUFR.

On the other hand, births to women whose status at the time of the survey is divorced or widowed are assumed to be births that occurred outside of union. This assumption leads to an underestimation of TUFR, resulting in an overestimation of M_o (or the effect of childbearing outside of union on fertility), as well as an overestimation of the effect of union patterns on fertility (i.e., an underestimation of C'_m). These two errors will to a large extent cancel each other out.

As with the TFRs and TMFRs, the TUFRs are calculated for the four years prior to the survey.

Index of Contraception

The index of contraception is calculated as

$$C_c = 1 - 1.08ue,$$

where u is the current contraceptive use prevalence rate among women in sexual union, and e is the average use-effectiveness of contraception.

Abstinence is excluded as a method because most of the women who reported using abstinence as a contraceptive method were practicing postpartum abstinence, which is captured in the C_i index. Periodic abstinence, however, is included as a method.

The average use-effectiveness of a method is calculated as the weighted average of the method-specific use-effectiveness levels, with the weights equal to the proportion of women using a given method. The levels used, adapted from Bongaarts and Potter (1983) (who employed use-effectiveness levels from a study by Laing (1978) in the Philippines), are shown below. We have divided one of the categories, other methods, into other modern methods and traditional methods in order to give traditional methods a lower use-effectiveness index of 0.30.

Pill	0.90
IUD	0.95
Sterilization	1.00
Other modern methods	0.70
Traditional methods	0.30

Index of Postpartum Infecundability

The index of postpartum infecundability is calculated as

$$C_i=20/(18.5+i),$$

where i is the mean number of months of postpartum infecundability (estimated as the mean number of months of postpartum amenorrhea or abstinence, whichever is longer) for women in union.

The mean number of months of postpartum infecundability is estimated by using the prevalence/incidence method. In this analysis, i is the period of nonsusceptibility, calculated as the number of mothers either amenorrheic or abstaining at the time of the survey (prevalence) divided by the average number of births per month over the last 36 months (incidence).

Index of Sterility

The index of sterility is estimated as

$$I_p=(7.63-.11s)/7.3,$$

where s is the proportion of ever-married women between ages 40 and 49 who have never had any children.

Bongaarts et al. (1984) used the percentage of women aged 45–49 who are childless. In this analysis, the percentage of childless women aged 40– 49 is used instead to increase the number of women in each subgroup and reduce the standard error in estimating s. It is assumed that most women have had their first birth by 40 years of age in sub-Saharan Africa.

Effects of Indices

To express the effects of each index in births per woman, the following calculations are used (Bongaarts, 1982).

- The effect of marriage patterns equals TMFR—TFR, where TMFR equals TFR/C_m.
- The effect of contraception equals TNMF—TMFR, where TNMF equals TFR/(C_m•C_c).
- The effect of postpartum infecundability and primary sterility equals TF—TNMF, where TF equals TFR/(C_m•C_c•C_i•I_p). The effect of postpartum infecundability alone equals TFR/(C_m•C_c•C_i) —TNMF. The effect of primary sterility alone equals TF—TFR/(C_m•C_c•C_i). When I_p is greater than 1, the effect of postpartum infecundability is estimated as TF—TNMF; that is, I_p is set equal to 1, because a number greater than 1 is not interpretable in the proximate determinants framework. In these cases, the effect of postpartum infecundability is slightly underestimated.

Care should be taken in interpreting these effects expressed in births per woman, because the number of births estimated depends on the order in which they are calculated. For example, by using the formulas outlined above, the effects of the proximate determinants for Botswana would be as follows (see Table 3–2 and Figure 3–1) in terms of number of births:

Proximate determinant	*Number of births*
Marriage patterns	0.74
Contraception	2.45
Postpartum infecundability	4.84
Primary sterility	0

If the order in which each variable is calculated is reversed, the results would be as follows (number of births):

Primary sterility (TFR/I_p—TFR)	0
Postpartum infecundability (TFR/(I_p•C_i) —TFR/I_p)	2.92
Contraception (TFR/(I_p•C_i•C_c) —TFR/(I_p•C_i))	3.38
Marriage patterns (TFR/(I_p•C_i•C_c•C_m) —TFR/(I_p•C_i•C_c))	1.68

Therefore, the order of estimation matters a great deal. However, because Bongaarts et al. (1984) used the first-outlined approach in their work, we have done the same for consistency.

The reduction in average number of births per woman can also be expressed in terms of percentages. In Ondo State, C_i=0.47, which indicates that C_i reduces fertility to 47 percent of what it would otherwise have been in the absence of postpartum breastfeeding and abstinence.

APPENDIX

The tables that follow present the proximate determinants of fertility by age (Table 3–A.1), by urban and rural residence (Table 3–A.2), and by level of education (Table 3–A.3). WFS and DHS data are presented.

TABLE 3–A.1 Proximate Determinants of Fertility by Age and by Survey

Country and Survey	Index of Marriage, C_m	Adjusted Index of Marriage, C'_m	Measure of Births Outside Marriage, M_o	Index of Contraception, C_c	Index of Postpartum Infecundability, C_i	Index of Sterility, I_p	Observed TFR
Ghana WFS							
National	0.88	0.81	1.08	0.95	0.56	1.01	6.4
15–24	0.77	0.68	1.14	0.96	0.55	1.01	2.0
25–34	0.96	0.91	1.06	0.93	0.58	1.01	2.6
35–49	0.92	0.86	1.06	0.96	0.55	1.01	1.8
DHS							
National	0.85	0.77	1.11	0.93	0.55	1.02	6.4
15–24	0.71	0.60	1.20	0.95	0.53	1.02	1.9
25–34	0.95	0.89	1.07	0.93	0.57	1.02	2.6
35–49	0.90	0.84	1.07	0.91	0.54	1.02	1.8
Kenya WFS							
National	0.91	0.81	1.12	0.96	0.64	1.00	8.2
15–24	0.81	0.66	1.23	0.97	0.64	1.00	2.6
25–34	0.97	0.91	1.07	0.95	0.65	1.00	3.2
35–49	0.95	0.88	1.08	0.95	0.62	1.00	2.3
DHS							
National	0.86	0.73	1.17	0.80	0.66	1.01	6.6
15–24	0.75	0.56	1.35	0.87	0.66	1.01	2.3
25–34	0.94	0.85	1.11	0.79	0.68	1.01	2.7
35–49	0.92	0.86	1.08	0.76	0.64	1.01	1.6

Senegal WFS							
National	0.94	0.89	1.05	0.99	0.65	0.99	7.2
15–24	0.87	0.79	1.09	0.99	0.63	0.99	2.5
25–34	0.98	0.95	1.03	0.99	0.66	0.99	3.0
35–49	0.97	0.94	1.03	1.00	0.66	0.99	1.7
DHS							
National	0.90	0.84	1.07	0.97	0.64	0.98	6.6
15–24	0.81	0.71	1.14	0.99	0.63	0.98	2.2
25–34	0.95	0.91	1.04	0.96	0.65	0.98	2.7
35–49	0.95	0.92	1.03	0.97	0.63	0.98	1.7
Sudan WFS							
Northern	0.80	0.78	1.03	0.96	0.63	0.93	6.0
15–24	0.61	0.60	1.03	0.97	0.64	0.93	1.9
25–34	0.92	0.89	1.02	0.95	0.62	0.93	2.7
35–49	0.93	0.91	1.02	0.97	0.65	0.93	1.5
DHS							
Northern	0.68	0.66	1.03	0.94	0.60	0.99	4.9
15–24	0.44	0.43	1.03	0.96	0.61	0.99	1.2
25–34	0.81	0.79	1.03	0.93	0.60	0.99	2.4
35–49	0.87	0.85	1.02	0.93	0.59	0.99	1.3

NOTE: Data are national-level WFS and DHS.

TABLE 3–A.2 Proximate Determinants of Fertility by Urban and Rural Residence and by Survey

Country and Survey	Index of Marriage, C_m	Adjusted Index of Marriage, C'_m	Measure of Births Outside Marriage, M_o	Index of Contraception, C_c	Index of Postpartum Infecundability, C_i	Index of Sterility, I_p	Observed TFR
Ghana							
WFS							
Urban	0.86	0.78	1.10	0.91	0.62	1.00	5.7
Rural	0.95	0.88	1.08	0.96	0.54	1.01	6.8
DHS							
Urban	0.78	0.70	1.11	0.89	0.60	1.01	5.3
Rural	0.90	0.83	1.08	0.95	0.54	1.03	6.9
Kenya							
WFS							
Urban	0.84	0.73	1.17	0.90	0.69	0.90	6.1
Rural	0.92	0.82	1.11	0.96	0.64	1.00	8.4
DHS							
Urban	0.82	0.66	1.24	0.74	0.70	0.96	4.7
Rural	0.87	0.75	1.17	0.81	0.66	1.01	7.0
Senegal							
WFS							
Urban	0.86	0.79	1.08	0.98	0.67	0.99	6.6
Rural	0.98	0.94	1.04	1.00	0.64	0.99	7.5
DHS							
Urban	0.79	0.71	1.12	0.92	0.69	0.96	5.6
Rural	0.98	0.93	1.04	0.99	0.62	0.99	7.3

Sudan[a]							
WFS							
Urban	0.72	0.69	1.03	0.90	0.70	0.95	5.1
Rural	0.83	0.81	1.03	0.99	0.61	0.93	6.4
DHS							
Urban	0.55	0.53	1.03	0.87	0.65	0.98	3.7
Rural	0.71	0.70	1.01	0.98	0.58	1.00	5.2

NOTE: Data are national-level WFS and DHS.

[a]WFS and DHS data for Sudan refer only to northern Sudan.

TABLE 3–A.3 Proximate Determinants of Fertility by Level of Education and by Survey

Country and Survey	Index of Marriage, C_m	Adjusted Index of Marriage, C'_m	Measure of Births Outside Marriage, M_o	Index of Contraception, C_c	Index of Postpartum Infecundability, C_i	Index of Sterility, I_p	Observed TFR
Ghana							
WFS							
None	0.93	0.88	1.06	0.98	0.54	1.01	6.7
1–4 years	0.90	0.80	1.13	0.95	0.58	1.01	6.9
5–7 years	0.88	0.78	1.13	0.93	0.62	1.05	7.1
8+years	0.83	0.76	1.09	0.88	0.60	0.99	5.3
DHS							
None	0.88	0.84	1.05	0.95	0.51	1.02	6.8
1–4 years	0.87	0.78	1.11	0.93	0.54	1.00	6.6
5–7 years	0.88	0.79	1.11	0.92	0.58	1.05	6.0
8+years	0.79	0.70	1.13	0.89	0.61	1.03	5.5
Kenya							
WFS							
None	0.96	0.87	1.10	0.98	0.61	0.99	8.2
1–4 years	0.93	0.84	1.11	0.96	0.64	1.03	9.0
5–7 years	0.90	0.79	1.13	0.94	0.69	1.05	7.9
8+years	0.83	0.75	1.11	0.83	0.70	1.03	7.0
DHS							
None	0.91	0.85	1.07	0.88	0.61	1.00	7.2
1–4 years	0.94	0.80	1.18	0.80	0.65	1.02	7.7
5–7 years	0.88	0.75	1.18	0.78	0.69	1.04	7.2
8+years	0.82	0.66	1.24	0.70	0.71	1.00	5.0

Senegal							
WFS							
None	0.96	0.92	1.04	1.00	0.64	0.99	7.4
Primary	0.98	0.89	1.10	0.96	0.67	1.05	7.1
Secondary+	0.56	0.53	1.06	0.88	0.71	1.05	3.0
DHS							
None	0.95	0.91	1.05	0.99	0.63	0.97	7.0
Primary	0.83	0.69	1.20	0.93	0.67	1.05	5.7
Secondary+	0.59	0.52	1.14	0.75	0.74	1.05	3.6
Sudan[a]							
WFS							
None	0.84	NA	NA	0.99	0.61	0.93	6.3
Primary incomplete	0.95	NA	NA	0.90	0.69	0.96	7.6
Primary complete+	0.88	NA	NA	0.73	0.79	0.88	6.0
DHS							
None	0.78	0.76	1.03	0.98	0.57	0.99	5.8
Primary	0.69	0.67	1.03	0.91	0.62	0.96	4.9
Secondary+	0.36	0.35	1.03	0.83	0.69	1.05	3.3

NOTE: Data are national-level WFS and DHS.

[a]WFS and DHS data for Sudan refer only to northern Sudan.

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4

Recent Trends in Marriage Ages

Etienne van de Walle

INTRODUCTION

The aim of this chapter is to review recent data on nuptiality in sub-Saharan Africa (Africa in short) and assess the demographic evidence of changes over time in the proportions married and the age at marriage. Demographers have been interested in nuptiality mostly because of its possible implications for fertility. In a classic article, Davis and Blake (1956) included the factors governing the formation and dissolution of unions in the reproductive period among the intermediate variables affecting exposure to intercourse. In their review of the proximate determinants of fertility, Bongaarts and Potter (1983:4) defined marriages as “relatively stable sexual unions” to which “socially sanctioned childbearing” is limited in most societies. As a consequence, fertility surveys that have featured so prominently in recent demographic research in Africa, particularly the World Fertility Surveys (WFS) and the Demographic and Health Surveys (DHS), have included questions on marriage. But the nature of the data sources and the actuality of the concern about fertility in Africa should not lead us to forget that marriage has long played a major role in the studies of anthropologists and

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sociologists because of its role in shaping descent systems and social organization.[1]

Much of the qualitative information collected by anthropologists, with its rich institutional and cultural context, is overlooked in the statistical studies pursued by the demographer. Marriage patterns in their own right nonetheless constitute an important topic of study for the student of population because they associate many socioeconomic, cultural, and demographic variables at the individual and societal levels. The evidence on nuptiality change could further the understanding of other social change. For example, the changing frequency of the types of unions that occur in a society (customary or civil marriages with full social recognition versus informal or temporary unions) may influence the prevalence of female-headed households and the economic environment of children. Even from the narrow perspective of the demographer, the type of union or the active involvement of a man in a household may affect infant mortality; a plausible mechanism is through the lesser access to resources by single mothers or wives of polygynists.[2] Moreover, mating patterns play a major role in the transmission of the human immunodeficiency virus (HIV), a major killer that will influence the size, growth, and distribution of African populations.

For better or worse, the nature of the sources will affect the analysis of these issues, and hence understanding of them. The vast body of ethnographic descriptions of African marriage presents a complexity of peoples, perspectives, and time periods, making interpretation difficult in a comparative context. Nuptiality data are most rich, detailed, and useful when they are provided on one particular subpopulation of a country—for example, the Yoruba of Nigeria, the Mbeere of Kenya, or even the Creoles of Freetown. Recent fertility surveys, however, have stressed international comparability and reduced the concepts to the simplest common denominator. Censuses, which represent a major source of information on marriage because of their wide coverage, have also used simple definitions (but not necessarily the same ones as the surveys).

The task, then, is to look at the available material for the purpose of ascertaining the evolution of simple indices of nuptiality in recent times. The fertility perspective will dominate, but cannot be exclusive of other concerns. For example, when one examines the fertility implications of recorded changes in nuptiality, the conclusion is that age at marriage has risen in many countries of sub-Saharan Africa, but that this trend appears to

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[1]The comparative insignificance of childbearing in the eyes of most anthropologists is obvious in a recent publication on the evolution of marriage in Africa by Parkin and Nyamwaya (1987).

[2]Adegbola (1987) has raised the issue of the relationship between premarital fertility and infant mortality; see also Lesthaeghe et al. (1989:329–330).

have little relationship to any change in fertility; the proportions single increase sharply in the age group 15–19, but the number of children ever born at the same ages often changes little, if at all. It is likely that the proportion of unmarried mothers is increasing—a change that may have important demographic and social consequences—but not in relation to total fertility. Excessive concentration on the fertility aspects of age at marriage would lead us to lose sight of the overall picture.

Before reviewing the empirical evidence on nuptiality, it is important to understand some problems concerning the use of these data. The first section of this chapter deals with the consideration of three crucial issues, without which it would be impossible to proceed. These are (1) the definition of marriage, (2) problems of recall and of age reporting encountered in retrospective reports, and (3) the measurement of age at first marriage. These problems are conceptually distinct, but their effects on available data may be difficult to disentangle. The second section is devoted to a look at data sources and findings. The topic of marriage has received a great deal of attention in recent publications (e.g., Lesthaeghe, 1989; United Nations, 1990). Because the results of the 1990 round of censuses have not yet appeared fully, the main new data sets consist of results from the DHS. The section discusses the extent to which retrospective evidence from surveys on the date and age at which individuals report they were married (as contrasted with information on the current marital status of individuals) can be used to evaluate trends in nuptiality. In the third section, I consider the effects of nuptiality changes on fertility.

It may be in order to list some of the topics that are not considered here. The discussion is limited to the marital status of women for two reasons. First, the issues raised by the nuptiality of men are even less well understood than those of women. Men marry later and spend a sizable portion of their adult life in the single state, although they probably lead in most cases a complex sexual life that does not appear in the statistical record. Moreover, in Africa, polygyny is a typical feature of men's married life, which dilutes the connection between their nuptiality and reproduction.[3] Second, the new sources on nuptiality (the WFS and DHS, discussed below) pay little attention to the marriage of men. Census data have provided the available information on men, and I have not tried to go beyond the available monographs on the subject (United Nations, 1988, 1990).

[3] For what a detailed investigation of male nuptiality would entail, see a suggestive study of South-Benin by Donadjè and Tabutin (1991). With an average age at marriage of 28 (compared to less than 20 for women), men are reported to have a total fertility of 11 children (compared to between 6 and 7 for women) because more than half end up in polygynous unions.

The next topic to which I cannot do justice, despite its interest, is the topic of premarital sexual activities of women. Informal unions may be fruitful and may also represent an early stage in the contracting of a marriage. They complicate the retrospective definition of unions in demographic surveys, as I point out, but to study them in depth, the anthropological approach is essential. It may be that informal unions and premarital or even illegitimate births[4] have become more frequent, but in the absence of reliable information, one confronts "the interpretive problem of sensing that marriage may be more informal than in the past without having any clear 'data' or clear chronology to support such a conclusion" (Guyer, 1988:1).

Finally, in the absence of new data from the last round of censuses, there is little information that would allow review of the conclusions made in the authoritative review of Lesthaeghe et al. (1989) on the subject of polygyny.[5] The institution remains alive and well, although its multiple forms, which owe some of their complexity to the ambiguity of the definition of what a stable union is, challenge the analyst.

CONCEPTUAL AND MEASUREMENT ISSUES

Definitions

The subject of nuptiality is complex and is governed by different rules and practices in different countries. It has long been accepted that the description of marital status in censuses can be kept simple because people are reasonably certain about their own present status when an interviewer asks questions; being "married" corresponds to a social reality recognizable in almost any culture, so that there is no need for elaborate definitions. There are clearly diminishing returns to adding questions or attempting to narrow concepts. However, the particular reality that people recognize as the married state is by no means uniform across societies. A corollary is that one does not always know what reality is covered by conventional census categories (single, married, widowed, and divorced), and it is always possible that the changes apparent over time from the comparison of several surveys and censuses taken at different dates are more changes of implicit (the population's) or explicit (the census taker's) definitions than changes

[4]By illegitimate births, we mean those births that have no socially recognized legitimacy. The term *illegitimate* is controversial (see Adegbola, 1987), but legitimacy of offspring is a recognized goal of marital unions.

[5]Their observations spanned a period roughly between 1960 and 1980.

in the underlying reality. Also of concern is the inverse danger that an apparent stability of some indicators of nuptiality in fact hides deep changes in the sociological reality. Lesthaeghe et al. (1989:244) remark that

> …"outside wives" are more akin to concubines than to women in a polygynous union since they are external and often illicit. But demographically they are of significance as an alternative mode of reproduction in societies undergoing socioeconomic change.

How they are defined in a census or survey will affect measures of trends and the impact of economic change on these trends.

Ever since censuses have been taken in sub-Saharan Africa, they have included a simple typology of marital status (single, married, widowed, or divorced), based on self-definition by the respondents. In this rather coarse net, a variety of people are caught as "married," including some who have not performed any ceremony of marriage or whose unions have not been formally recognized by society. It is likely, however, that what pass for marriages in a census are relatively stable unions, benefiting from a degree of public recognition; in many instances, cohabitation is also involved, although there are forms of marriages in Africa, particularly among matrilineal groups, in which cohabitation is not essential (see, for example, van de Walle and Meekers (1988) for Côte d'Ivoire). Generally, marriage in Africa is "a process," and therefore there is some ambiguity in determining exactly when a couple is married.

The ambiguity is less critical in a census than in a fertility survey where retrospective questions are asked about age at, or date of, marriage. A retrospective question of the type—At what age were you first married? —is different in nature from the assessment of the current marital status of an individual at the time of a survey or census. Even if perfect recall by the respondent is assumed, identification of the date (by month and year) when a woman's first conjugal union started is conceptually difficult. A number of unions that have some features of marriage, and might have been reported as such at the time they were still extant, may retrospectively appear never to have taken place; also, some unions that turned out to be successful would not have been reported as "marriages" in their early stages, but with the benefit of hindsight appear to have started in earnest at a time when their status was actually quite uncertain. Such systematic misreporting introduces biases in the *a posteriori* reporting of age at marriage in surveys.

The WFS and DHS surveys have introduced new concepts in the description and measurement of African marriage. Designed as fertility surveys, they have focused on one aspect of the marital state—exposure to sexual intercourse. For female respondents in surveys, being married was held by the designers of the WFS and the DHS to be synonymous with "living in union" or "living with a man"; the fact of cohabitation was the single most important criterion distinguishing a marriage for these surveys.[6] The concept is not exactly comparable with the commonly accepted (but somewhat imprecise) category of married in a census, and comparisons of these surveys with censuses taken at the same time usually reveal differences that must be due to the definitions used. Moreover, differential coverage may account for some of the difference between census and survey results; censuses may be better at capturing young adults than surveys. Yet, because censuses and surveys are usually not taken exactly in the same year, the differences between the two sources in the same countries have sometimes been attributed to changes in nuptiality. Table 4–1 presents the comparison of the percentage ever married at ages 15–19, 20–24, and 40–44 in the two kinds of sources.

The expectation is that surveys should find more women living in union than there are married women in the census, and typically fewer widows and divorcees. Blanc and Rutenberg (1990:53) give the following rationale:

> It is expected that the retrospective estimates of the proportion of women ever married calculated from DHS data will be higher than the estimates from previous censuses or surveys for three reasons. First,…censuses often use a less inclusive definition of marriage than that of the DHS surveys…Second, information on marital status and date of marriage in DHS surveys usually comes from the individual questionnaire, for which the respondent is a woman, rather than from the household questionnaire, for which the respondent is often a male head of household. A third factor which might act to improve the validity of estimates from DHS surveys, relative to earlier censuses and surveys, is that the quality of reporting of …marriage dates may have improved in recent years…

Surprisingly, Table 4–1 does not conform to these expectations when one compares direct estimates based on DHS and census data for each country. At age 15–19 (and where available, age 20–24), the proportions ever married were *higher* in the census than in the DHS for Botswana, Burundi, Kenya, Togo, Uganda, and Zimbabwe; it is only at 40–44 that the DHS always finds a higher proportion of ever-married women. Because all the DHS surveys in Table 4–1 have a later date than the census, part of the difference could be explained by a time trend, either in the age at marriage or in the accuracy

[6]According to the DHS Interviewer's Manual (Institute for Resource Development, 1987:59):

"Lived with a man" means that they stayed together for some time, intending to have a lasting relationship, regardless of the formal status of the union…. For example, if a woman went to live with her boyfriend and his family, and stayed for several years, she would be considered as "living together", whether or not the couple had any children. On the other hand, if a woman had a boyfriend for a year but never lived with him, she would not be considered as ever having married or lived with him.

of reporting. Blanc and Rutenberg tried to remove the effect of the change over time by reconstructing from DHS data the proportion ever married at the date of the previous census; in doing so, they had to rely heavily on the retrospective reporting of dates of union, which I argue here is incompatible with current status data. I show the results of their reconstruction in Table

TABLE 4–1 Comparison of Women Ever Married (percent)

			Age		
Country	Source	Date	15–19	20–24	40–44
Botswana	DHS, R[a]	1981	13.1	42.2	82.8
	Census	1981	7.3	31.2	78.9
	DHS	1988	6.1	30.3	81.5
Burundi	DHS, R[a]	1979	21.7	76.3	98.7
	Census	1979	19.2	72.6	97.4
	DHS	1987	6.8	66.7	99.1
Kenya	Census	1979	28.8	–	97.9[b]
	DHS	1989	20.1	68.2	98.5
Liberia	DHS, R[a]	1984	38.1	77.0	98.4
	Census	1984	35.7	70.9	96.4
	DHS	1986	36.0	75.3	98.3
Mali	DHS, R[a]	1976	66.2	95.9	100.0
	Census	1976	51.1	88.0	98.0
	DHS	1987	75.4	98.0	99.7
Senegal	DHS, R[a]	1976	52.5	87.1	100.0
	Census	1976	38.6	76.1	97.5
	DHS	1986	43.5	77.4	100.0
Togo	DHS, R[a]	1981	40.1	81.8	100.0
	Census	1981	43.3	81.8	97.2
	DHS	1988	27.2	75.8	99.6
Uganda	Census	1969	49.9	86.5	93.9[b]
	DHS	1988–1989	40.8	83.0	99.0
Zimbabwe	DHS, R[a]	1982	29.9	80.7	98.7
	Census	1982	26.1	76.5	97.0
	DHS	1988	19.8	71.5	99.1

NOTE: Data are from national-level census and DHS.

[a]R: Reconstruction for census date.

[b]At age 50.

SOURCE: Data from Blanc and Rutenberg (1990: Table 2.5) for reconstruction and census proportions; United Nations (1990) for census data on Kenya in 1979 and Uganda in 1969; otherwise, Lesetedi et al. (1989); Segamba et al. (1988); Kenya (1989); Chieh-Johnson et al. (1988); Traore et al. (1989); Ndiaye et al. (1988); Agouke et al. (1989); Kaijuka et al. (1989); and Zimbabwe (1989).

4–1 (labeled DHS, R). The reconstructed proportions ever married are usually substantially higher than those recorded in the census, but they are also much higher than those at the actual time of the survey. This disparity suggests a severe bias in the proposed reconstruction.

A likely explanation of the difference between current marital status as measured at the times of surveys and censuses is that the criterion of cohabitation, which is part of the DHS definition of a union (as of the time of the interview), excludes many people who would have defined themselves to a census taker as married. It is true that surveys also may include people living in unions who are not viewed as married by the census, but their number is smaller than that of the noncohabiting married who are excluded. Other reporting biases in the retrospective reporting of dates or ages at the onset of the first union vitiate their use in the comparison by Rutenberg and Blanc.

Despite the general principle of looking at unions (defined by the criterion of cohabitation) rather than at formalized marriages, there was a remarkable diversity in the phrasing of the WFS questions, and sometimes they were different enough to yield quite different results in neighboring countries with similar populations, such as Ghana and Côte d'Ivoire. Additional diversity must have resulted from the use of local languages in the interviewing. The DHS has standardized questions to a greater extent than the WFS, but here too, there is some variety in the phrasing, which may reflect diversity in the legal definition of marriage in particular countries, or even in the ideologies of survey takers. It is interesting, for example, that all the DHS surveys in French-speaking countries (with the exception of Togo) have more or less denied the existence of consensual unions, whereas all the English-speaking countries (with the exception of Zimbabwe and Sudan) recognized their importance by giving them a separate column (headed "living together") in the published survey reports.[7] Among the DHS reports for French-speaking countries, the one for Senegal stated explicitly that "marriage remains the only socially accepted framework for sexual links" (Ndiaye et al., 1988:13); in Burundi, "cases of concubinages are rarely declared as being marriages" (Segamba et al., 1988:17); in Mali (Traoré et al., 1989), the survey categories appeared "very ambiguous" to the authors of the report, and married women were classified in the report with women "living with someone." In contrast, among English-speaking countries, the Liberia (Chieh-Johnson, et al., 1988) DHS seems to have elicited an extraordinary proportion of responses qualifying the union as consensual: 38 percent of women between 15 and 49 "lived together," whereas only 29

[7]Zimbabwe and Togo adopt a similar solution toward consensual unions: they classify them with marriage, not because they are unimportant but because they are difficult to distinguish.

percent were "married"; in Botswana, the report stated that "a union is not prerequisite to childbearing" and "current marital status…does not take into account the large proportion of women in stable relationships that do not involve cohabitation" (Lesetedi et al., 1989:11).

TABLE 4–2 Never-Married Females in Botswana by Age (percent) —Successive Censuses and Surveys

	Census		Family Health Survey	
Age	1971	1981	1984	1988
15–19	87	93	47	94
20–24	56	69	4	70
25–29	37	47	0.5	43
30–34	27	32	0.4	30
35–39	20	25	0.1	25
40–44	17	21	0.0	19
45–49	13	17	0.0	20

SOURCES: Botswana (1985); Lesetedi et al. (1989).

Rather small differences in phrasing of the survey or census questions can yield extraordinary differences in the proportions ever married. For Botswana, there are two censuses and two Family Health Surveys (FHS) in the 1970s and 1980s, providing an opportunity to examine trends in the proportion married over time. From the 1971 and 1981 censuses, and the 1988 FHS (taken under the DHS program), the age at marriage seems to be relatively late in Botswana, the proportions who never marry are high for an African country, and there is a trend toward later marriage. However, the 1984 FHS breaks the trend, giving an opposite impression of early and universal marriage (see Table 4–2).

In comparing the two FHS surveys, the main difference appears to be between those "in a consensual union" in 1984 (52.3 percent of women aged 15–49) and those "living together" in 1988 (10.8 percent). In 1984, the operative survey question on consensual unions was, Have you ever had a partner? In 1988, the criterion of cohabitation was introduced: Have you ever been married or lived with a man? Marriage in Botswana still involves the payment of bridewealth (Timæus and Graham, 1989:373), a prolonged and cumbersome process. Heads of cattle that are part of the bridewealth are an important factor of production in Tswana agriculture (Peters, 1986), and marriage is an index of the economic viability of a household. On the other hand, living with a man in a country where half of the women currently in union reported that their partner was not living with them at the time of the 1984 survey (Botswana, 1985:48) is probably not a good indication of the stability of a relationship or of its likelihood to bring forth offspring. If the aim is to provide a denominator of "women in union" for the study of fertility, it could be argued that the census definition (or its 1988 FHS extension) is unduly restrictive. A convincing case could probably also be made that the 1984 FHS definition was too inclusive.

Marriage, as contrasted with temporary and unstable free unions, remains an important concept in Botswana. Timæus and Graham argued that late marriage was an important feature of the demography of Botswana, and one that had been established for some time. They acknowledged, however, that the effect of late marriage on fertility was "less than one might expect" (Timæus and Graham, 1989:381). It is probable that marriage has important social consequences for women and men, and that the permanence of the institution of the bridewealth is connected more to some aspects of social organization than to the biological reproduction that keeps demographers busy and conditions survey design. A classic article by Comaroff and Roberts (1977; see also Caldwell et al., 1991) has examined some of the conflictual aspects of marriage in Botswana, and the different interests served for men and women. Informal relationships may be exploitative of women (Timæus and Graham, 1989:381), and their consequences for the welfare of children and the structure of society are worthy subjects of study. It is possible, however, that historical changes in the timing and prevalence of marriage had little influence on fertility.

Botswana may appear to be an extreme case in the demography of marriage in Africa, and the very high proportions of never-married women recorded by the 1988 Family Health Survey (see Table 4–2) are not replicated elsewhere. But there are many indications from other countries that the criterion of cohabitation may not be the *sine qua non* identifier of a union. In Lomé, Togo, for example, the APEL (Arrivée du Prochain Enfant à Lomé) survey of 1983–1984 found that 31 percent of women in union were living in a different residence than their mates (Ekouevi, 1992). A preliminary conclusion should be that the haziness of the concepts will make comparisons over time and space hazardous.

Problems of Recall and of Age Reporting

In addition to the problem of definition discussed in the previous section, retrospective questions of the kind included in the WFS or the DHS— In what month and year did you start living with your first husband? — suffer from a fundamental weakness when asked in societies where people do not know their ages; moreover, it is possible that older women tend to "forget" the existence of earlier unions or to edit them out in their reports. The question continues to be asked in surveys, and in particular was asked in both the WFS and the DHS; it is therefore worthwhile to look at the results. Taken at face value, the information may provide interesting information about trends (inferred from differences in the ages at first marriage reported by successive cohorts) and about differentials between ethnic or social groups.

The raw material used here is drawn from the DHS.[8] All of the country reports (except for Botswana) contain a table that presents reported age at first marriage or union, classified by age of the respondent at the time of the survey. Several of the DHS reports comment on the reliability of the evidence. The report for Burundi notes that women appear to have a relatively precise knowledge of their date of marriage: in the survey, 58 percent gave the month and year of occurrence. Similarly, in Zimbabwe, 77 percent of the women were able to do so; the report notes, however, "a tendency on the part of some women to report the date (age) when the marriage was officially registered rather than the date (age) when the couple first began living together" (Zimbabwe, 1989:18). In Ghana, only 29 percent of ever-married women reported both a month and a year of first marriage; the report notes: "In addition to the difficulty in correct dating of events, the formalization of marriage itself may span a number of years" (Ghana, 1989:11). These problems are akin to problems of definition addressed in the previous section. If reported dates indeed correspond to a stage of formalization or to a date of registration, the reporting of age at marriage might be biased upward.

The staff of the DHS has addressed the issue of the quality of data on age at first marriage (Blanc and Rutenberg, 1990). Table 4–3 gives the percentage of ever-married women by age who reported their date of first union by year and month, and for whom no imputation was necessary. The information is particularly deficient in West African countries but has been improving in recent cohorts. In Mali, for example, less than 10 percent of women were able to provide month and year of first union, and it is hard to place too much reliance on the precision of the ages given and the reliability of trends. In Burundi, Uganda, and Zimbabwe, the percentages of unions with precise dates are much higher, perhaps because these correspond to recorded Christian ceremonies. Incidentally, the quality of reporting is related to the level of education of the respondents, which raises the question of whether apparent trends in age at marriage that characterize cohorts or educational groups are genuine or are at least partly the result of better reporting.

The evidence on reported age at marriage in the DHS is most interest

[8]For a review of this evidence in the WFS, see Lesthaeghe et al. (1989:245). They express skepticism about the apparent trends in cohort comparisons based on a single retrospective survey.

ing when it can be compared with similar information collected in the WFS at an earlier date (because the two surveys used a similar definition of union based on the criterion of cohabitation) and when the same cohorts of women can be compared in both surveys. Blanc and Rutenberg concluded from their comparisons (which involved only two sub-Saharan countries, Ghana and Senegal) that the median ages at first marriage "match reasonably well"; according to these authors (Blanc and Rutenberg, 1990:49), "The median ages reported in the two surveys are usually within one-half year of each other and trends across cohorts are generally similar [i.e., indicating an age at marriage rising with time]." The fit is indeed satisfactory for Ghana and Senegal, two countries that have accuracies of reporting of ages at union that are, respectively, in the middle and at the lower end of the range in Table 4–3. Comparisons can also be attempted for Kenya and the Sudan.[9]

TABLE 4–3 Ever-Married Women Who Reported Month and Year of First Union (percent)

	Age of Women			
Country, Date	20–24	30–34	45–49	All Women
Botswana, 1988	76.2	64.6	60.6	65.7
Burundi, 1987	78.6	53.2	38.8	57.7
Ghana, 1988	35.8	28.1	19.1	29.3
Liberia, 1986	37.2	28.2	14.9	29.0
Mali, 1987	9.3	6.4	0.2	5.9
Senegal, 1986	19.0	14.3	8.5	16.6
Togo, 1988	31.1	15.6	4.5	19.6
Uganda, 1988–1989	91.4	86.0	69.5	86.0
Zimbabwe, 1988–1989	88.0	76.5	58.4	76.9

NOTE: Data are national-level DHS.
SOURCE: Blanc and Rutenberg (1990: Table 2.1).

In Kenya, for example, the two surveys were not exactly 10 years apart, but the timing is close enough to attempt a comparison between those aged 20–24 in 1977–1978 and those aged 30–34 in 1989, and similarly for other cohorts as well. The Sudanese surveys are also almost 10 years apart. Table 4–4 compares the percentages of cohorts married before age 15, at 15– 17, at 18–19, and the published medians.[10]

[9]WFS and DHS data for Sudan refer only to northern Sudan.
[10]The medians in the WFS are computed from single-year distributions of ages at marriage and in the DHS from grouped data.

TABLE 4-4 Comparison of Reported Ages at First Union, Kenya and Sudan

Age at Time of Survey		Age at First Union (%)							
		<15		15-17		18-19		Median	
WFS	DHS	WFS	DHS	WFS	DHS	WFS	DHS	WFS	DHS
Kenya (WFS 1977-1978), DHS (1989)									
20-24	30-34	13	23	31	28	21	17	18.1	17.9
25-29	35-39	16	20	34	31	21	20	17.5	17.9
30-34	40-44	21	25	34	30	23	20	17.1	17.3
35-39	45-49	22	18	32	28	21	21	17.1	18.5
Sudan (WFS 1978-1979), DHS (1989-1990)									
20-24	30-34	26	26	21	24	10	10	18.6	18.1
25-29	35-39	31	33	28	28	16	12	17.0	16.4
30-34	40-44	42	37	27	31	11	10	15.7	15.8
35-39	45-49	38	34	27	31	12	12	16.2	16.3

NOTE: WFS and DHS data for Sudan refer only to northern Sudan; data are national-level for Kenya.

SOURCES: Data from Kenya (1980, 1989); Sudan (1982, 1991).

Lesthaeghe et al. (1989:245) noted in their examination of the WFS data that overreporting of the age at first marriage was typical for older women, and they attributed the tendency of the median to rise as one goes back in time to “advancing age and decreasing literacy of respondents.” The difference in the medians for most cohorts (but not for the oldest one, consisting of women aged 45–49 in 1989) between the two surveys in Kenya appears to be within the expected random range of imprecision. In Sudan, the match is good, and the difference exceeds half a year for only one cohort. However, the reporting of ages at marriage in both countries as either “before 15,” “from 15 to 17,” or “from 18 to 19” is rather different in the two surveys and cannot be explained by lapses of recall. The robustness of the median hides some diversity in the actual reporting of ages. These results do not generally give the impression of a problem that would be restricted largely to older women. The differences between reported proportions vary, in some cases, more between surveys than they do between cohorts in the same survey.

It is difficult to draw any conclusions about the adequacy of retrospective reports on age at union for inferring trends. The consistency of the evidence on the median age at marriage from two surveys that use similar methodologies is reassuring for Ghana, Kenya, Senegal, and Sudan. In three of the countries, both surveys indicate a rise in the median age at first marriage; for Kenya, however, the apparent trend in the cohort medians for the WFS had disappeared in the DHS medians.

Measurement

The DHS reports have systematically presented median reported ages at first marriage by current age of women; age is a proxy for birth cohort, and the tabulation of these data is designed to show trends, if such trends exist. The median is the interpolated age at which 50 percent of all women are married. As computed in the WFS or the DHS, the median age at marriage does not take into account those women who will never marry. In most African countries, most women eventually go on to marry, and the effect of this assumption is relatively minor. (I explore this point more at length in the appendix to this chapter, but it has no direct bearing on the argument of this section.)

It has been convenient to use current status measures of demographic phenomena where recollection of exact dates is deemed unreliable. One of the oldest and most widely accepted estimates based on current status is the singulate mean age at marriage (SMAM).[11] SMAM is vulnerable to misstatement of ages and has the further drawback of assuming, in principle, a closed population with unchanging behavior. In general, however, it has proved a robust measure of the age at first marriage.

It is interesting to compare estimates obtained retrospectively for the youngest cohorts and the singulate mean age at marriage based on data from the same surveys, as in Table 4–5. The result is by now well established: SMAM is always higher than either the median or the mean age at first marriage or union computed on the basis of retrospective records. This result is not an issue of survey-imposed definitions, because the current reports of marital status use the same criteria of union as the retrospective ones.

There are several possible explanations for the differences:

1. Time trends: SMAM assumes stable proportions single over time. If changes had taken place, SMAM would likely reflect an earlier period when marriage was earlier. The observed difference, however, goes in the wrong direction.
2. Particular properties of the measurement techniques: For example,

[11]The singulate mean age at marriage is an estimate of the mean age at first marriage of those who ever marry, computed from the proportions of people who are single. For details of the computation, see United Nations (1983: Annex I).

the median tends to be younger than the mean because of the skewness of the distribution of marriages; the weight of such effects should be light in most instances (for a detailed discussion, see appendix to this chapter).

TABLE 4-5 Summary of Various Estimates of Age at First Union

	Age at Time of Survey						
Country	20-24	25-29	30-34	35-39	40-44	45-49	SMAM
Burundi	[a]	19.5	19.5	19.6	19.4	19.7	21.5
Ghana	18.7	18.5	18.1	18.1	17.6	17.8	20.2
Kenya	19.8	18.6	17.9	17.9	17.3	18.5	20.5
Liberia	18.2	17.9	17.2	17.2	16.0	16.6	20.1
Mali	15.9	15.9	15.6	15.6	15.6	15.8	16.4
Nigeria	17.8	17.2	16.3	17.3	16.8	17.3	19.6
Senegal	17.2	16.7	16.5	16.2	16.1	15.9	19.5
Sudan[b]	[a]	20.5	18.1	16.4	15.8	16.3	23.8
Togo	18.6	18.4	17.7	18.5	18.0	18.7	20.3
Uganda	17.8	17.5	17.0	16.8	16.6	16.7	18.9
Zimbabwe	19.7	18.8	18.5	19.0	18.1	18.6	20.4

NOTE: Data are national-level DHS.

[a]Majority of women in age group have not yet married.
[b]DHS data for Sudan refer only to northern Sudan.

SOURCES: Data on median ages based on retrospective declarations of women and SMAM computed from the proportions never married at the time of the survey, as reported in Segamba et al. (1988); Ghana (1989); Kenya (1989); Chieh-Johnson et al. (1988); Traoré et al. (1989); Nigeria (1992); Ndiaye et al. (1988); Sudan (1991); Agouké et al. (1989); Kaijuka et al. (1989); and Zimbabwe (1989).

3. The processual nature of marriage: As discussed above, current reports of marital status may tend to underestimate the prevalence of unions that, with the benefit of hindsight, will turn out to have been the beginning of a marriage that withstood the test of time; conversely, retrospective reports may trace the beginnings of a union to its earliest signs of viability.
4. Problems of recall: Women who do not know their ages do not know their ages at marriage either. Instead of reporting their true ages at the time of union, they may report (or the interviewer may write in) the age at which it is believed that girls should be married in a particular society. The existence of such normative ages has been reported in various contexts.[12]

[12]In Bamako and Bobo-Dioulasso, van de Walle and van de Walle (1988) recorded a strong feeling among women that a girl ought to be married at age 17.

5. Fabrication: Short of outright lying, informants may glamorize their earlier informal unions, particularly if they have produced children. As Bleek (1987:319) warns, "Embarrassing questions in a survey produce unreliable answers." (Bleek uses the misreporting of marriage as an example.)

There are potential causes of retrospective bias that could work in the opposite direction. Women may fail to report past periods of cohabitation that had no lasting consequences. Moreover, as noted above, the formalization of marriage may take several years in Ghana and in Zimbabwe, there is a tendency to report formal registration dates instead of dates of first cohabitation. The net effect of these influences, however, is to bias the retrospectively reported age at first marriage downwards.

I conclude this section, then, with the hypothesis that the retrospective measure of age at union and the singulate mean age at marriage measure different and irreducible dimensions of nuptiality. Of the two, SMAM conforms better to the definition of a union at the time of the survey. The SMAMs computed from current status reports in the WFS and the DHS take into account the criterion of cohabitation, which defines a union for these surveys. In retrospective reports, however, a number of other criteria are introduced, and the overall tendency may be to relax the definition and produce earlier ages at first union.

ASCERTAINING TIME TRENDS IN AGE AT MARRIAGE

Retrospective Evidence from Surveys

The distribution of median ages at first union in the DHS has been used routinely to chart the temporal evolution of age at marriage and has been interpreted as reflecting the experience of successive cohorts. For example, according to the Uganda survey report (Kaijuka et al., 1989:14), "The median age at marriage suggests that there has been recently a slight rise in the age at first union, since women aged 20–24 and 25–29 entered their first union later (age 18) than women aged 30 and above (age 17)."

Table 4–5 presents the evidence from median ages at first union classified by age at time of survey. In several countries (Kenya, Nigeria, Senegal, Zimbabwe) there is a dramatic increase in the age reported by the very last cohort, aged 20–24 at the time of the survey, which seems too large to be plausible; in Burundi and the Sudan, moreover, 50 percent of the women in the age group had not yet married. I believe that medians based on the age group 20–24 tend to be higher than the other medians. A plausible interpretation is that the downward biases inherent in the retrospective reporting of age at marriage (which were discussed in the previous section) operate less strongly in that age group than in later ones. There are still many women aged 20–24 who are regarded as single at the time of the interview on the basis of their current status, who would later report an earlier age at marriage. Several countries, however, have taken the change in the proportions married at that age at face value.[13]

If one disregards the age group 20–24, the evidence of a clear trend in age at marriage is very inconclusive. Only in Sudan and Liberia is there a sizable increase; elsewhere, either the trend line is flat (Burundi, Mali, Nigeria, Togo, Zimbabwe), or the change is less than one year (Ghana, Kenya, Senegal, Uganda). Over a period of 20 years (the difference between the cohorts aged 25–29 and 45–49), this change is very small. The margin of uncertainty inherent in the techniques of measurement and the concepts used exceeds the measured differences.

Evidence from Current Status Data

The time taken to publish census results is so long that there are few new readings on the evolution of nuptiality over time. Writing in the late 1980s, Lesthaeghe et al. (1989:324) summarized the evidence:

> In countries with two or more censuses, *all* proportions single, irrespective of sex and age group, tend to show an increase over time. In Angola, Kenya, and Tanzania the proportions single women 15–19 rise by approximately 0.080 per decade, implying an increase in SMAM of almost half a year. In Liberia and Ghana, the increment is of the order of 0.110 and 0.200 respectively for the decade of the 1960s, implying a SMAM increase of 8 and 13 months.

Lesthaeghe et al. believed that the increase was spent by 1975, but they thought that census returns from the 1980s would shed additional light on the trend. Unfortunately, most of this information is not yet available at this writing. I repeat that information from the WFS or the DHS on current marital status is not strictly comparable to census data. As shown in Table 4–1, in seven out of nine DHS where the comparison could be made, the singulate mean age at marriage computed from DHS proportions ever married was greater than that computed from census data.

I have obtained preliminary data for 14 regions from the 1988 census of Tanzania and have compared them to data from the census of 1978, 10 years earlier. This evidence is presented in Table 4–6. In that country at least, the tendency toward higher proportions single has continued into the most recent intercensal period and may be accelerating. For females, the

[13]The report for Nigeria states: "On a national scale, age at marriage has not changed appreciably over time. Only among the youngest women (15–24) has there been a shift from marrying during the mid-teen years to the later teen years" (Nigeria, 1992:60).

differences in singulate mean age at marriage between 1978 and 1988 averaged 1.4 years, a very large increase. (Increase for males—not shown—is not as spectacular and averages only 0.9 year.) The change in the proportion single in the age group 15–19 is not as large for 1968–1978, but it is larger in subsequent age groups up to and including 30–34; the proportions married in the older cohorts, now in their forties, remain unchanged. The picture may be interpreted as evidence that the proportion never marrying is moving progressively up the age distribution, and that the cohorts that have entered the marriage market since the 1960s will not partake in the universal marriage that used to prevail in Tanzania. Instead of a change in the age at marriage, the data would then reflect a change in the prevalence of permanent celibacy. The extent to which this is the result of a change in the definition of marriage or of a genuine change in the proportions in union is a moot point. I presume that the proportions at risk of childbearing have not changed very much and that the importance of the change in nuptiality lies elsewhere. This point receives further discussion in the next section.

TABLE 4–6 Singulate Mean Age at Marriage and Proportions Married, Women: Selected Regions of Tanzania

			Percentage Single			
	SMAM		15–19		20–24	
Region	1978	1988	1978	1988	1978	1988
Dodoma	19.15	20.55	62.45	70.07	16.22	25.86
Arusha	19.14	20.95	62.48	75.55	17.09	28.70
Kilimanjaro	21.78	24.05	86.69	90.42	36.91	51.30
Tanga	19.58	20.74	71.36	74.01	18.36	27.97
Morogoro	19.52	21.47	64.75	71.55	19.25	33.08
Dar es Salaam	19.38	22.09	57.81	78.48	19.57	41.99
Lindi	18.73	20.12	57.67	66.52	12.74	22.84
Mtwara	18.82	19.64	60.57	66.96	12.04	19.45
Ruvuma	19.81	20.44	72.30	69.59	17.98	24.72
Iringa	20.45	22.17	77.02	84.90	25.67	36.29
Mbeya	18.63	19.79	58.17	65.35	11.78	20.15
Kigoma	19.16	20.01	67.10	73.18	13.43	19.05
Shinyanga	18.48	19.17	54.56	59.32	10.08	16.87
Kagera	18.47	19.31	58.90	67.95	8.03	14.39

SOURCES: Data from Tanzania (1982) and unpublished tabulations from the 1988 Tanzania census.

Table 4–7 presents the available estimates of the singulate mean age at marriage in African countries, compiled from various sources. This material is very disparate in nature, and it is hard to compare the various cen

TABLE 4-7 Singulate Mean Age at Marriage, Women

Region and Country	Data Source				
	Date	Type	SMAM	Difference[a]	Source[b]
Western					
Benin	1961	Survey	16.9		UN
	1982	WFS	18.3	nc	UN
Burkina Faso	1975	Census	17.4		UN
Côte d'Ivoire	1975	Census	18.4		UN
	1978	WFS	18.9	nc	UN
Ghana	1960	Census	17.8		UN
	1971	Census	19.4	(1960-1971) 1.6	UN
	1979-1980	WFS	19.4		WFS
	1988	DHS	20.2	(1980-1988) 0.8	DHS
Guinea	1955	Survey	16.0		UN
Guinea-Bissau	1950	Survey	18.3		UN
Liberia	1962	Census	18.0		UN
	1970	Survey	18.7		UN
	1974	Census	19.4	(1962-1974) 0.7	UN
	1984	Census	19.7	(1974-1984) 0.3	DHS
	1986	DHS	20.1	nc	DHS
Mali	1960	Survey	16.2		UN
	1976	Census	18.0		UN
	1987	DHS	16.4	nc	UN
Mauritania	1977	Census	19.5		UN
Nigeria	1981-1982	WFS	18.7		UN
	1990	DHS	19.6	(1981-1990) 0.9	DHS
Senegal	1960	Survey	17.4		UN
	1976	Census	19.0	nc	UN
	1978	WFS	18.3		UN
	1986	DHS	19.5	(1978-1986)	DHS
Togo	1958	Census	17.6		UN
	1971	Census	18.5	(1958-1971) 0.9	UN
	1988	DHS	20.3	nc	DHS
Middle					
Cameroon	1976	Census	18.8		UN
	1978	WFS	18.8	nc	UN
Central African	1959	Survey	17.3		UN
Republic	1975	Census	18.4	(1959-1975) 1.1	UN
Chad	1963	Survey	16.5		UN
Congo	1960	Survey	17.6		UN
	1974	Census	19.6	(1960-1974) 2.0	UN
	1984	Census	21.9	(1974-1984) 2.3	UN
Gabon	1960	Survey	17.7		UN
Zaire	1955	Survey	18.3		DTA
Western Zaire	1975-1976	Survey	20.1	nc	UN

Region and Country	Data Source					
	Date	Type	SMAM	Difference[a]		Source[b]
Eastern						
Burundi	1965	Survey	20.8			UN
	1970-1971	Census	21.5			UN
	1979	Survey	20.8			UN
	1985	Survey	20.7	(1965-1985)	–0.1	YB
	1987	DHS	21.9	nc		UN
Ethiopia	1978	Survey	17.5			YB
	1981	Survey	17.7			UN
	1984	Survey	17.1	(1978-1984)	0.4	UN
Kenya	1962	Census	18.4			UN
	1969	Census	18.5			DHS
	1977-1978	WFS	20.0			DHS
	1979	Census	20.3	(1962-1979)	1.9	UN
	1989	DHS	20.5	(1978-1989)	0.5	DHS
Madagascar	1975	Census	20.3			UN
Malawi	1977	Census	17.8			UN
Mozambique	1950	Census	19.4			UN
	1980	Census	17.6	nc		UN
Rwanda	1970	Survey	20.1			UN
	1978	Census	21.0			UN
	1983	WFS	21.2	nc		UN
Somalia	1980-1981	Survey	20.1			UN
Uganda	1969	Census	17.7			UN
	1988-1989	DHS	18.9	nc		DHS
Tanzania	1967[c]	Census	17.9			UN
	1978[c]	Census	19.1	(1967-1978)	1.2	UN
	1978[c]	Survey	19.2			YB
	1978	Census	19.1			YB
	1988[d]	Census	20.8	(1978-1988)		1.4
Zambia	1969	Census	18.2			UN
	1980	Census	19.4	(1969-1980)	1.2	UN
Zimbabwe	1982	Census	20.4			UN
	1988-1989	DHS	20.4	nc		DHS
Southern						
Botswana	1971	Census	24.8			UN
	1981	Census	26.4	(1971-1981)	1.6	UN
	1984	Survey	17.6			FHS
	1988	DHS	17.4	nc		DHS
Lesotho	1966	Census	20.3			UN
	1977	WFS	20.5	nc		UN
South Africa	1951	Census	22.8			UN
	1960	Census	22.8	(1951-1960)	0.0	UN
	1980	Census	25.7	(1960-1980)	2.9	UN
	1985	Census	26.1	(1980-1985)	0.4	YB

Region and Country	Data Source					
	Date	Type	SMAM	Difference[a]		Source[b]
Northern Sudan	1973	Census	18.7			UN
	1979	WFS[e]	21.5			UN
	1989-1990	DHS[e]	23.8	(1979-1989)	2.3	DHS

[a]nc: not comparable.
[b]DHS, computed from percentage never married given in First Country Reports, for survey or earlier comparison; DTA = Brass et al. (1968:Table 5.7); FHS = Botswana (1985); UN = United Nations (1990:Annex Table A.1); WFS = Ghana (1983), YB = United Nations Yearbooks (passim).
[c]Mainland only.
[d]Total for 12 provinces. SMAM for same provinces in 1978 was 19.4, and difference is calculated on that basis.
[e]Refers only to northern Sudan.

suses and surveys over time. I have calculated change over time for sources that appear to use the same definition of marriage, but have avoided matching census or earlier survey data with the WFS and DHS, for reasons explained earlier.

For all its imperfect nature, the evidence in Table 4–7 appears to suggest that the age at marriage has been increasing since the beginning of data collection. Eastern and southern Africa appear to be breaking the average age of 20 years; age at marriage appears to remain lower in western and middle Africa. The extent to which the increasing age at first marriage hides changes in the proportions that will ever marry is not clear. If young cohorts behave differently from their elders, in terms of the proportion ultimately marrying, the SMAM ceases to be a reliable estimate of the age at marriage in a period.

AGE AT MARRIAGE AND FERTILITY

This section looks at three distinct subjects: first, the relationship between age at marriage and age at first birth in retrospective reports of women in fertility surveys; second, the relation between age at marriage (as indexed by the proportions ever married in age groups 15–19 and 20–24) and the children ever born to women in those age groups; and third, the evidence that a decline in the proportions married over time has resulted in a decline in the number of children ever born.

Evidence from Retrospective Reports

Recently, Westoff (1992) examined WFS and DHS data on age at first marriage and age at first birth, reported retrospectively by women in successive age groups; he treated those as indications of cohort changes. Westoff (1992:3) distinguished three types of countries: "the first category in which there are clear and strong indications of increases in age at marriage and age at first birth; a second group in which there may be some recent changes underway, and a third group that shows little or no evidence of any change."

Countries in northern Africa, which do not concern us here except for the Sudan, make up the first category that generally shows clear increases in ages both at marriage and at first birth. The second category includes some countries for which the increases in ages at marriage are quite sustained over four age groups (women aged 20–24, 25–29, 30–34, and 35–39 in the same survey) or over six age groups (when information from WFS and DHS can be spliced together). The countries in this second category are Kenya, Mauritania, Nigeria, Senegal, Togo, Uganda, and Zimbabwe, although the change in Togo is less than half a year. None of these countries has an equally clear trend in the age at first birth. The third group— Cameroon, Côte d'Ivoire, Lesotho, Liberia, and Mali—shows no clear trends. There is an apparent sustained rise in the age at marriage in Liberia, but it is coupled with a trend downward in the age at first birth. Table 4–8 presents the data on median age at first birth from the DHS in sub-Saharan Africa used by Westoff. (For the evidence on median age at first union, see Table 4–5 above.) The impression is hard to resist that age at first birth is fairly constant, whatever the age at marriage.

Westoff (1992:18) also looked at the correlates of changes in total fertility over time, between the WFS and the DHS. He found that the decline in the proportion married by age 20 was one of two proximate determinants that influenced the decrease in total fertility (the other one being the increase in the proportion of women using contraception, which had the greater effect). There was, however, a strong northern African bias in the data set, since four countries out of the seven having both a DHS and a WFS are North African: Egypt, Morocco, Sudan, and Tunisia. Among the sub-Saharan African countries—Ghana, Kenya, and Senegal—there is no suggestion that reported changes in age at marriage by successive cohorts have resulted in a measurable change in fertility, contrary to Westoff's overall conclusion.

It is hard to draw conclusions about "sub-Saharan Africa" on the basis of the evidence used by Westoff, for countries having either two surveys or only one. About Mali, Liberia, Cameroon, Côte d'Ivoire, and Lesotho, Westoff (1992:19) himself grants that there is no evidence of increase (a conclusion qualified by noting that the data for the last three countries are "more than a decade out of date"):

TABLE 4–8 Median Age at First Birth by Cohort Based on Retrospective Reports from DHS

Country	20–24	25–29	30–34	35–39
Burundi	21.9	20.9	21.1	21.1
Ghana	19.9	20.0	19.2	19.8
Kenya	19.3	18.6	18.3	18.7
Liberia	18.5	19.0	19.4	19.8
Mali	18.4	19.0	18.6	19.1
Nigeria	19.7	19.6	19.0	19.0
Senegal	19.0	19.0	19.0	18.7
Sudana	24.4	22.8	20.8	19.4
Togo	19.5	19.2	18.8	19.5
Uganda	18.6	18.3	18.0	18.0
Zimbabwe	20.1	19.5	19.4	19.8

[a]DHS data for Sudan refer only to northern Sudan.
SOURCE: Westoff (1992: Figure 2).

> The remaining countries all show some suggestion, weak or strong, for the recent emergence of a trend toward increasing age at marriage and [sic: should be "or"] age at first birth. These include Kenya, Mauritania, Nigeria, Senegal, Togo, Uganda, Zimbabwe, and possibly Ghana.

He goes on to say that in Nigeria and Senegal, increases in the age at marriage and first birth "have been chiefly responsible for the recent declines in fertility that have become evident in the DHS." Westoff's citing age at marriage and age at first birth together, as if they were strongly linked, is puzzling, as is his assessment that there is "recent emergence of a trend toward increasing… age at first birth" (Westoff, 1992:19–20).

My own assessment of the evidence is that there is no clear evidence in the WFS or the DHS that a rise in age at marriage is causing a decline of fertility in sub-Saharan Africa. One should not forget that the indices used are very weak. To a large extent, the information about age at first birth and age at marriage comes from women who do not know their own ages; sometimes a frightening proportion of the answers are provided by imputation. On the basis of retrospective reports from one survey, it is extremely difficult to estimate time trends, either in age at marriage or in age at first birth. If the DHS results are taken at face value, there has not been much of a change in recent years—but the data are flawed and could hide real change. One must, therefore, look at other evidence.

TABLE 4–9 Proportions Never Married, Children Ever Born (CEB) and Proportions Childless, Women Aged 15–19 and 20–24

	Never Married (%)		CEB		Childless (%)	
Country	15–19	20–24	15–19	20–24	15–19	20–24
Botswana	93.9	69.7	0.3	1.2	76.5	25.4
Burundi	93.2	33.3	0.0	0.9	96.8	44.8
Ghana	75.6	22.6	0.2	1.3	80.7	27.9
Kenya	79.9	31.8	0.3	1.6	78.6	21.5
Liberia	64.0	24.7	0.5	1.8	62.8	19.3
Mali	24.6	2.0	0.6	1.9	55.5	17.6
Nigeria	61.4	21.7	0.3	1.4	76.5	32.3
Senegal	56.5	22.6	0.3	1.6	73.9	26.4
Sudan[a]	72.8	24.2	0.1	0.8	91.3	62.9
Togo	72.8	24.2	0.3	1.4	78.6	26.0
Uganda	59.2	17.0	0.4	1.9	69.7	16.7
Zimbabwe	80.2	28.5	0.2	1.3	83.7	28.8

NOTE: Data are national-level DHS.
[a]DHS data for Sudan refer only to northern Sudan.
SOURCES: Lesetedi et al. (1989); Segamba et al. (1988); Ghana (1989); Kenya (1989); Chieh-Johnson et al. (1988); Traoré et al. (1989); Nigeria (1992); Ndiaye et al. (1988); Sudan (1991); Agouké et al. (1989); Kajuka et al. (1989); and Zimbabwe (1989).

Proportions Ever Married and Children Ever Born

Table 4–9 presents data from DHS surveys on the proportions never married, the number of children ever born, and the proportions of childless women aged 15–19 and 20–24. On the basis of the proportion childless enumerated by age of mother, and by using a technique similar to the one that is used to compute the singulate mean age at marriage, it is possible to compute what one might call (by analogy to Hajnal's neologism "singulate") the "nulliparate mean age at first birth" (or NMAFB).[14] This information appears in Table 4–10.

There is not a strong relation between the numbers of children ever born and the proportions never married in the DHS data, which are shown graphically in Figure 4–1 for ages 20–24. Lesthaeghe et al. (1989:330; Figure 6.14) looked at the relationship in the WFS data and concluded that

[14]For the logic behind the computation of the singulate mean age at marriage, see Hajnal (1953). The term *singulate* refers to the fact that mean age at first marriage is equal to the number of years spent single by those who eventually marry; by analogy, the mean age at first birth is equal to the number of years spent childless by those who eventually have a child.

"a rise in ages at first marriage for women may not necessarily be converted into a shortening of the reproductive age span." I would prefer to avoid any conclusion about the effect of a change in age of marriage and instead speculate that what is recorded as "in union" in the DHS and the WFS is not clearly an index of exposure to the risk of childbearing. If the married state were the context of socially sanctioned childbearing, one would expect to find a strong positive relationship between the proportions single and the proportions childless; as can be seen for women aged 20–24 in Figure 4–2, however, this relationship is not strong. The outliers are the Sudan, where late marriage appears to have had a genuine effect on the proportion childless, and Botswana, where it has very little effect. Admittedly, the relationship is much stronger for ages 15–19 (see Figure 4–3). The proportion single at ages 15–19 for females is a good proxy for age at marriage, and age at marriage is closely related to the proportion having a child; yet the proportion single is larger than the proportion childless at 15–19 in Botswana, Kenya, and Liberia.

TABLE 4–10 Synthetic Measures of Ages at First Marriage and at First Birth

Country	SMAM	NMAFB	Difference
Botswana	17.4	19.5	2.1
Burundi	21.5	22.2	0.7
Ghana	20.2	20.4	0.2
Kenya	20.5	19.3	–1.2
Liberia	20.1	18.8	–1.3
Mali	16.4	18.0	1.6
Nigeria	19.6	19.8	0.2
Senegal	19.5	18.6	–0.9
Sudan[a]	23.8	23.9	0.1
Togo	20.3	19.6	–0.7
Uganda	18.9	17.7	–1.2
Zimbabwe	20.4	19.8	–0.6

NOTE: Data are national-level DHS.

[a]DHS data for Sudan refer only to northern Sudan.

SOURCES: Computed from proportions single and childless in Lesetedi et al. (1989); Segamba et al. (1988); Ghana (1989); Kenya (1989); Chieh-Johnson et al. (1988); Traoré et al. (1989); Nigeria (1992); Ndiaye et al. (1988); Sudan (1991); Agouké et al. (1989); Kaijuka et al. (1989); and Zimbabwe (1989).

Figure 4–4 shows the relationship between age at marriage (SMAM) and age at first birth (NMAFB). Here the relationship is also clear, but

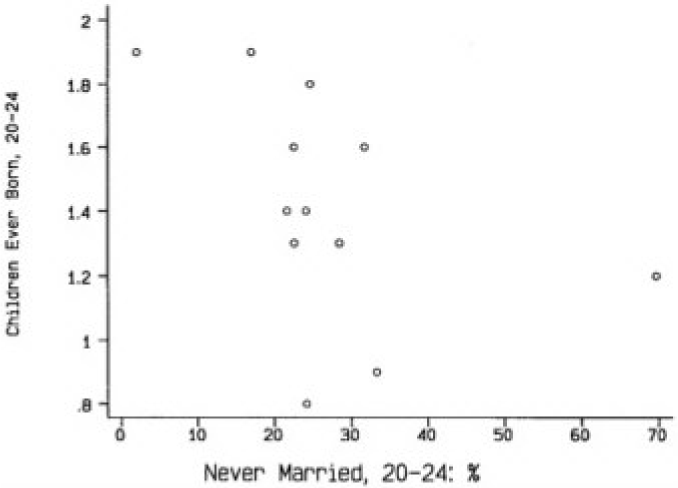

FIGURE 4–1 Percentage married and children ever born (CEB) for women aged 20– 24 (DHS data). SOURCES: Botswana (1985); Segamba et al. (1988); Ghana (1989); Kenya (1989); Chieh-Johnson et al. (1988); Traoré et al. (1989); Nigeria (1992); Ndiaye et al. (1988); Sudan (1991); Agounké et al. (1989); Kaijuka et al. (1989); Zimbabwe (1989).

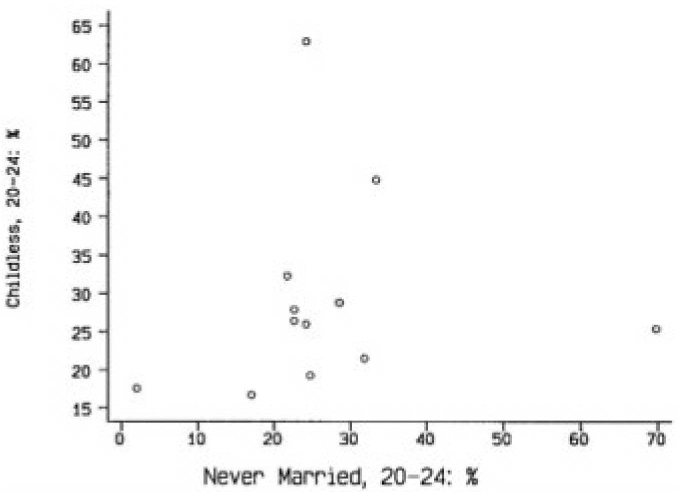

FIGURE 4–2 Percentage married and childless for women aged 20–24 (DHS data). SOURCES: Botswana (1985); Segamba et al. (1988); Ghana (1989); Kenya (1989); Chieh-Johnson et al. (1988); Traoré et al. (1989); Nigeria (1992); Ndiaye et al. (1988); Sudan (1991); Agounké et al. (1989); Kaijuka et al. (1989); Zimbabwe (1989).

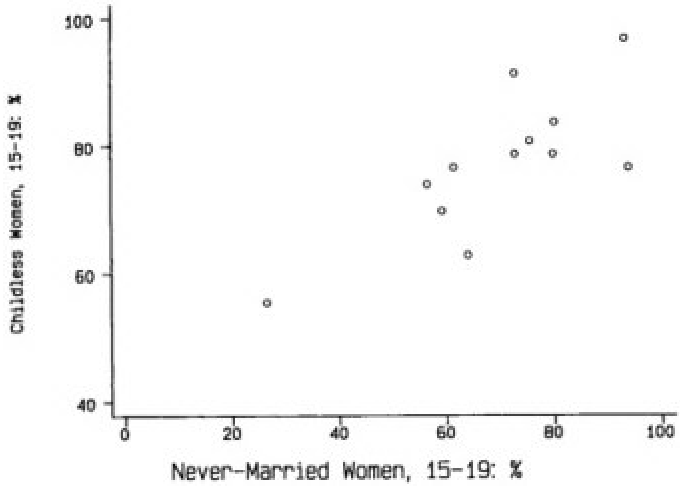

FIGURE 4–3 Never-married and childless women, ages 15–19 (in percent). SOURCES: Botswana (1985); Segamba et al. (1988); Ghana (1989); Kenya (1989); Chieh-Johnson et al. (1988); Traoré et al. (1989); Nigeria (1992); Ndiaye et al. (1988); Sudan (1991); Agounké et al. (1989); Kaijuka et al. (1989); Zimbabwe (1989).

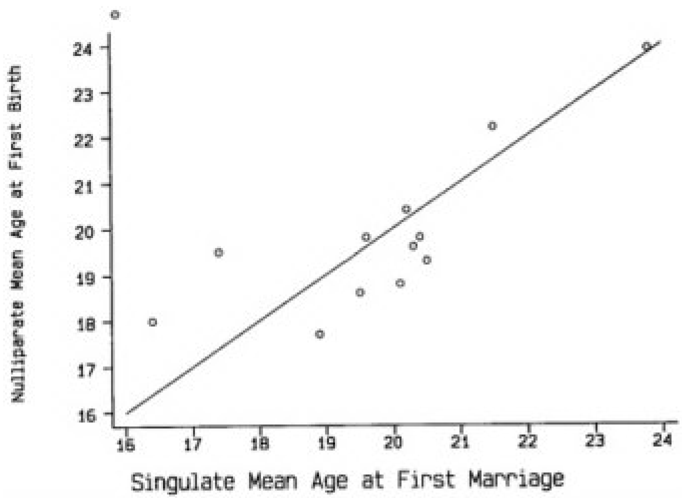

FIGURE 4–4 Singulate mean age at first marriage and nulliparate mean age at first birth (DHS data). SOURCES: Botswana (1985); Segamba et al. (1988); Ghana (1989); Kenya (1989); Chieh-Johnson et al. (1988); Traoré et al. (1989); Nigeria (1992); Ndiaye et al. (1988); Sudan (1991); Agounké et al. (1989); Kaijuka et al. (1989); Zimbabwe (1989).

approximately equal numbers of countries are found on either side of the 45-degree line that would describe the relationship if age at first marriage and age at first birth were the same; one would expect marriage to precede the first birth by a number of months if it truly marked the start of exposure. However, births occur in the absence of marriage, and marriages are not always followed immediately by births.

Changes in Proportions Married and Children Ever Born

A test of changes would be the comparison of proportions ever married and children ever born over time. If age at marriage reflected the beginning of exposure to the risk of childbearing, its changes should be related to those recorded in the number of children ever born (CEB) at young ages. Kenya offers the longest series, with a steady increase in the proportion single at the youngest ages, but little change in the number of children ever born (Table 4–11). Over time, the age at marriage has been going up in Kenya, but the exposure to the risk of childbearing appears to have remained almost constant (it is too early to say whether the drop in CEB in 1989 is a real change).

CONCLUSION

Several conclusions emerge from this review of recent data on age at marriage and the proportions married. The first is that the tools of investigation remain inadequate. Recent surveys have collected detailed and sophisticated information on nuptiality with the clear rationale of using it in a

TABLE 4–11 Proportions Single and Children Ever Born, Kenya

	Proportion Single (%)		Children Ever Born	
Data Source	15–19	20–24	15–19	20–24
1962 census	55	13	0.4	1.7
1969 census	64	18	0.4	1.9
1977 National Demographic Survey	71	22	0.3	1.8
1977–1978 Kenya Fertility Survey	72	21	0.4	1.8
1979 census	71	25	0.3	1.9
1984 Kenya Contraceptive Prevalence Survey	74	24	0.4	2.0
1989 Kenya Demographic and Health Survey	80	32	0.3	1.6

SOURCE: Kenya (1989:10, 25).

subordinate position in the study of fertility. But the links between fertility and nuptiality have proved tenuous and variable in sub-Saharan Africa.

There are tantalizing suggestions that nuptiality has changed in recent years. Whether the change is purely structural, because more women live in cities and have gained schooling (factors that tend to delay marriage), or whether the changes represent a profound transformation of the patterns of early and universal marriage that affect the entire population is a question that cannot be settled easily with the data at hand. The changes are certainly linked with deep transformations in the African family and are accompanied by, or perhaps in part caused by, increasing female independence inside and outside of unions. (The extensive literature on this subject includes Little, 1973; Burnham, 1987; Guyer, 1988; Locoh, 1988; Obbo, 1981; and many others.)

Various authors have discussed the recent evolution of African marriage in negative terms in sharp contrast with earlier interpretations based on convergence and modernization theory (Goode, 1970). Thus, Caldwell et al. (1991) talk about the “destabilization of the traditional sexual system”; Frank and McNicoll (1987) discuss the “caribbeanization” of African nuptiality. The same authors advance the hypothesis that new types of female-headed households that are emerging may offer promising opportunities for the deliberate control of reproduction. The debate on African nuptiality is likely to be increasingly cast in terms either of resilient adaptation by the African family to the forces of socioeconomic change or of social pathology; the HIV epidemic will feature prominently in this debate.

There have been speculations on the possible consequences of the new nuptiality patterns for fertility through variables other than exposure to the risk of pregnancy. Although the direct effect of a later age at marriage on total fertility by curtailing the period of exposure is probably at work in such countries as Burundi or the Sudan, where rules against premarital sex have remained strong, the effect of a delay in age at marriage on fertility may be more subtle in most other countries, including Kenya, Botswana, and Togo. Van de Walle and Foster (1990) suggested that premarital sexual relations may constitute a training ground for the use of birth control, because young women want to avoid the pregnancies that would jeopardize their prospects of education and jobs. The acquired knowledge of techniques of contraception and abortion would later be carried over to marriage. Other mechanisms may link the types of sexual unions to the duration of sexual abstinence or breastfeeding, to infecundability and male sterility, and to the prevalence of sexually transmitted diseases.

This chapter opens by stressing the fact that there are demographic topics other than fertility for which nuptiality patterns and intrahousehold relationships may be crucial: Infant mortality and the transmission of AIDS are obvious examples. There are good reasons to continue to investigate nuptiality in surveys in view of its epidemiologic and social importance. More reflection will be needed on the best ways to ask questions about nuptiality and to interpret the answers. The next task will be to continue to analyze the nuptiality data from fertility surveys and see how they can be improved in future data collection efforts. Moreover, the publication of censuses from the 1990 round will provide fresh information to help document the changes that are thought to be taking place. It has been noted that the Tanzanian data suggest the old norm of universal female marriage may be changing. This finding will have to be confirmed in subsequent research, and its meaning ascertained.

The simple questions used in conventional censuses (the “Are you married?” type) and the more sophisticated questions in fertility surveys (Have you ever been married or lived with a man?) cannot go very far when one tries to ascertain changes over time or to capture the qualitative diversity of the types of unions or sexual relationships that exist. The statistical record is weak or void when one attempts a typology of types of union or tries to distinguish free unions and informal relations from more durable marriages. To make sense of the evolution here, there is a need to resort to other methodologies or to the descriptions of other social scientists. Their observations do not range as wide as the representative samples characterizing the sociological survey; what they gain in depth, they also lose in breadth. More work on linking anthropological or ethnographic study findings with statistical data collection in large sample surveys could greatly enhance knowledge of marriage patterns and their consequences in sub-Saharan Africa.

APPENDIX: MEDIAN AND MEAN AGE AT FIRST MARRIAGE

Computation of the median age at marriage may, or may not, take into account those women who will never marry, or, for practical purposes, have not married before a given age, such as 50, after which very few marry for the first time. In the estimates published by the WFS or the DHS, the median is the age at which half of the women in a cohort are married. The difference is illustrated by considering Kenya and Botswana. In Kenya, almost all women go on to get married; such is not the case, however, in Botswana. The comparison between the two countries appears in Table 4– A.1, which uses the proportions of currently never-married women in the DHS.

If one treats these proportions as a cohort of women aging through an unchanging nuptiality schedule, the respective median ages at marriage for Kenya and Botswana, obtained by interpolation of the proportions in Table 4–A.1, would be 20.6 and 26.2 years. If one limits the computation of the median, however, to those women who will ultimately marry (98.5 percent in Kenya and 81.5 percent in Botswana), the question becomes: When would half of the 98.5 percent of Kenyans who ever get married (or 49.3 percent) and half of the 81.5 percent of those in Botswana (or 40.8 percent) be married? The medians become 20.5 years for Kenya and 24.5 for Botswana. This seems a more legitimate computation of the median (see Shryock and Siegel, 1976:166). It cannot be used, however, before one knows the proportion of women who are likely ever to marry in a cohort and is, therefore, not always practical for estimation of the age at first union of young women reporting in a survey.

TABLE 4–A.1 Proportions Never Married Women, Kenya and Botswana (percent)

Age	Kenya, 1989	Botswana, 1988
15–19	79.8	93.9
20–24	31.8	69.7
25–29	10.7	43.3
30–34	5.4	30.4
35–39	3.2	25.1
40–44	1.5	18.5
45–49	2.4	20.2

NOTE: Data are national-level DHS.
SOURCES: Data from Lesetedi et al. (1989); Kenya (1989).

Limiting the discussion to Kenya, where most women marry, note that the two computations of the median yield very similar results and that these results in turn are close to the singulate mean age at marriage, 20.5, which is also computed on the basis of current marital status of women at the time of enumeration.

The published WFS and DHS estimates of the median age of marriage by cohort are based on retrospective reporting of the ages at which women were first married, not on current marital status as in the previous comparison. In Table 4–A.2, I have systematically computed the mean age at marriage by cohort for the DHS, by assuming that women were all married in the middle of the age group at which they reported their marriage. The computation uses all the information available and is likely to be less affected than the median by the concentration of marriages at the younger ages; its value should therefore, on the whole, tend to be a bit higher. It is obvious, however, that estimates of the means are generally close to estimates of the median based on the same retrospective data. This exercise suggests that medians and means based on the same type of data tend to be similar, but that retrospective and current status reports differ systematically.

TABLE 4–A.2 Mean Age at First Marriage of Women

Age	Burundi	Ghana	Kenya	Liberia	Mali	Senegal	Togo	Zimbabwe
20–24	19.1	17.9	18.3	17.3	16.5	16.9	17.7	18.3
25–29	19.5	18.6	18.3	18.1	16.8	17.4	18.4	18.8
30–34	19.5	18.5	18.1	17.9	16.4	17.6	18.3	18.7
35–39	20.1	18.4	18.1	19.8	16.4	17.3	18.8	19.8
40–44	19.8	18.1	17.8	17.3	16.6	17.2	18.5	18.4
45–49	19.9	18.6	18.7	18.3	16.9	17.0	19.0	19.0
Mean of the means	19.7	18.5	18.2	18.2	16.6	17.4	18.5	18.8
Median[a]	19.5	18.1	18.2	17.2	15.7	16.4	18.5	18.7

NOTE: Data are national-level DHS.

[a]Median value of the medians for each group computed from Table 4–5.

SOURCES: Data from Segamba et al. (1988); Ghana (1989); Kenya (1989); Chieh-Johnson et al. (1988); Traoré et al. (1989); Ndiaye et al. (1988); Agounké et al. (1989); and Zimbabwe (1989).

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5

Trends in Childhood Mortality

Althea Hill

INTRODUCTION

A broad, comparative outline of levels, patterns, and trends in childhood mortality across the African continent was presented in a paper written in 1987 and published recently (Hill, 1989, 1991, 1992). That paper covered sub-Saharan mainland Africa between roughly the late 1940s and the late 1970s and made use of all the data on child survival available at the time of writing. The overall findings are summarized in Figures 5–1 and 5–2, which display summary estimates over time for all countries possessing usable data.

Four major features, all clearly visible in the figures, emerged from the findings of that paper. These were

1. declines in childhood mortality since World War II in almost all countries for which data were available;
2. much variation among countries in the type of decline;
3. much variation among countries in the level of childhood mortality in all periods; and
4. a marked overall difference in mortality levels between countries in western and middle Africa and countries in eastern and southern Africa,

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with a rough gradient running from higher mortality in the northwest to lower mortality in the southeast of the continent.

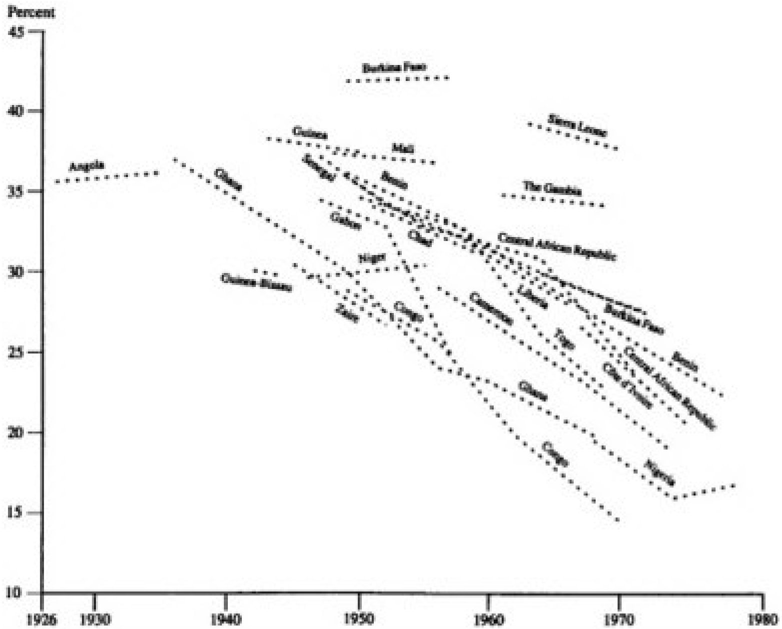


FIGURE 5–1 Risk of dying before age 5, western and middle Africa, 1926–1980. SOURCE: Hill (1991: Figure 3–2).

With regard to this last point, there were indications that this gradient, having been very distinct at the start of the period of study, was becoming progressively blurred as more and more western and middle African countries reduced their mortality levels to near or within the eastern and southern range. However, the picture was still too indefinite for firm conclusions at that time.

The paper also noted three exceptions to these general patterns:

1. Some countries had experienced periods of static or rising mortality, almost all against a background of civil war and disruption of normal socioeconomic development (e.g., Ethiopia, Mozambique, Rwanda, and Sudan).
2. The mortality of a few western and middle African countries (notably Ghana, Congo, and Cameroon) had fallen to well within the eastern and southern range.
3. One eastern African country, Malawi, had a level of mortality toward the upper end of the western and middle African range.

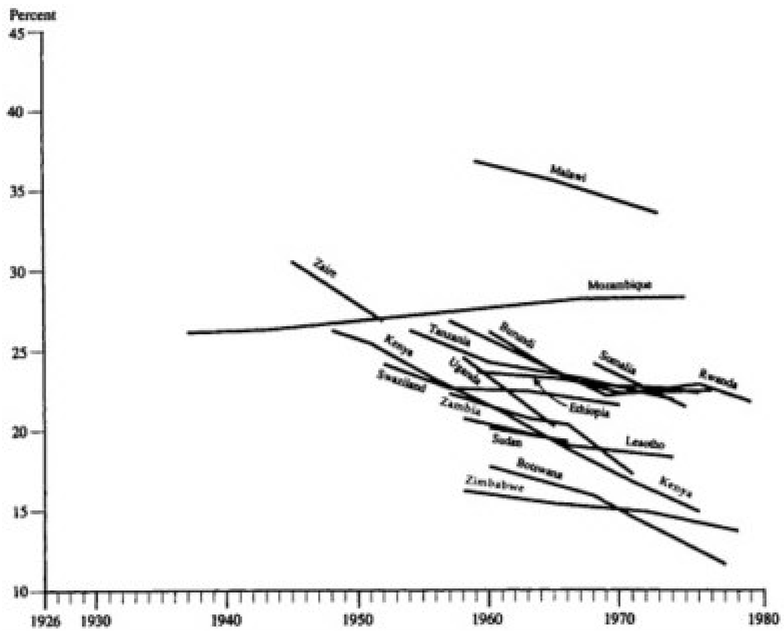


FIGURE 5–2 Risk of dying before age 5, eastern and southern Africa and Sudan, 1926–1980. SOURCE: Hill (1991: Figure 3–3).

DATA DEVELOPMENTS SINCE 1987

In 1987, when the aforementioned review of levels and trends in childhood mortality in Africa was prepared, almost no data on developments in the 1980s were yet available. As shown in Table 5–1, several censuses and surveys had indeed been carried out between 1980 and 1987, but very few of them had yet yielded available results. Over the last five years, however, a considerable quantity—though by no means all—of new data collected during the 1980s has been released. This chapter reviews levels and trends in many of the countries for which fresh data are available for analysis, and examines whether the conclusions of the previous review still hold both at country and at continental levels.

In total, new national-level data are available for 16 countries (about 40 percent of all mainland sub-Saharan countries); these are Botswana, Burkina Faso, Burundi, Côte d'Ivoire, The Gambia, Ghana, Kenya, Liberia, Malawi, Mali, Nigeria, Senegal, Sudan, Togo, Zaire, and Zimbabwe. Data are also available for a large part of Uganda. In addition, data from small-

TABLE 5–1 African Censuses and Surveys Since 1980

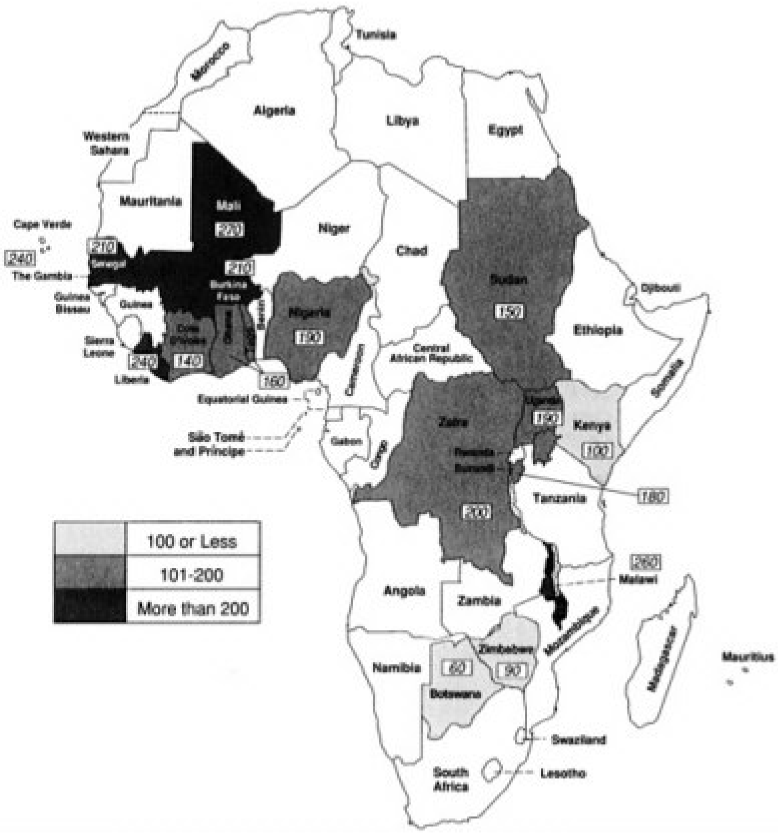
Country	Type of Operation[a]	Date	Status of Mortality Data
Western			
Benin	WFS	1981	Published
Burkina Faso	Census[b]	1985	Available
Côte d'Ivoire	WFS[b]	1980–1981	Published
	LSMS	1985–1986	Partly available
	Census[b]	1988	Available
The Gambia	Census[b]	1983	Published
Ghana	Census	1984	Not collected
	LSMS	1987–1988	Not yet available
	DHS[b]	1988	Published
Guinea	Census	1983	Abandoned
Guinea-Bissau	Census	1979	Not yet available
Liberia	Census	1984	Partly available
	DHS[b]	1986	Published
Mali	Census[b]	1987	Available
	DHS[b]	1987	Published
Niger	Census	1988	Available
Nigeria	Demographic survey	1980–1981	Unavailable
	WFS[b]	1981–1982	Published
	DHS (Ondo State)	1987	Published
	DHS (national)[b]	1990	Available
Senegal	DHS[b]	1986	Published
	Census	1988	Partly available
Sierra Leone	Census	1985	Not yet available
Togo	Census	1981	Not collected
	DHS[b]	1988	Published
Middle			
Angola	Census (Luanda only)	1983–1984	Available
	Southeast region survey[b]	1988	Available
Cameroon	Census	1987	Partly available
	DHS	1991	Available
Congo	Census	1984	Partly available
Zaire	CPS (small area)	1984	Published
	Census[b]	1984	Partly available
Eastern			
Burundi	DHS[b]	1987	Published
	Census	1990	Not yet available
Ethiopia	Demographic survey	1980–1981	Published
	Census	1984	Not yet available
	National demographic survey	1990	Partly available
Kenya	National demographic survey[b]	1983	Partly available
	CPS	1984	Published
	DHS[b]	1989	Published
	Census	1989	Not yet available
Malawi	National demographic survey[b]	1982	Published

Country	Type of Operation[a]	Date	Status of Mortality Data
	WFS type[b,c]	1984	Published
	Census	1987	Partly available
Mozambique	Census[b]	1980	Available
	WFS type[b,c,e]	1987	Partly available
Rwanda	WFS type[c]	1983	Published
Somalia	Demographic survey	1980	Published
	Census	1986–1987	Possibly lost
Tanzania	Census	1988	Partly available
Uganda	Census	1980	Mostly lost
	DHS (south only)[b]	1988–1989	Published
Zambia	Census	1980	Not published
	DHS	1992	Partly available
Zimbabwe	Census[b]	1982	Partly published
	CPS[b]	1984	Published
	Demographic survey[b]	1987	Partly published
	DHS[b]	1988	Published
Southern			
Botswana	Census[b]	1981	Published
	CPS[b]	1984	Published
	Demographic survey	1987	Not yet available
	DHS[b]	1988	Published
Lesotho	Census	1986	Not yet available
Swaziland	Census	1986	Not yet available
	DHS type[d]	1986	Not yet available
Northern			
Sudan	Census[b]	1983	Available
	DHS (northern only)[b]	1989–1990	Published

[a]WFS: World Fertility Survey; LSMS: Living Standards Measurement Survey; DHS: Demographic and Health Survey; CPS: Contraceptive Prevalence Survey.
[b]Data set used in this chapter.
[c]Survey modeled after WFS, but not part of the WFS series.
[d]Survey modeled after DHS, but not part of the DHS series.
[e]Data from Maputo, the capital city, are used here.

scale surveys in Mozambique and Angola are examined, because of the particular interest and data scarcity in those two countries.

The methodology employed is the same as for the previous review (see appendix A to this chapter). The mainstay of the analysis is information on child survival, collected from mothers in censuses and surveys and analyzed by using the Trussell variant of the Brass child survival method (Trussell, 1975); estimates based on Coale-Demeny North and South families of life tables (Coale and Demeny, 1983) are compared, and those that appear to fit the data best are selected.[1] Direct data on child deaths from maternity histories are used for evaluation but not for the final estimates. More methodological details are given in Hill (1989, 1991, 1992).



Summary estimates of dying before age 5 (per 1,000), selected African countries between 1979 and 1985.

[1]Coale and Demeny developed four model life table families (East, West, North, and South) to reflect the different age and sex patterns of mortality derived from historical data from eastern-central, northwestern, Scandinavian, and southern countries of Europe, respectively. The North and South models provide the best fit for the African age pattern of mortality in childhood (see the appendix to this chapter for details). Estimates based on these two models are given in the appendix B tables for each country discussed. In some cases, the estimates from both models are also presented in the figures; however, because of space limitation, only one of the models is usually presented in a figure.

Every stage of the analysis and estimation for each country is standardized as much as possible in order to put individual country results into a framework of continental levels, patterns, and trends. Inevitably, estimation from large quantities of imperfect data is a subjective process in which individual judgment must play a large part. (See map for summary of continental levels of child mortality.)

NEW COUNTRY DATA AND RESULTS

Botswana and Zimbabwe

These two countries are examined together because they are neighbors, their levels of overall development are very similar, their mortality levels and trends were also very similar up to 1980 (see Figure 5–2), and their data collection schedules in the 1980s were almost identical. They each had a census at the beginning of the decade, a Contraceptive Prevalence Survey (CPS) in 1984, an intercensal demographic survey (ICDS) in 1987 (unfortunately not yet available for Botswana), and a Demographic and Health Survey (DHS) in 1988.

The results of the analysis of all available mortality data for both countries are presented in Tables 5–B.1 and 5–B.2 of appendix B, and are shown graphically in Figures 5–3, 5–4, and 5–5. In both, there is a marked contrast between the smoothness and regularity of the census results and the irregular, seesaw, and often rather wild results from various surveys; no doubt the much larger numbers available for analysis from the census are largely responsible. However, the consistency and plausibility of the results from the 1980s survey data differ sharply between the two countries.

For Botswana, provided the South model is used, all the data except the direct DHS reports are highly consistent. They show a continued decline in childhood mortality from 1955 to 1985, with the decline possibly accelerating during the late 1970s and early 1980s. Because Botswana enjoyed rapid economic growth and fast-developing infrastructure and social services throughout the 1970s and 1980s, such a trend is not at all surprising. The very low level of mortality achieved by the mid-1980s—a probability of dying by age 5 of not much more than .050, which implies an infant mortality rate between 30 and 40 deaths per 1,000 live births—should also be acceptable because the DHS shows that child health and nutrition are excellent. Botswana appears now to have perhaps the lowest mortality in sub-Saharan Africa.

By contrast, the 1980s survey data for Zimbabwe are confused and inconsistent, with the exception of the larger-scale 1987 demographic survey of the traditional type, which fits well with the two sets of census data. The 1984 CPS results not only are highly irregular in trend—first steeply up

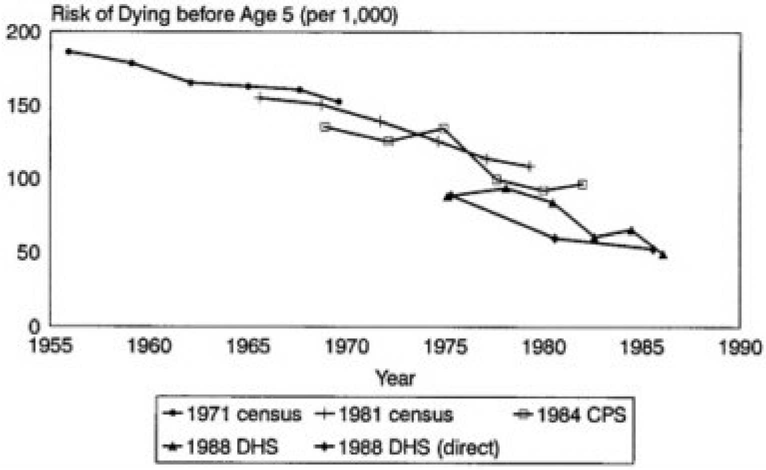


FIGURE 5–3 Risk of dying before age 5, Botswana, 1955–1990, South model. SOURCES: 1971 census (Botswana, 1972); 1981 census (Botswana, 1983); 1984 Contraceptive Prevalence Survey (CPS) (Botswana, 1985); 1988 Demographic and Health Survey (DHS) (Lesetedi et al., 1989).

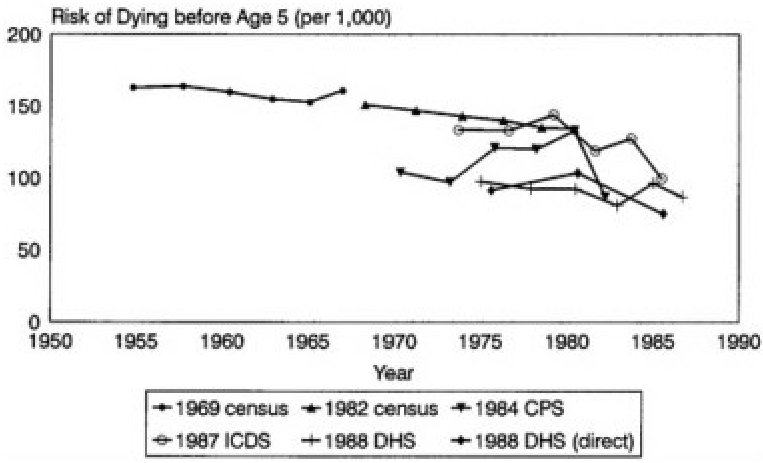


FIGURE 5–4 Risk of dying before age 5, Zimbabwe, 1950–1990, North model. SOURCES: 1969 census (Rhodesia, n.d.); 1982 census (Zimbabwe, 1985a); 1984 Contraceptive Prevalence Survey (CPS) (Zimbabwe, 1985b); 1987 Intercensal Demographic Survey (ICDS) (Zimbabwe, 1991); 1988 Demographic and Health Survey (DHS) (Zimbabwe, 1989).

and then even more steeply down, all in the space of less than 15 years—butappear quite at odds with all the other data. The 1988 DHS mortality levels are much too low compared with the other data sources, except perhaps in the most recent few years. The best choice seems to be a combination of the 1987 demographic survey results with those of the two censuses, which would also yield mortality levels similar to those from the DHS around the mid-1980s. North appears the better-fitting model for the two censuses, but South gives better consistency thereafter; there seems no clear-cut reason to prefer one over the other.

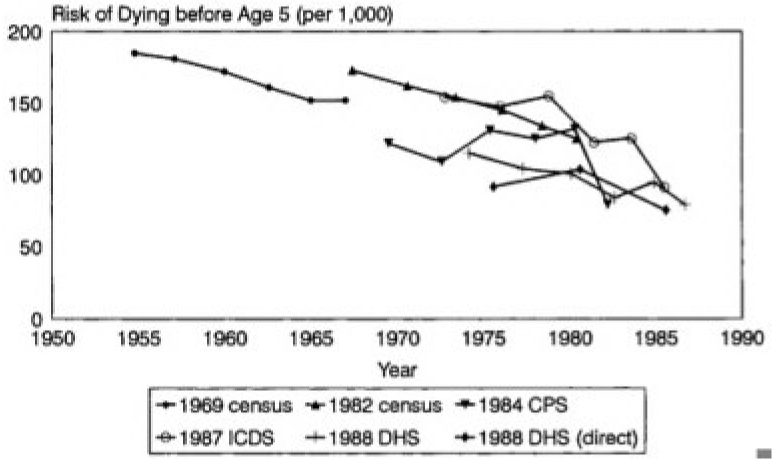


FIGURE 5–5 Risk of dying before age 5, Zimbabwe, 1950–1990, South model. SOURCES: 1969 census (Rhodesia, n.d.); 1982 census (Zimbabwe, 1985a); 1984 Contraceptive Prevalence Survey (CPS) (Zimbabwe, 1985b); 1987 Intercensal Demographic Survey (ICDS) (Zimbabwe, 1991); 1988 Demographic and Health Survey (DHS) (Zimbabwe, 1989).

The resulting trend is again of a continued mortality decline from the early 1970s to the mid-1980s, gentle at first, then with perhaps an acceleration of decline in the 1980s; there is also a hint in the data of some temporary stagnation or rise in mortality during the late 1970s, the period of the war for independence. The relatively low overall level of childhood mortality achieved by the mid-1980s—a probability of dying by age 5 of about .080 to .090—is again consistent with Zimbabwe's good general level of income and development and the excellent child health and nutrition noted in the DHS. Such a level would place Zimbabwe behind Botswana, but still among the very lowest-mortality countries in Africa.

Middle and Eastern Africa

Mozambique and Angola, the two major former Portuguese colonies, have enjoyed neither stability nor solid economic growth for many years. In both, a long and painful war for independence was followed by a short period of relative peace before internal conflicts resumed. No new national-level data for the 1980s are yet available for Mozambique, and none were collected in Angola. Survey data from two small areas in the southern parts of these countries are, however, available and are presented in this chapter. These are Maputo, the capital city of Mozambique (data from a 1987 national World Fertility Survey (WFS) type of survey), and rural parts of the southwest region of Angola bordering on Namibia (data from a local socioeconomic-demographic survey in 1988). The results from these new data sets, combined with the latest available national data, are shown in Tables 5–B.3 and 5–B.4, and summarized graphically in Figures 5–6 and 5–7.

The trend in childhood mortality in Maputo between the early 1970s and the mid-1980s is broadly consistent with the picture already evident in the national census results. There was possibly a mortality decline through the earlier 1970s (when the Portuguese were still developing Maputo as a modern city headquarters containing a major concentration of the Portuguese settler population), followed by stagnation from the mid-1970s through

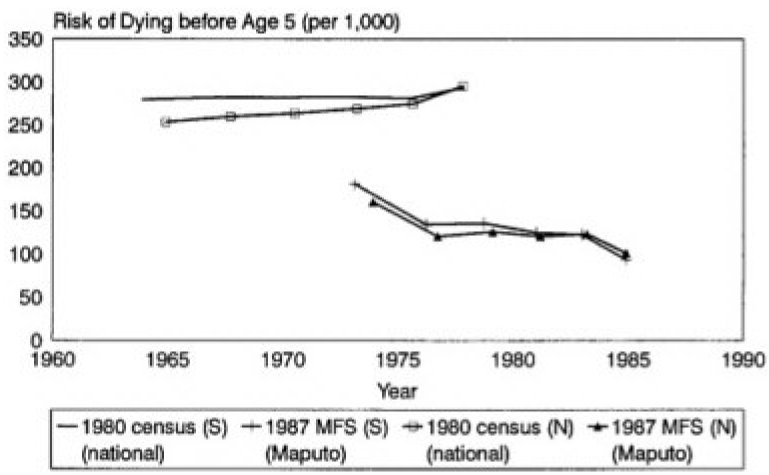


FIGURE 5–6 Risk of dying before age 5, Mozambique and Maputo, 1960–1990, North and South models. SOURCES: 1980 census (Mozambique, n.d.); 1987 Maputo Fertility Survey (MFS) (WFS-type survey) (Mozambique, 1987).

the mid-1980s, during which the Portuguese withdrawal was followed by the onset of a crippling civil war. The overall level of childhood mortality in Maputo during the late 1970s and 1980s was, however, relatively low, with a probability of dying by age 5 of .120 to .140—much lower than the corresponding level of .270 to .280 for Mozambique as a whole.

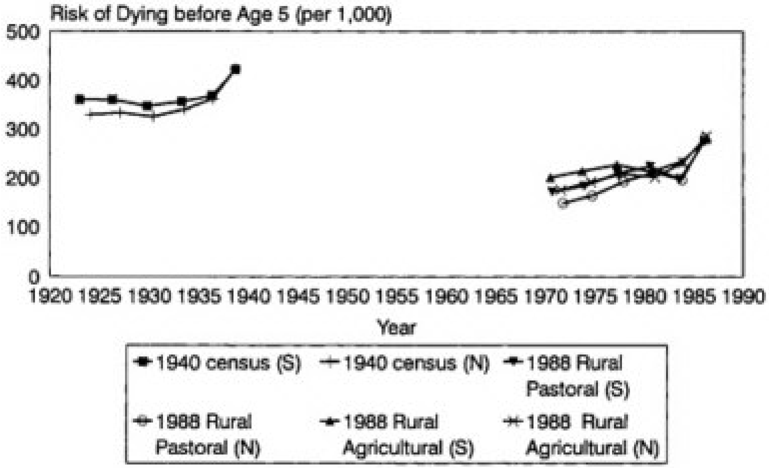


FIGURE 5–7 Risk of dying before age 5, Angola and southwestern Angola, North and South models. SOURCES: 1940 census (Heisel, 1968); 1988 rural survey (Angola, 1990).

The picture in southwestern Angola is even worse. Rural pastoral and agricultural populations appear to have experienced stagnating or rising childhood mortality from 1970 to the mid-1980s, even though this area was relatively prosperous and least affected by the postindependence civil war. According to the analysis of the 1940 census reported in Brass et al. (1968), the region, then called Huila, enjoyed by far the lowest childhood mortality in Angola at that time. The childhood mortality estimates emerging from the 1988 rural survey, with probabilities of dying by age 5 of .200 to .250, represent an improvement over the levels found in the 1940 census data, but are still very high given the area's location in the lowest-mortality part of Africa.

Full results from the Malawi census of 1987 are not yet available. However, given Malawi's extraordinarily severe childhood mortality in earlier periods—probabilities of dying by age 5 of .330 to .370, which are high for any part of sub-Saharan Africa (see Figures 5–1 and 5–2) —it is of interest to examine the additional data on trends from the mid-1960s to the beginning of the 1980s that emerge from the two surveys carried out in

1982 and 1984. These are shown in Table 5–B.5 and summarized in Figure 5–8.

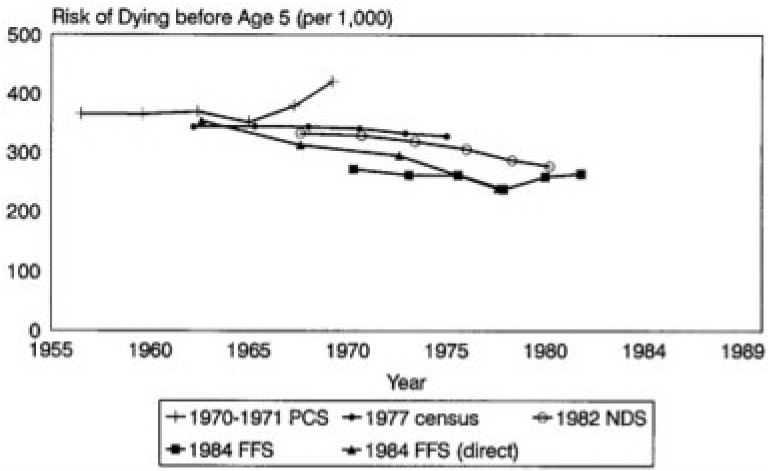


FIGURE 5–8 Risk of dying before age 5, Malawi, 1955–1990, South model. SOURCES: 1970–1971 Population Change Survey (PCS) (Malawi, 1973); 1977 census (Malawi, 1980); 1982 National Demographic Survey (NDS) and 1984 Family Formation Survey (FFS) (Malawi, 1987c).

The picture is mixed. Results from the 1982 survey, an intercensal national demographic survey, fit well with earlier data, provided the South model is used. However, the direct and indirect data from the 1984 WFS-type survey match poorly both with each other and with other data sources, except at the beginning and end, respectively, of their periods of reference. It seems best to accept the 1982 results and to discard most of those from 1984.

Use of the South model produces a trend of very gentle mortality decline through the early 1970s (as earlier data also indicated), followed by something of an acceleration during the rest of the decade. The probability of dying by age 5 falls to about .260 to .280 by the beginning of the 1980s, leaving Malawi still among the very highest-mortality countries in all Africa at that time.

Zaire is another country for which data are available only from the early 1980s. However, because the previous data set (a national demographic survey (NDS)) dated back to the mid-1950s, with long periods of instability and stagnation in economic growth in between, the trends shown by the data from the first census in 1984 (10 percent sample) are of great interest. The 1984 results, in combination with the 1955 survey results, are given in Table 5–B.6 and summarized graphically in Figure 5–9.

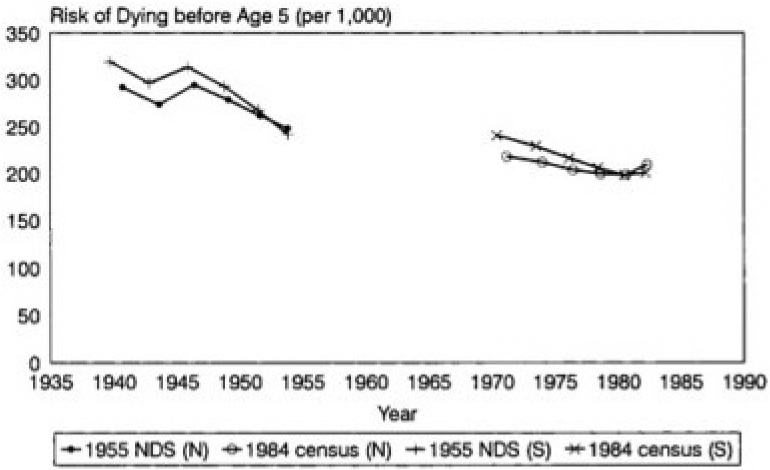


FIGURE 5–9 Risk of dying before age 5, Zaire, 1935–1990, North and South models. SOURCES: 1955 National Demographic Survey (NDS) (Romaniuk, 1968); 1984 census (Schneidman, 1990).

The two data sets appear to be reasonably consistent, particularly if the North model is used. They display a trend of continuous decline in childhood mortality from 1940 to 1980. The decline was perhaps steeper up to the mid-1950s or so, and (partly by inference) shallower thereafter. This pattern is consistent with the concentrated effort at socioeconomic development made by the Belgians during the 1950s, and the subsequent more sporadic pattern of economic growth and development of social services that was possible during the succeeding two decades of intermittent turmoil and political difficulties. The probability of dying before age 5 of around .210 to .220 in the early 1980s maintains Zaire in its previous position within the middle range for western and middle Africa, and close to the top of the range for eastern and southern Africa.

Burundi, an eastern neighbor of Zaire, is also a former Belgian colony. From earlier data it appeared that childhood mortality had declined in the 1950s and early 1960s, but then more or less stagnated through the mid-1970s. Trends in the early 1980s, as well as the 1970s, can be examined from the results of the 1987 DHS. These are shown, together with earlier data, in Table 5–B.7, and are summarized graphically in Figure 5–10.

The new results appear very consistent with previous data, particularly if the South model is used. They indicate a renewed and fairly marked decline in childhood mortality during the early and mid-1980s. In the mid-1980s, the probability of dying before age 5 was .170 to .180, keeping Burundi in the middle of the eastern-southern Africa range.

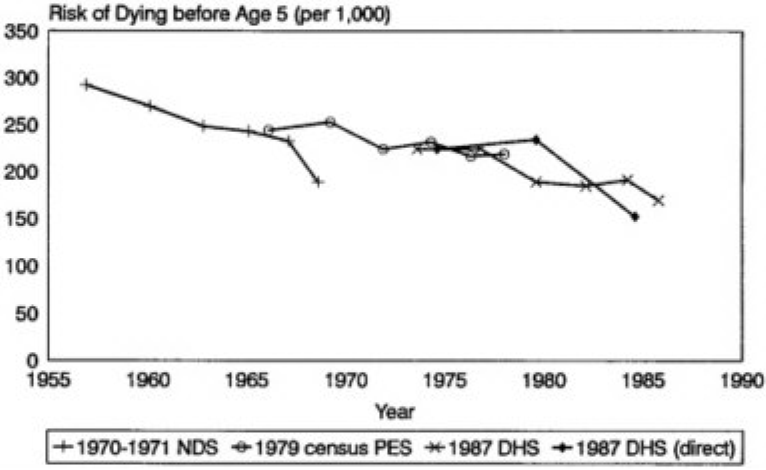


FIGURE 5–10 Risk of dying before age 5, Burundi, 1955–1990, South model. SOURCES: 1970–1971 National Demographic Survey (NDS) (Burundi, 1974); 1979 census postenumeration survey (PES) (Burundi, 1979); 1987 Demographic and Health Survey (DHS) (Segamba et al., 1988).

Uganda, a prosperous and fast-developing country in the 1950s and 1960s, has since suffered civil wars, economic collapse, and the AIDS epidemic. No large-scale data set has been available to examine demographic changes since 1969 (the date of the last published census) because of the theft and destruction of most of the 1980 census data (information from the Census Commissioner). The 1988–1989 DHS now provides some information for the southern part of the country; unfortunately, most of the then unsettled north could not be surveyed. The DHS results are shown with earlier data in Table 5–B.8 and summarized graphically in Figure 5–11. When examining them it should be borne in mind that in the 1960s the parts of Uganda covered by the DHS had similar levels of childhood mortality to those omitted.

These results, though internally somewhat confused, nevertheless display a complete transformation in childhood mortality trends in Uganda over the past two decades. The extremely rapid decline of the 1950s and 1960s gave way during the course of the 1970s to stagnation or an actual rise in mortality. There is an indication of renewed mortality decline in the early 1980s, but this trend cannot be taken as firm and, in any case, would almost certainly not be true in the unsurveyed north. The risk of dying before age 5 in the mid-1980s was .180 to .190 in southern Uganda; thus if a national level at most .01 or .02 higher is assumed, the results do not differ greatly from the levels of the late 1960s. The net result of the disruptions of the last 20 years has thus been to wipe out the country's previous two decades' improvement in childhood mortality. The new mortality level pushes Uganda from its previous position in the middle of the eastern and southern African mortality range close to the top.

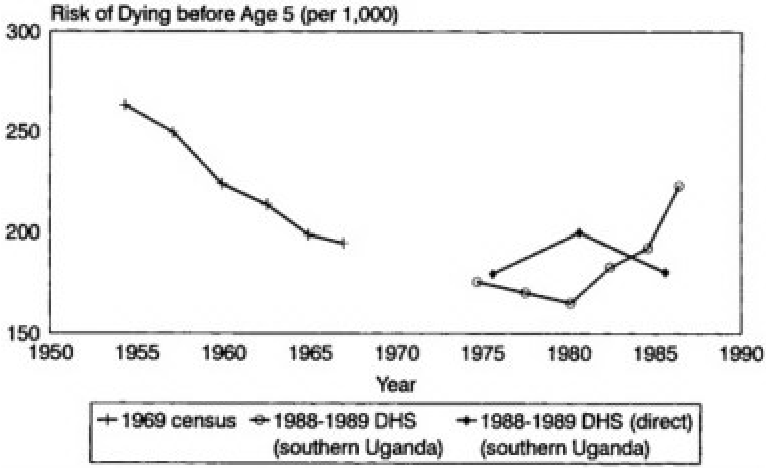


FIGURE 5–11 Risk of dying before age 5, Uganda, 1950–1990, North model. SOURCES: 1969 census (Uganda, 1969); 1988–1989 Demographic and Health Survey (DHS) (Kaijuka et al., 1989).

Unlike Uganda, Kenya has been relatively peaceful and prosperous since independence in 1962 and has collected a mass of demographic data since its independence, including four censuses, two national demographic surveys, a WFS, a CPS, and a DHS. Data on childhood mortality are available from all except the CPS and the most recent census, and two (the 1983 NDS and the 1989 DHS) provide information for the 1980s. The results from all are given in Table 5–B.9 and summarized graphically in Figure 5–12.

These results display a very clear overall picture of a continuous and rapid decline in child mortality during the past 45 years. The probability of dying by age 5 was more than halved between 1945 and 1985, from more than .250 to about .100. The North model yields better consistency between data sets than the South—with census data, in particular, dovetailing almost perfectly—but the general picture is similar in both.

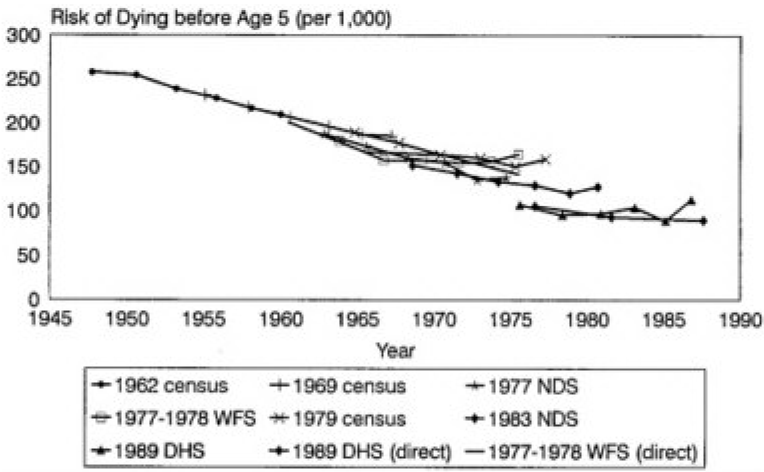


FIGURE 5–12 Risk of dying before age 5, Kenya, 1945–1990, North model. SOURCES: 1962 census (Kenya, 1962); 1969 census (Kenya, 1969); 1977 National Demographic Survey (NDS) (Kenya, 1980); 1977–1978 World Fertility Survey (WFS-indirect) (Kenya, 1980); World Fertility Survey (WFS-direct) (Rutstein, 1983); 1979 census (unpublished data); 1983 National Demographic Survey (NDS) (unpublished data); 1989 Demographic and Health Survey (DHS) (Kenya, 1989).

Trends in the 1980s are not as clear as earlier, because only survey data are available thus far, and the DHS data in particular do not fit smoothly with earlier data sets. There is a suggestion from the internal trend within the DHS data that the mortality decline may have bottomed out in the late 1970s and early 1980s, but the most recent data points from the DHS do in fact yield a much lower mortality level than previous data sets, which suggests a continued decline. These uncertainties may be resolved by the 1989 census results when they become available, but must remain unresolved for the present. In considering the total picture from all data sets, however, it appears at present that childhood mortality continued to fall in Kenya in the 1980s and that Kenya is among the lowest-mortality countries in Africa, but behind Botswana and Zimbabwe.

Sudan

Sudan, like other countries in sub-Saharan Africa, has suffered extensive periods of large-scale civil war. The two censuses of 1973 and 1983, both held fortuitously in the sole period of peace from 1973 to the mid-1980s, covered the entire country, and separate analyses are also available for the north from 1973; the WFS and DHS surveys were held only in the north. These results are shown in Table 5–B.10 and presented graphically in Figures 5–13 and 5–14.

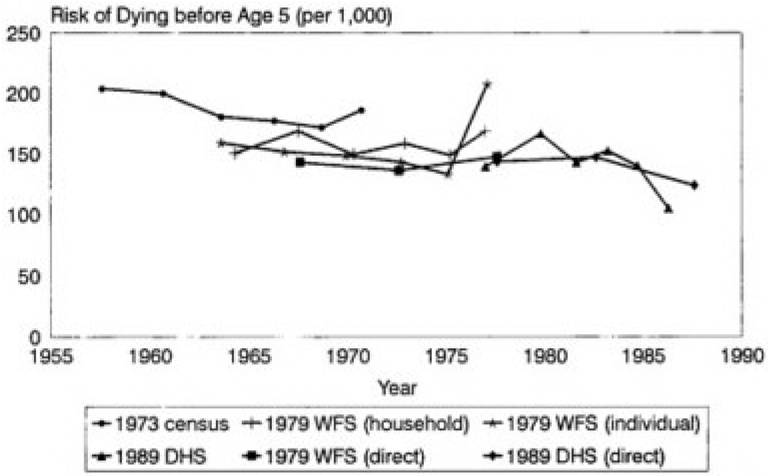


FIGURE 5–13 Risk of dying before age 5, northern Sudan, 1955–1990, South model. SOURCES: 1973 census (Sudan, n.d.); 1979 World Fertility Survey (WFS) (Sudan, 1982); 1989 Demographic and Health Survey (DHS) (Sudan, 1991).

The quality of these data clearly leaves much to be desired, and the results are sometimes inconsistent; data from the 1973 census, which proved to be a substantial undercount in the recently pacified and resettled south, are particularly difficult to reconcile with later data. However, the picture for northern Sudan, at least, shown in Figure 5–13, is clearly one of stagnation in childhood mortality from the late 1960s through the mid-1980s. There was possibly some decline before the mid-1960s and in the late 1980s. The overall level of mortality of about .150 up to the mid-1980s would raise northern Sudan to the middle range for eastern and southern Africa at that date.

The picture for all Sudan, including southern Sudan, shown in Figure 5– 14, is less clear. By using the South model, it would be barely possible to reconcile the two censuses by hypothesizing a decline from the mid-1950s to the mid-1960s, a plateau up to the early 1970s, a sharp decline till the mid-1970s, and then a further plateau up to the early 1980s, but this appears very far-fetched. The large undercount in 1973 may have affected the comparability of the two censuses.

The overall probability of dying by age 5 of about .150 around 1980—

surprisingly indicating similar levels of mortality in north and south Sudan, unlike earlier data—would bring all Sudan down from its previous position in the upper-middle mortality range for eastern and southern Africa to the lower range at that time. Given the picture presented by data for northern Sudan, this favorable shift for all Sudan could be attributed only to a rapid decline in childhood mortality in the south, presumably immediately after the peace accord in 1973. However, in view of the difficulties in reconciling data (discussed above), it would be prudent to suspend judgment on both levels and trends in childhood mortality in southern and all Sudan until such time as further data become available for the south.

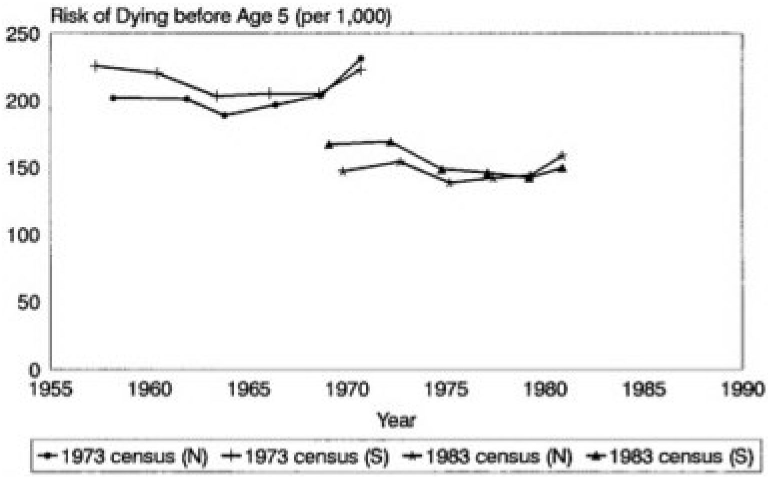


FIGURE 5–14 Risk of dying before age 5, Sudan (national), 1955–1990, North and South models. SOURCES: 1973 census (Sudan, n.d.); 1983 census (Sudan, 1989).

Western Africa

Senegal, Mali, Burkina Faso, and The Gambia

The western Sahel countries—Senegal, Mali, Burkina Faso, and The Gambia—are treated as a group because of their many similarities. Climate, ecology, and economic structure vary little across the group. These countries have all been relatively peaceful and politically stable, and all but Senegal, which benefited to some extent from its very early colonial development, are desperately poor. All had extremely severe levels of childhood mortality from the 1940s through most of the 1960s, with national prob abilities of dying in the range of .300 to .450—levels among the highest ever observed not only within Africa, but anywhere in the post-World War II world.

The francophone countries (Mali, Senegal, Burkina Faso) each had a national demographic survey at the time of independence around 1960, but then failed to collect any usable national demographic data for the next 15 to 25 years. All had censuses in the mid-1980s, and Mali and Senegal also had a DHS at about the same time. The Gambia has collected national demographic data only through two censuses in 1973 and 1983. Results are given in Tables 5–B.11 through 5–B.14 and are presented graphically in Figures 5–15 to 5–18.

The overall results, despite some obvious deficiencies, are very encouraging. All of these poor and high-mortality countries show a very substantial decline in childhood mortality during the last 20 years, though the picture is clearer in some countries than others.

The data for Senegal, which are the richest and most plentiful, present a reasonably consistent picture, particularly if the South model is used. They indicate a substantial early fall in childhood mortality from 1940 to 1960, followed by a plateau until the early 1970s, and then a renewed sharp decline to the mid-1980s.

The sparser data for Mali show no early decline, but rather indicate a continuing plateau at a very high mortality level until around the early 1970s. There is a problem of consistency between the 1987 DHS and the 1987 census, whose trend lines intersect at one point only around 1980; but because the census also fits much worse with the 1960 data than the DHS does, the latter is to be preferred. The DHS shows a steep fall from the mid-1970s to the mid-1980s, similar to the trend in Senegal. Again, the South model appears to provide better consistency.

Early trends in Burkina Faso are difficult to discern, because the data from the 1960–1961 survey cannot be made consistent with the results of the two censuses in 1975 and 1985 (see Hill, 1989, 1991, 1992 for a discussion of this problem). However, it seems plausible that Burkina Faso also remained at a high-mortality plateau during the 1940s and 1950s. The data from the two censuses, which agree extraordinarily well if the South model is used, show a gradual decline during the 1960s that accelerated during the 1970s. They then indicate another plateau in childhood mortality in the early 1980s, but this plateau cannot be regarded as firm because similar plateaus or rises in the Senegal and Mali DHS indirect data (as well as the Mali census) are contradicted by the direct data, which show a continued decline. The forthcoming data from the Senegal census will provide another useful piece of evidence here (see Working Group on Senegal, forthcoming).

The more limited data for The Gambia appear also somewhat difficult

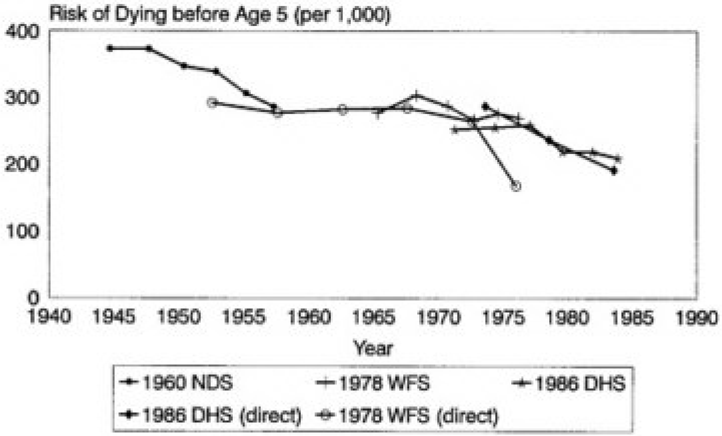


FIGURE 5–15 Risk of dying before age 5, Senegal, 1955–1990, South model. SOURCES: 1960 National Demographic Survey (NDS) (Verrière, n.d.); 1978 World Fertility Survey (WFS-direct) (Rutstein, 1983); World Fertility Survey (WFS-indirect) (Ewbank, 1985); 1986 Demographic and Health Survey (DHS) (Ndiaye et al., 1988).

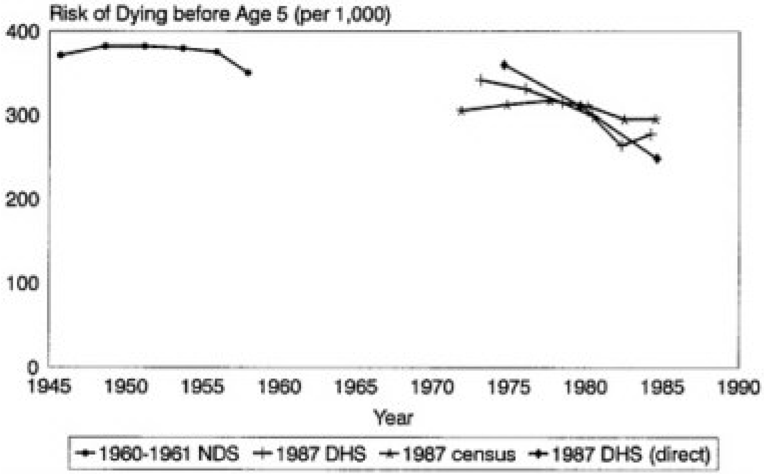


FIGURE 5–16 Risk of dying before age 5, Mali, 1945–1990, South model. SOURCES: 1960–1961 National Demographic Survey (NDS) (Mali, n.d.); 1987 Demographic and Health Survey (DHS) (Traoré et al., 1989); 1987 census (unpublished data).

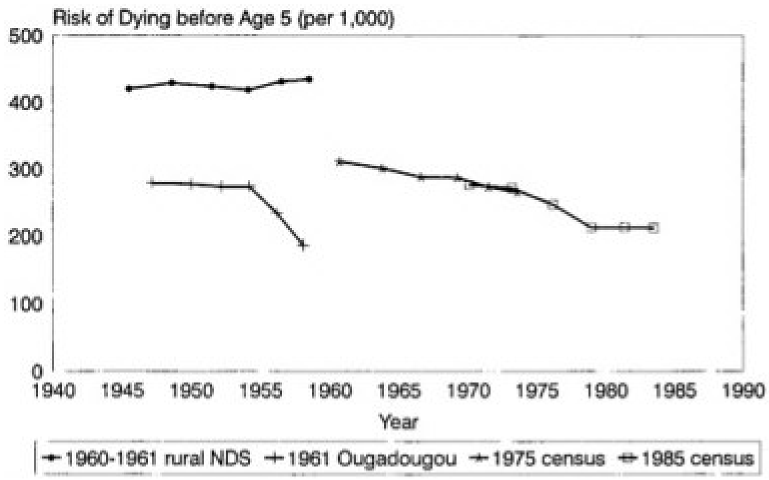


FIGURE 5–17 Risk of dying before age 5, Burkina Faso, 1945–1990, South model. SOURCES: 1960–1961 rural national demographic survey (NDS) and 1975 census (Burkina Faso, 1981); 1961 Ougadougou (Burkina Faso, n.d.); 1985 census (unpublished data).

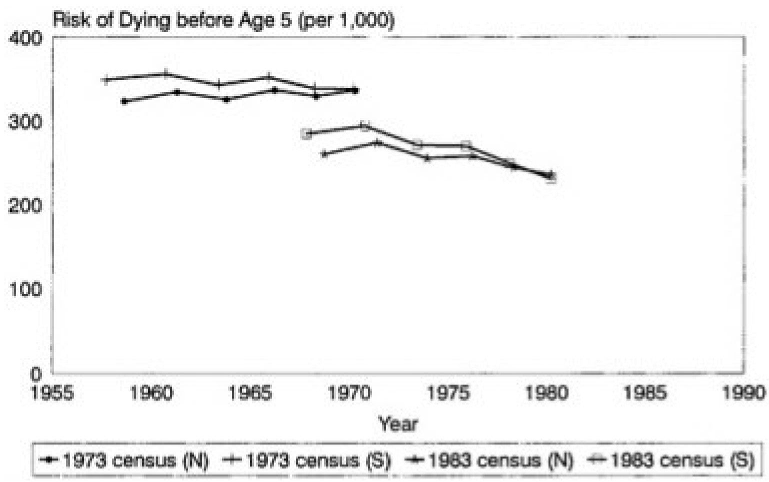


FIGURE 5–18 Risk of dying before age 5, The Gambia, 1955–1990, North and South models. SOURCES: 1973 census (The Gambia, 1976); 1983 census (The Gambia, 1987).

to reconcile, though the South model gives slightly better results. However, again the most plausible interpretation is of little change in the very high childhood mortality in The Gambia between the late 1950s and early 1970s, followed by a marked drop by the early 1980s. It is encouraging that these trends duplicate what has been observed in the country's long-running small-scale Keneba study, through which demographic and health trends have been monitored in a small rural population since 1947 (McGregor, 1991).

Such childhood mortality improvements in these countries in the 1970s and (less clearly) in the early 1980s are certainly good news. However, the resulting probabilities of dying by age 5 of around .200 to .250 in the early to mid-1980s keep the region in the middle to upper part of the childhood mortality range in all of Africa.

Togo, Ghana, and Côte d'Ivoire

Togo, Ghana, and Côte d'Ivoire form a natural and contiguous grouping. All three are closely related in culture and ethnic composition, and have suffered economic reversals of varying degrees in recent decades. Ghana and Côte d'Ivoire share a common ecology, and migration streams between Ghana and Togo have been substantial for many decades. A comparison of the mortality histories of these three countries ought therefore to be instructive.

Ghana and Togo shared a common census schedule and methodology in 1960, 1970, and 1980, although Ghana also, and very unusually for that date, collected child survival information in its 1948 census. In addition, both had a DHS in 1988, while Ghana also held a WFS in 1980. Côte d'Ivoire, by contrast, collected no national demographic data until the 1979– 1980 multiround survey, followed closely by a 1980–1981 WFS and then by the second census in 1988. Some demographic data were also collected in the 1985–1986 Living Standards Measurement Survey (LSMS), but only part of these have been tabulated. Results for the three countries are given in Tables 5–B.15 through 5–B.17 and displayed graphically in Figures 5–19 to 5–21.

The results for Togo and Côte d'Ivoire are very similar. The data for both give a consistent picture—astonishingly so for Côte d'Ivoire—provided the South model is used. Each country shows a continuous and fairly rapid decline in childhood mortality between 1960 and 1985, with the probability of dying by age 5 being roughly halved from about .300 to .150 or lower during those 25 years. Earlier data for Togo indicate some decline between 1945 and 1960 also, but much gentler. There is also some indication of a plateau in the early 1980s for Togo from the DHS direct data, but this cannot be regarded as firm because (in the reverse case to those of the

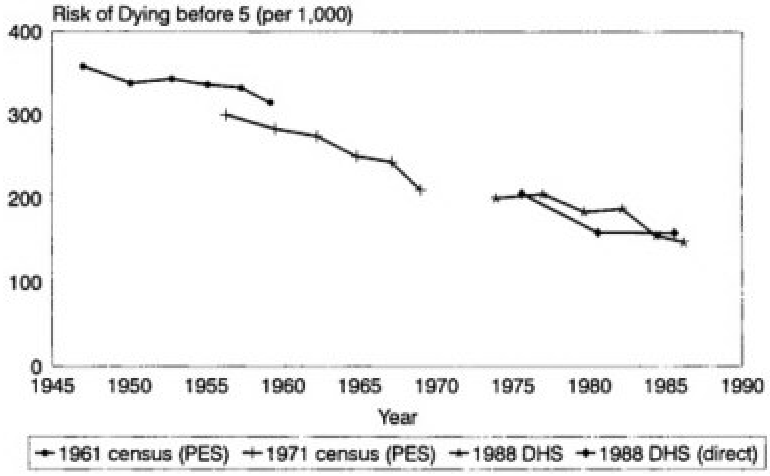


FIGURE 5–19 Risk of dying before age 5, Togo, 1945–1990, South model. SOURCES: 1961 census postenumeration survey (PES) (United Nations, 1978); 1971 census postenumeration survey (PES) (Adognon, 1980); 1988 Demographic and Health Survey (DHS) (Agounké et al., 1989).

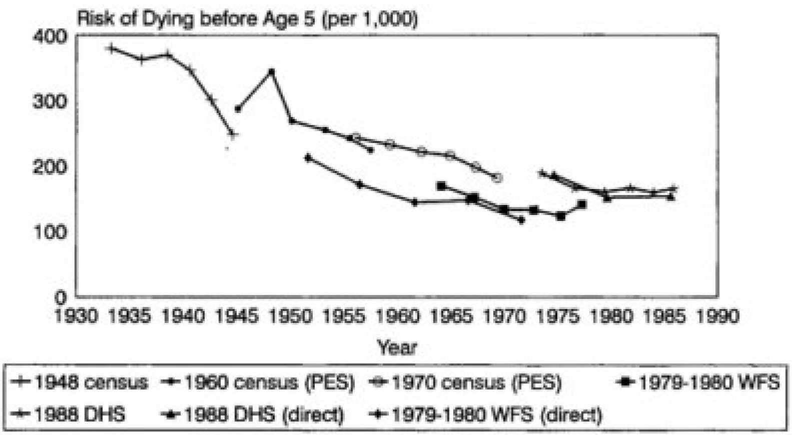


FIGURE 5–20 Risk of dying before age 5, Ghana, 1930–1990, South model. SOURCES: 1948 census (Ghana, n.d.); 1960 census postenumeration survey (PES) (Gaisie, 1969); 1970 census postenumeration survey (PES) (Ramachandran, 1979); 1979–1980 World Fertility Survey (WFS) (Owusu, 1984); 1988 Demographic and Health Survey (DHS) (Ghana, 1989).

Senegal and Mali DHS noted above), the indirect data show an opposite trend of continued decline.

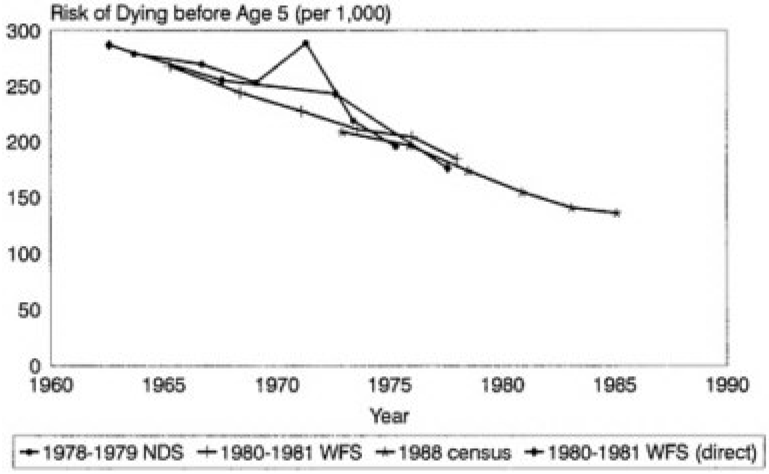


FIGURE 5–21 Risk of dying before age 5, Côte d'Ivoire, 1960–1990, South model. SOURCES: 1978–1979 National Demographic Survey (NDS) (Côte d'Ivoire, n.d.); 1980–1981 World Fertility Survey (WFS) (Côte d'Ivoire, 1984); 1988 census (unpublished data).

The results for Ghana are much less consistent overall, although the South model still provides the smoothest fit. Not surprisingly, the data from 1948 appear very rough, but the 1960 data are also irregular in part and the WFS results are confirmed as being quite inconsistent with all the other data sets. However, by leaving them aside and selecting the smoother parts of the 1948 data, a picture emerges that resembles trends in Togo and Côte d'Ivoire in some respects. There is again a continuous decline roughly halving the probability of dying from around .300 to slightly more than .150, but over a longer and earlier period from roughly the late 1940s to 1980. There is, as for Togo, evidence of a still earlier decline during the 1930s and 1940s, probably also gentler than the succeeding trend. However, the picture looks bleaker for trends since 1980 than in the other two countries, with both direct and indirect results indicating at least a stall in mortality decline—possibly even a rise—dating from the end of the 1970s.

The mid-1980s estimates of the probability of dying in the three countries of about .140 to .160 place them near the bottom of the western and middle African mortality range, and in fact close to the middle of the eastern and southern African range.

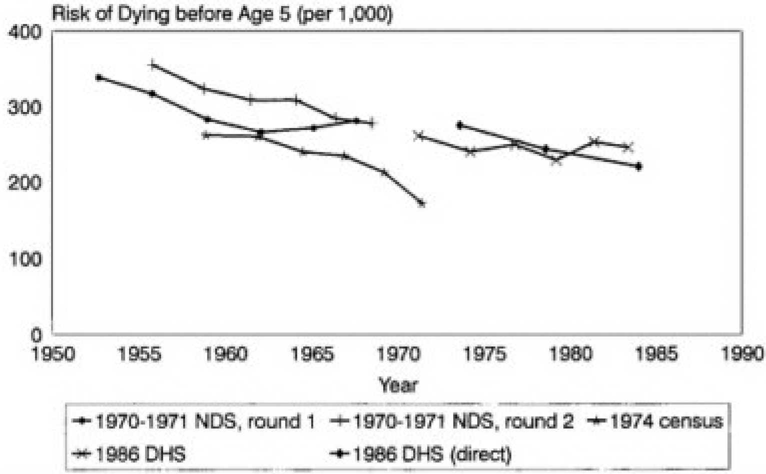


FIGURE 5–22 Risk of dying before age 5, Liberia, 1950–1990, South model. SOURCES: 1970–1971 National Demographic Survey (NDS) (Massalee, 1974; United Nations, 1978); 1974 census (Liberia, 1977); 1986 Demographic and Health Survey (DHS) (Cheih-Johnson et al., 1988).

Liberia

Unlike the countries discussed above, Liberia is experiencing serious internal instability. Its available demographic data are limited, consisting to date of a 1970–1971 multiround national demographic survey, a 1974 census, and a DHS in 1986. Results from these data are given in Table 5–B.18 and displayed graphically in Figure 5–22.

These results show fair overall consistency between the 1970–1971 and the 1986 data sets, with the South model as usual performing slightly better; they indicate an overall gentle decline in childhood mortality since 1950 from a probability of dying of about .360 to .250 by the late 1970s and probably not much change thereafter. The 1974 census data are quite inconsistent with either of the other two data sets, almost certainly due to the use of erroneous imputation techniques during data processing; they may thus be left aside as uninformative.

However, a more detailed assessment of levels and trends in childhood mortality in Liberia, particularly over recent years, is hampered by internal inconsistencies in both the 1970–1971 and the 1986 data sets. The gap between child survival data from the 1970 and 1971 rounds of the multiround survey is probably less serious. It has been attributed to a devastating cholera epidemic among children between the rounds, though it is conceiv able that improvements in the quality of data collection between rounds could also have played a part. The inconsistency between the direct and indirect DHS results is more troubling, because they indicate quite different trends in childhood mortality between the early 1970s and mid-1980s: a steady marked decline and a steady marked stall or slight rise, respectively.

Without additional supporting data, for example, from the so far unavailable 1984 census, no firm conclusion regarding recent trends can be drawn. The overall mid-1980s probability of dying before age 5 of about or slightly less than .250, however, would push Liberia up from its previous position in the middle of the western and middle Africa range to a place near the top.

Nigeria

Nigerian data on childhood mortality—as for every other demographic phenomenon—have been scanty and unsatisfactory until recently. The censuses of 1952–1953, 1962, 1963, and 1973, and the national demographic surveys of 1965 and 1980–1981, either collected no data on child survival or never tabulated or analyzed them. The 1971–1972 demographic survey produced child survival data that were too poor to be usable. Those collected in the 1981–1982 Nigeria fertility survey (one of the WFS series) yielded puzzling trends and levels of childhood mortality that were extremely low by comparison with all other neighboring countries and other small-scale surveys in Nigeria itself (Hill, 1989, 1991, 1992).

The 1990 Nigeria DHS data are therefore of particular interest, both because they are the first to emerge for the 1980s and because they provide a further opportunity to evaluate hitherto very doubtful levels and trends. The results are given in Table 5–B.19 and shown in Figure 5–23. They also are unsatisfactory. Like those of the 1981–1982 WFS, the indirect data show a faintly "bucket-shaped" trend of childhood mortality that first falls and then rises again to reach or surpass its earlier level; the presumption must be that this repeated pattern is at least partly due to data errors.

The DHS results, both direct and indirect, are also quite inconsistent in level with those of the WFS, showing much higher childhood mortality where the two data sets overlap in time. North and South models give much the same picture in this respect, although North provides a better fit between direct and indirect results for both the WFS and the DHS. Because the DHS sample frame, based on the preliminary cartography for the carefully prepared 1991 census, was almost certainly much more accurate than the out-of-date frame of dubious quality used for the WFS (which came ultimately from preparations for the nullified 1973 census) and because many difficulties were encountered in the WFS fieldwork, the DHS results are to be preferred.

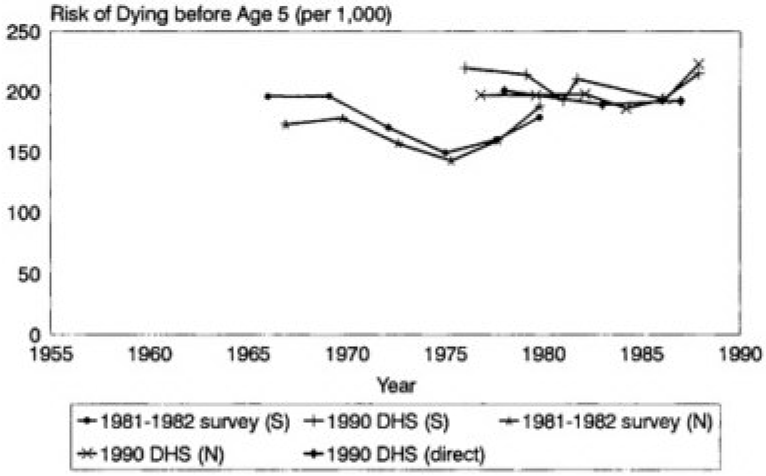


FIGURE 5–23 Risk of dying before age 5, Nigeria, 1950–1990, North and South models. SOURCES: 1981–1982 World Fertility Survey (WFS) (unpublished data); 1990 Demographic and Health Survey (DHS) (Nigeria, 1992).

By using the DHS, therefore, and taking due note of the possible existence of data errors mentioned above, a cautious conclusion would be that childhood mortality in Nigeria changed rather little between the mid-1970s and 1990. The probability of dying by age 5, according to both the North model for indirect results and the direct reports of child deaths, varied only between .190 and .200. The sharp upturn in the late 1980s shown in the indirect data must be considered dubious, given the similar pattern in the WFS data, combined with the absence of any such trend in the direct data for either the WFS or the DHS.

A level of .190 to .200 for the 1980s would place Nigeria in the middle range for western Africa, worse than the best performers on the coast such as Côte d'Ivoire, Togo, and Ghana, but better than the Sahel countries and Liberia. Given only a single acceptable data set with a limited time frame, it is difficult to place these results in the socioeconomic context. Nigeria experienced a massive oil boom during the 1970s and early 1980s, followed by a sharp economic downturn and persisting economic difficulties for the rest of the decade, yet apparently childhood mortality changed rather little during boom or bust. Earlier trends are uncertain.

OVERVIEW OF TRENDS IN COUNTRIES WITH NEW DATA

To facilitate a general overview of trends in childhood mortality for these 17 countries with new national data (including Uganda), the results for each country have been summarized in the same fashion as in Hill (1989, 1991, 1992). They are shown in Table 5–2 and displayed graphically in Figures 5–24 and 5–25.

Viewed as a group, these results show a general continued decline in childhood mortality during the 1970s and 1980s for the majority of African countries with recent data. This decline occurred both in countries that prospered during those years and in countries with poor or negative economic growth.[2] Of the exceptions—countries where childhood mortality clearly has stagnated or risen over the past 20 years—all but two (Ghana and Nigeria) have been afflicted by persistent and serious civil conflicts.

CONCLUSIONS ON CHILDHOOD MORTALITY TRENDS

How then do the broad conclusions from the earlier review (Hill, 1989, 1991, 1992) of childhood mortality trends in Africa—set out briefly at the beginning of this chapter—stand up to these new data on the 1970s and 1980s for about 40 percent of mainland sub-Saharan African countries? Of the four major features found earlier—namely, almost universal mortality declines, great variation in decline, great variation in mortality levels, and a marked differential in eastern-southern and western-middle African mortality levels—only the first seems unchanged.

There appear recently to be few cases of very slow decline; either mortality did not fall at all (in a few cases) during the 1970s and 1980s, or it fell substantially. Mortality levels also appear to have come closer together, particularly at the higher end of the mortality range. Relatedly, the western and middle-eastern and southern gradient does appear to be blurring. There remains a clear distinction between the highest-mortality group of countries, which are still almost all in western and middle Africa, and the lowest-mortality group, which are still all or almost all in eastern and southern Africa. However, there is now also a noticeable bunching and overlapping between the two broad regions in the middle reaches of the mortality spectrum.

This bunching and blurring of the former gradient arises in turn from the effects of trends in countries that fall into the three classes of exceptions

[2] See Working Group on Demographic Effects of Economic and Social Reversals (1993) for an analysis of the effects on child mortality of economic change in Botswana, Ghana, Kenya, Nigeria, Senegal, Togo, and Uganda.

TABLE 5–2 Summary Trends in Childhood Mortality in Sub-Saharan African Countries with 1980s Data Sets

Country	Coale-Demeny Model Used	Date of Reference	Estimated Probability of Dying Before Age 5
Western			
Burkina Faso	South	1948.5	.421
		1956.4	.423
1963.7	.300		
1971.4	.275		
1973.2	.264		
1981.3	.212		
Côte d'Ivoire	South	1966.9	.256
		1972.4	.219
1977.0	.194		
1979.7	.164		
1984.1	.138		
The Gambia	South	1960.6	.349
		1967.0	.345
1973.4	.278		
1979.1	.240		
Ghana	South	1935.9	.371
		1948.0	.301
1955.4	.241		
1959.2	.233		
1967.1	.199		
1975.1	.178		
1980.6	.164		
1985.0	.163		
Liberia	South	1957.3	.321
		1965.6	.281
1974.0	.250		
1981.3	.242		
Mali	South	1949.9	.382
		1954.8	.377
1974.6	.336		
1979.4	.307		
1983.2	.271		
Senegal	South	1946.2	.373
		1951.6	.343
1956.2	.296		
1968.1	.289		
1974.5	.270		
1978.4	.239		
1982.9	.213		
Togo	South	1949.9	.347
		1957.2	.328
1963.5	.262		
1968.0	.227		
1976.9	.196		
1984.2	.163		

Country	Coale-Demeny Model Used	Date of Reference	Estimated Probability of Dying Before Age 5
Middle			
Zaire	North	1943.6	.287
		1951.5	.263
1973.9	.211		
1980.5	.202		
Eastern			
Burundi	South	1959.9	.270
		1966.1	.238
1970.6	.238		
1975.8	.223		
1984.0	.182		
Kenya	North	1950.5	.251
		1957.9	.219
1964.2	.192		
1967.6	.177		
1974.2	.155		
1977.7	.125		
1984.1	.096		
Malawi	South	1958.1	.367
		1964.2	.355
1972.8	.334		
1978.2	.290		
1980.9	.262		
Uganda	North	1957.1	.245
		1964.7	.202
(1976.1)	(.173)		
(1983.5)	(.188)		
Zimbabwe	North	1957.5	.162
		1964.0	.154
1971.1	.147		
1978.4	.136		
1983.4	.115		
1985.9	.092		
Southern Africa			
Botswana	South	1959.0	.177
		1967.4	.159
1970.2	.145		
1979.9	.096		
1984.4	.059		
Northern			
Sudan	South	1958.9	.223
		1964.7	.204
1969.7	.214		
1970.6	.168		
1976.0	.147		
1980.1	.146		

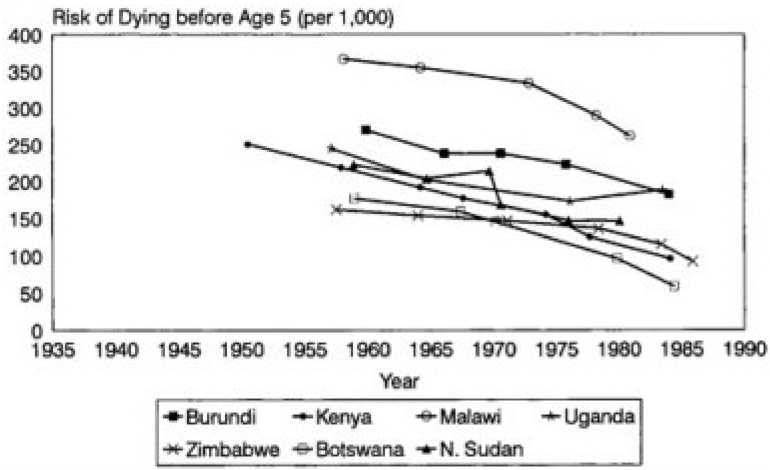


FIGURE 5–24 Risk of dying before age 5, 1935–1990, selected eastern and southern African countries. SOURCE: Table 5–2.

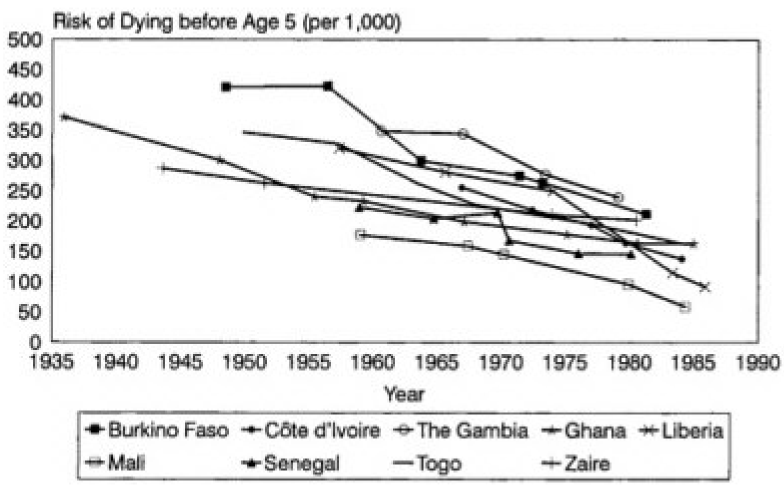


FIGURE 5–25 Risk of dying before age 5, selected western and middle African countries, 1935–1990. SOURCE: Table 5–2.

to the major four features noted in the earlier paper. These exceptions were countries experiencing periods of static or rising mortality (usually related to civil strife); countries that had crossed over from mortality levels prevalent in western and middle Africa to levels more commonplace in eastern and southern Africa; and finally, the solitary case of Malawi, an eastern country with a western mortality level.

In the first category, sadly still increasing in numbers, many such countries have been, and continue to be, located in eastern Africa, and hence as a group have retarded mortality declines in that part of the continent. In the second category, the number of crossovers has grown with the addition of (at a minimum) Togo and Côte d'Ivoire, and the maintenance of eastern and southern levels in Ghana despite its overall bottoming out of mortality decline. In the third category, Malawi's mortality has started to decline from its previous position on a plateau among the very highest even in western Africa and is now barely distinguishable from a general group of countries with high but quickly falling mortality.

It is unclear what will happen to childhood mortality in sub-Saharan Africa in the coming decades. Will the general trend toward lower mortality continue, or will a plateau be reached? As long as data collection is undertaken at national levels, these questions can be answered. If political and economic turmoil, however, make data collection difficult or impossible, these questions may not be answered until well into the next century.

APPENDIX A: SUMMARIZATION PROCESS FOR TABLE 5–2: COUNTRY NOTES

General Note on Methodology

The basic technique employed in this analysis was the Trussell variant of the Brass child survival method, as described in the U.N. Manual X (United Nations, 1983). By this method, series of the mean proportions of children ever born who have since died, as reported by women aged 15–19, 20–24, 25–29, 30–34, 35–39, 40–44, and 45–49 years, are converted into a series of probabilities of survival of children to age 1, 2, 3, 5, 10, 15, and 20 years, respectively. The older the mothers are, the longer ago their children on average were born and died, so the successive dates to which these probabilities apply can also be estimated. The method was applied, by using the AFEMOPC computer program, to all available sets of child survival data. The resulting retrospectively dated series of survival probabilities, expressed as matching levels in North and South Coale-Demeny model life tables, were graphed and evaluated for consistency and regularity, both within each data set and between data sets collected at different times. Data from mothers aged 15–19 years were not used because they are generally considered highly unreliable.

Theoretically, results from all four Coale-Demeny models (East, West, North, and South, corresponding to different age and sex patterns of mortality derived from historical data from eastern-central, northwestern, Scandinavian, and southern countries of Europe, respectively) could have been examined. However, in practice, North and South models are usually found to best fit African age patterns of mortality in childhood, because both incorporate relatively high levels of mortality between 1 and 5 years of age, a feature undoubtedly existing in most if not all African populations. They also offer extremes in terms of the trends derived from their use: West is usually close to North in this respect, and East to South. Thus, the use of North and South provides a maximum test of the robustness of estimated trends and fit of two data sets to choice of model. Confining analysis to two models also increases the degree of standardization. Thus, although there are a few countries, mainly in the extreme south of the continent, where West might perform as well or better than North and South, the analysis was restricted to results from North and South.

Good-quality data from small-scale surveys in Senegal and The Gambia have demonstrated the existence of an age pattern of mortality very different from any Coale-Demeny model. Levels of mortality in the second and third years of life are much higher than in any European pattern or indeed anywhere else in the developing world with reliable data. The risk of dying between the first and fifth birthdays may actually equal or exceed the risk of dying in infancy. The use of a model life table embodying this pattern gave a much more coherent set of trends for earlier data for Senegal (Hill, 1989, 1991, 1992) and might well improve estimates in other countries in the region. However, it is uncertain how far beyond Senegal and The Gambia this age pattern may extend, and selective use of the model would prejudice standardization of the methodology and comparability of the results. Hence, this model was not used for final estimates for Senegal in the previous paper and is not used here. To examine and compare mortality levels and trends across African countries, it is necessary to summarize the country data shown and discussed in detail in the text for each country. The normal procedure adopted for each child survival data set, if the data were sufficiently smooth and consistent, was to take an average of the three earliest data points (covering information from women aged 35 to 49 years) and the three latest data points (covering information from women aged 20 to 34 years). However, frequent deviations from the norm were necessary, and are noted and discussed below. Direct data from maternity histories were taken into account but not used directly.

Country Analyses

Botswana and Zimbabwe

For Botswana, the sources considered were the 1971 census (thought to provide data of good quality), the 1981 census (good), the 1984 CPS (fair), and the 1988 DHS direct and indirect data (fair). The direct DHS data were not used. It was difficult to select groups of points for averaging with so many overlapping trend lines. The final selection was groups of the earliest three and the latest three points from the 1971 census; the earliest three points from the 1981 census; the latest three points from the 1984 CPS; and the latest three points from the 1988 DHS indirect data (which come out very close to the latest direct data point).

For Zimbabwe, the sources considered were the 1969 census (good), the 1982 census (good), the 1984 CPS (poor), the 1987 ICDS (fair), and the 1988 DHS direct and indirect data (fair). The CPS and the direct DHS data were not used. Again there was a problem with overlapping trend lines, and also with the inconsistency of all but the most recent DHS data with earlier data sets. The final selection was groups of the earliest three and the second and third latest points from the 1969 census; the earliest three and the latest three points from the 1982 census; the latest three points from the 1987 ICDS; and the latest two points from the 1988 DHS indirect data (which come out somewhat higher than the latest direct data point).

Middle and Eastern Africa

For Burundi, the sources considered were the 1970–1971 NDS (good), the 1979 census PES (good), and the 1987 DHS direct and indirect data (fair). The DHS direct data were not used. Although using the South model gave better overall consistency between the earlier data and the DHS, it gave a rougher fit between 1970–1971 and 1979. Therefore some selection of points was required to yield a reasonably smooth trend. The following averaging of groups was done: the earliest three points from the 1970–1971 survey; the second and third latest points from 1970–1971; the two points for women aged 35 to 39 and 40 to 44 from the 1977 census; the three latest points from 1977 plus the two earliest points from the 1987 DHS; and the three latest points from 1987.

For Kenya, the sources considered were the 1962, 1969, and 1979 censuses (all good); the 1977 and 1983 NDS (fair); the 1977–1978 WFS direct and indirect data (fair); and the 1989 DHS direct and indirect data (fair). North performed better overall, particularly with regard to the censuses. The direct WFS and DHS data were not used, though they agreed reasonably well with those portions of other data sets that they overlapped. Given the number and closeness of the data sets, there was an enormous general problem of overlap; therefore, values were selected across data sets to give the smoothest trend and, in particular, to avoid the repeated upward inflection for women aged 20 to 24. It was also assumed that in general, the survey data from the older women were less reliable than those from the younger; hence these were not used. As a result of all these factors, no data were used from the 1977 NDS or the 1977–1978 WFS. The final choice of groups of points for averaging was the three earliest and the three latest points from the 1962 census; and the two points for women aged 25 to 29 and 30 to 34 from the 1969 census, the 1979 census, the 1983 NDS, and the 1989 DHS.

For Malawi, the sources considered were the 1970–1971 population change survey (PCS; poor), the 1977 census (good), the 1982 national demographic survey (good), and the direct and indirect data from the 1984 family formation survey (FFS; poor). The direct data from the 1984 FFS were not used. Again there was a problem of overlapping trend lines and inconsistency of all but the most recent FFS data. The final selection was groups of the earliest three points from the 1970–1971 PCS; the two PCS points for women aged 25 to 29 and 30 to 34 plus the two earliest 1977 census points; the three latest 1977 points; the three latest 1982 NDS points; and the two latest 1984 FFS points (which come out substantially higher than the latest direct FFS point).

For Uganda, the sources considered were the 1969 census (good) and the (southern Uganda only) 1988–1989 DHS direct and indirect data (poor). The direct DHS data were not used. North gave a better fit between the census and the DHS. Because the trends in the DHS indirect data were rather wild (and at variance with the direct data), groups of points for averaging were selected to dampen them a bit. The final choice of groups was the three earliest and the three latest points from the 1969 census; the two earliest from the 1987 DHS; and the two points for women aged 25 to 29 and 30 to 34 from the DHS.

For Zaire, the sources considered and used were the 1955 national demographic survey (fair) and the 1984 census (10 percent sample; good). There was no overlapping or inconsistency. Averaging was done for groups of the two 1955 national demographic survey points for women aged 35 to 39 and 40 to 44; and the three earliest and three latest 1984 census points.

Sudan

For Sudan, the sources considered and used were the 1973 census (good) and the 1983 census (good). The 1979 WFS and the 1989–1990 DHS were not considered because they covered northern Sudan only. It was not possible to reconcile the trends from the two censuses, though South performed better than North. Therefore, the data are summarized as two separate trend lines. For each census, averaging is done in three groups of two points each—namely, the two earliest, the two middle, and the two latest. This procedure translates the trends in the data better.

Western Africa

For Burkina Faso, the sources considered and used were the 1960–1961 rural national demographic survey (fair), the 1961 Ouagadougou demographic survey (fair), the 1976 postcensal survey (good), and the 1985 census (good). There was a problem of extreme inconsistency between the 1960–1961 surveys (weighted to produce national values—see Hill, 1989, 1991, 1992, for details) and the two censuses, which agreed extremely well. The South model performed better than the North, but still could not bridge the gap. Two separate trend lines were therefore used, the first for the 1960–1961 data and the second for the 1976 and 1985 data. Each data set was summarized by averaging the three earliest and three latest data points, and the rural and Ouagadougou results were combined to yield national values.

For Côte d'Ivoire, the sources considered were the 1978–1979 NDS (fair), the 1980–1981 WFS direct and indirect data (good), and the 1988 census (good). The 1978–1979 data were not used because they overlapped substantially with the WFS indirect data but were much rougher; neither were the direct WFS data used. The South model gave much better consistency between data sets. Groups of points chosen for averaging were three groups of two points each from the WFS, and because the WFS and census data overlapped so closely, only two groups of two points were taken, with the two earliest points from the overlapping period omitted.

For The Gambia, the sources considered and used were the 1973 census (fair) and the 1983 census (fair). The South model was better at reconciling the two sources, but there was still a worrying gap in levels at the point of overlap. The alternative of summarizing the data as two separate trend lines, as for Sudan and Burkina Faso, was considered but rejected, because the gap was neither so great as for Burkina Faso nor so at variance with internal trends as for Sudan. The selection of groups of points for averaging was aimed at smoothing over this gap as much as possible. The final choice was the three earliest points from the 1973 census; the two points for women aged 25 to 29 and 30 to 34 from 1973; the three points for women aged 30 to 34, 35 to 39, and 40 to 44 from the 1983 census; and the two latest points from 1983.

For Ghana, the sources considered were the 1948 census (poor), the 1960 census PES (poor), the 1970 census PES (good), the 1979–1980 WFS direct and indirect data (poor), and the 1988 DHS direct and indirect data (fair). The WFS data were quite inconsistent with other data sources and hence were not used; nor were the direct DHS data, though they differ little from the indirect results if the South model is used. South also gave marginally better consistency overall and was chosen; the principal difference entailed by using North instead would be a distinct rise in mortality during the 1980s, rather than the plateau given by South. The final choice of groups of points for averaging was as follows: for 1948, only the three earliest points, with the three latest omitted; for 1960 and 1970 each, two groups of the three earliest and three latest points; and for 1988, three groups of two points each, namely, the two earliest, the two middle, and the two latest.

For Liberia, the sources considered were the 1970 and 1971 rounds of the 1970–1971 population growth survey (fair), the 1974 census (poor), and the 1986 DHS direct and indirect data (fair). The 1974 census data were quite inconsistent with the other data sets and were not used. Nor were the DHS direct data, which—though generally reasonably close to the indirect—show a contrary trend for the early 1980s of continued decline rather than a stall or slight rise. The South model gave better consistency overall. An average of each of the corresponding points for 1970 and 1971 was taken (see Hill, 1989, 1991, 1992, for discussion), with the result then divided into two groups of the three earliest and three latest points for averaging to summarize. The DHS data were summarized in the same way, disguising the clear 1980s stall in the full indirect data, but the alternative of three groups of two points each yields a clear rise not visible in the South model results—or in the direct data, which show a continued decline.

For Mali, the sources considered were the 1960–1961 NDS (fair), the 1987 census (fair), and the 1987 DHS direct and indirect results (fair). South gave the best overall consistency. The DHS direct data were not used but agreed reasonably well with the indirect results. The 1987 census was not used because it agreed with neither the 1960–1961 survey nor the DHS (except around 1980). To smooth the overall trend, the earliest and latest data points from the 1960–1961 survey were not used, and averages were taken of the two points for women aged 25 to 29 and 30 to 34, and the two points for women aged 35 to 39 and 40 to 44. Data from the WFS were grouped in three groups of two points each, namely, the two earliest, the two middle, and the two latest.

For Nigeria, the sources considered were the 1981–1982 Nigeria fertility survey direct and indirect data (poor) and the 1990 Nigeria DHS direct and indirect data (fair). The WFS was not used. The DHS direct data were not used but agree well with the indirect results if a North model is used. Because the trend shown in the indirect results (a slight decline followed by a rise) could not be represented adequately by two averages of three data points each, the data were grouped into three pairs of two points each, and three averages were taken. This procedure reproduces quite well the three-point trend from the direct data, though, as discussed in the text, the most recent point may be too high because of data errors.

For Senegal, the sources considered were the 1960 NDS (good), the 1978 WFS direct and indirect data (fair), and the 1986 DHS direct and indirect data (fair). The direct data were not used but agree well overall with all the other data sets. South gave the best fit overall. To smooth the rather rough and overlapping 1978 and 1986 trend lines, some careful selection of groups of points for averaging was necessary. The final choice was three groups of two points each from the 1960 survey, namely, the two earliest, the two middle, and the two latest; the two earliest and three latest points from the 1978 WFS; and the two middle and two latest points from the 1986 DHS.

For Togo, the sources considered were the 1961 census PES (fair), the 1971 census PES (fair), and the 1988 DHS direct and indirect data (poor). The DHS direct data were not used but are mostly consistent with indirect results. The South model produced much better consistency overall, but there was still something of a gap between 1961 and 1971 trends. To smooth this, two groups for averaging of two points each for women aged, respectively, 20 to 24 plus 25 to 29, and 30 to 34 plus 35 to 39, were chosen from the 1971 data. For each of the 1961 and 1988 data sets, two groups of the three earliest and three latest points were used.

APPENDIX B

TABLE 5–B.1 Child Survival Analysis Results, Botswana

	Coale-Demeny North Model		Coale-Demeny South Model	
Data Set	Reference Date	Probability of Dying Before Age 5	Reference Date	Probability of Dying Before Age 5
1971 census	1956.77	.1637	1955.85	.1862
	1959.73	.1613	1959.05	.1786
	1962.59	.1530	1962.13	.1654
	1965.28	.1568	1965.01	.1628
	1967.66	.1617	1967.55	.1606
	1969.60	.1623	1969.60	.1525
1981 census	1966.51	.1341	1965.58	.1550
	1969.42	.1346	1968.73	.1505
	1972.22	.1276	1971.74	.1391
	1974.87	.1205	1974.58	.1257
	1977.26	.1149	1977.13	.1138
	1979.26	.1176	1979.25	.1085
1984 CPS	1969.81	.1159	1968.93	.1353
	1972.69	.1115	1972.06	.1254
	1975.38	.1237	1974.94	.1345
	1977.88	.0959	1977.61	.0996
	1980.12	.0935	1980.01	.0921
	1982.01	.1050	1982.00	.0965
1988 DHS	1975.78	.0737	1975.06	.0881
	1978.55	.0836	1978.08	.0937
	1980.80	.0775	1980.49	.0839
	1982.78	.0589	1982.58	.0607
	1984.58	.0665	1984.48	.0654
	1986.15	.0537	1986.13	.0495
	Reference Date		Equivalent Value of $q5$	
1988 DHS Direct data	1973–1977		.0886	
	1978–1982		.0598	
	1983–1988[a]		.0527	

[a]Includes deaths in 1988 up to one month before interview.

SOURCES: 1971 census (Botswana, 1972); 1981 census (Botswana, 1983); 1984 Contraceptive Prevalence Survey (CPS) (Botswana, 1985); 1988 Demographic and Health Survey (DHS) (Lesetedi et al., 1989).

TABLE 5–B.2 Child Survival Analysis Results, Zimbabwe

	Coale-Demeny North Model		Coale-Demeny South Model	
Data Set	Reference Date	Probability of Dying Before Age 5	Reference Date	Probability of Dying Before Age 5
1969 census	1954.8	.163	1954.0	.185
	1957.7	.164	1957.1	.181
	1960.4	.160	1960.0	.172
	1962.9	.155	1962.6	.161
	1965.1	.153	1965.0	.152
	1967.0	.161	1967.0	.152
1982 census	1968.3	.151	1967.4	.173
	1971.2	.147	1970.6	.162
	1973.9	.143	1973.4	.154
	1976.3	.140	1976.1	.145
	1978.5	.135	1978.4	.134
	1980.4	.134	1980.4	.125
1984 CPS	1970.3	.104	1969.5	.122
	1973.2	.097	1972.6	.109
	1975.8	.121	1975.4	.131
	1978.2	.120	1978.0	.125
	1980.4	.133	1980.3	.132
	1982.2	.087	1982.2	.079
1987 ICDS	1973.65	.1335	1972.82	.1535
	1976.56	.1329	1975.98	.1476
	1979.20	.1440	1978.81	.1550
	1981.60	.1188	1981.37	.1226
	1983.72	.1274	1983.63	.1253
	1985.47	.0996	1985.46	.0910
1988 DHS	1974.99	.0976	1974.17	.1151
	1977.89	.0925	1977.31	.1041
	1980.49	.0925	1980.10	.1005
	1982.86	.0810	1982.63	.0837
	1984.96	.0965	1984.86	.0946
	1986.71	.0867	1986.70	.0790
	Reference Date		Equivalent Value of *q*5	
1988 DHS Direct data	1973–1977		.0916	
	1978–1982		.1036	
	1983–1988[a]		.0751	

[a]Includes deaths in 1988 up to one month before interview.

SOURCES: 1969 census (Rhodesia, n.d.); 1982 census (Zimbabwe, 1985a); 1984 Contraceptive Prevalence Survey (CPS) (Zimbabwe, 1985b); 1987 Intercensal Demographic Survey (ICDS) (Zimbabwe, 1991); 1988 Demographic and Health Survey (DHS) (Zimbabwe, 1989).

TABLE 5–B.3 Child Survival Analysis Results, Mozambique

	Coale-Demeny North Model		Coale-Demeny South Model	
Data Set	Reference Date	Probability of Dying Before Age 5	Reference Date	Probability of Dying Before Age 5
1980 census	1964.86	.2532	1963.89	.2794
	1967.69	.2596	1966.97	.2819
	1970.48	.2636	1969.96	.2818
	1973.17	.2689	1972.83	.2826
	1975.64	.2746	1975.48	.2810
	1977.78	.2954	1977.75	.2929
1987 fertility survey (Maputo)	1984.87	.1013	1984.85	.0937
	1983.16	.1235	1983.04	.1226
	1981.20	.1206	1980.97	.1248
	1979.06	.1257	1978.70	.1357
	1976.70	.1206	1976.17	.1342
	1973.93	.1605	1973.14	.1814

SOURCES: 1980 census (Mozambique, n.d.); 1987 Maputo Fertility Survey (MFS) (WFS-type survey) (Mozambique, 1987).

TABLE 5–B.4 Child Survival Analysis Results, Angola

	Coale-Demeny North Model		Coale-Demeny South Model	
Data Set	Reference Date	Probability of Dying Before Age 5	Reference Date	Probability of Dying Before Age 5
1940 census	1924.06	.3299	1922.99	.3605
	1927.13	.3334	1926.29	.3606
	1930.43	.3256	1929.83	.3472
	1933.63	.3403	1933.29	.3565
	1936.44	.3625	1936.32	.3681
	1938.70	.4240	1938.71	.4227
1988 demographic-socioeconomic survey, Southwest region—rural, pastoral	1971.78	.1484	1970.70	.1716
	1974.74	.1637	1973.90	.1834
	1977.90	.1924	1977.29	.2097
	1981.00	.2121	1980.62	.2238
	1983.78	.1962	1983.63	.1981
	1986.12	.2817	1986.11	.2757
1988 demographic-socioeconomic survey, Southwest region—rural, settled population	1971.57	.1757	1970.46	.2009
	1974.57	.1921	1973.70	.2142
	1977.84	.2083	1977.21	.2268
	1981.05	.2018	1980.67	.2130
	1983.92	.2314	1983.77	.2339
	1986.29	.2861	1986.29	.2795

SOURCES: 1940 census (Heisel, 1968); 1988 rural survey (RDS) (Angola, 1990).

TABLE 5–B.5 Child Survival Analysis Results, Malawi

	Coale-Demeny North Model		Coale-Demeny South Model	
Data Set	Reference Date	Probability of Dying Before Age 5	Reference Date	Probability of Dying Before Age 5
1970–1971 population change survey—children ever born and children surviving	1957.3	.340	1956.5	.366
	1960.2	.344	1959.6	.365
	1962.8	.354	1962.4	.370
	1965.3	.339	1965.0	.352
	1967.4	.374	1967.3	.380
	1969.2	.419	1969.2	.421
1977 census	1963.1	.318	1962.2	.344
	1965.9	.324	1965.3	.345
	1968.4	.327	1968.0	.344
	1970.9	.327	1970.6	.341
	1973.1	.326	1972.9	.333
	1975.0	.328	1975.0	.328
1982 NDS	1968.5	.307	1967.6	.333
	1971.3	.308	1970.7	.329
	1973.9	.303	1973.4	.319
	1976.3	.294	1976.0	.306
	1978.4	.283	1978.3	.287
	1980.3	.282	1980.3	.277
1984 family formation survey	1970.2	.262	1970.3	.272
	1973.0	.253	1973.1	.262
	1975.6	.254	1975.6	.262
	1977.9	.242	1977.9	.238
	1980.0	.252	1980.0	.259
	1981.8	.274	1981.8	.264
	Reference Date		Equivalent Value of $q5$	
1984 family formation survey Direct data	1960–1964		.354	
	1965–1969		.313	
	1970–1974		.295	
	1975–1979		.239	

SOURCES: 1970–1971 Population Change Survey (PCS) (Malawi, 1973); 1977 census (Malawi, 1980); 1982 National Demographic Survey (NDS) and 1984 Family Formation Survey (FFS) (Malawi, 1987c).

TABLE 5–B.6 Child Survival Analysis Results, Zaire

	Coale-Demeny North Model		Coale-Demeny South Model	
Data Set	Reference Date	Probability of Dying Before Age 5	Reference Date	Probability of Dying Before Age 5
1955 NDS	1940.72	.2923	1939.74	.3196
	1943.57	.2741	1942.84	.2970
	1946.40	.2949	1945.87	.3139
	1949.13	.2790	1948.79	.2931
	1951.62	.2622	1951.46	.2676
	1953.77	.2485	1953.75	.2422
1984 census	1971.18	.2181	1970.40	.2407
	1974.00	.2120	1973.48	.2293
	1976.44	.2037	1976.08	.2162
	1978.62	.1996	1978.40	.2060
	1980.58	.1984	1980.48	.1980
	1982.26	.2093	1982.24	.2006

SOURCES: 1955 National Demographic Survey (NDS) (Romaniuk, 1968); 1984 census (Schneidman, 1990).

TABLE 5–B.7 Child Survival Analysis Results, Burundi

	Coale-Demeny North Model		Coale-Demeny South Model	
Data Set	Reference Date	Probability of Dying Before Age 5	Reference Date	Probability of Dying Before Age 5
1970–1971	1957.62	.2697	1956.90	.2922
NDS	1960.57	.2524	1967.10	.2697
	1963.06	.2367	1962.77	.2483
	1965.23	.2379	1965.08	.2430
	1967.10	.2354	1967.05	.2324
	1968.57	.1993	1968.58	.1886
1979 census	1966.82	.2218	1966.06	.2442
PES[a]	1969.74	.2353	1969.24	.2529
	1972.25	.2119	1971.93	.2239
	1974.47	.2259	1974.29	.2316
	1976.41	.2188	1976.34	.2165
	1977.97	.2286	1977.97	.2188
1987 DHS	1974.37	.2019	1973.61	.2241
	1977.35	.2073	1976.84	.2243
	1979.95	.1779	1979.63	.1889
	1982.24	.1804	1982.08	.1845
	1984.21	.1945	1984.16	.1911
	1985.76	.1800	1985.76	.1692
	Reference Date		Equivalent Value of $q5$	
1987 DHS	1972–1976		.2241	
Direct data	1977–1981		.2341	
	1982–1986[b]		.1518	

[a]Postenumeration survey.
[b]The survey year, 1987, is included.
SOURCES: 1970–1971 National Demographic Survey (NDS) (Burundi, 1974); 1979 census postenumeration survey (PES) (Burundi, 1979); 1987 Demographic and Health Survey (DHS) (Segamba et al., 1988).

TABLE 5–B.8 Child Survival Analysis Results, Uganda

	Coale-Demeny North Model		Coale-Demeny South Model	
Data Set	Reference Date	Probability of Dying Before Age 5	Reference Date	Probability of Dying Before Age 5
1969 census	1954.28	.2630	1953.34	.2889
	1957.12	.2495	1956.42	.2708
	1959.86	.2237	1959.36	.2400
	1962.47	.2135	1962.15	.2236
	1964.85	.1987	1964.70	.2008
	1966.91	.1945	1966.89	.1863
1988–1989 DHS[a]	1974.71	.1755	1973.87	.1977
	1977.54	.1702	1976.95	.1868
	1980.09	.1651	1979.68	.1773
	1982.43	.1828	1982.17	.1897
	1984.55	.1922	1984.43	.1926
	1986.37	.2228	1986.35	.2148
	Reference Date		Equivalent Value of $q5$	
1988–1989 DHS[a]	1973–1977		.1796	
Direct data	1978–1982		.1999	
	1983–1988[b]		.1804	

[a]DHS data refer only to southern Uganda.
[b]Includes calendar year 1988 up to the month preceding the date of interview.
SOURCES: 1969 census (Uganda, 1969); 1988–1989 Demographic and Health Survey (DHS) (Kaijuka et al., 1989).

TABLE 5–B.9 Child Survival Analysis Results, Kenya

	Coale-Demeny North Model		Coale-Demeny South Model	
Data Set	Reference Date	Probability of Dying Before Age 5	Reference Date	Probability of Dying Before Age 5
1962 census	1947.71	.2579	1946.80	.2831
	1950.55	.2546	1949.90	.2753
	1953.24	.2392	1952.77	.2551
	1955.76	.2285	1955.47	.2383
	1958.05	.2171	1957.92	.2187
	1960.02	.2100	1960.00	.2016
1969 census	1955.07	.2320	1954.19	.2563
	1957.94	.2179	1957.31	.2371
	1960.59	.2068	1960.15	.2211
	1963.07	.1962	1962.80	.2039
	1965.30	.1869	1965.18	.1872
	1967.19	.1853	1967.17	.1764
1977 national demographic survey	1962.77	.1874	1961.92	.2101
	1965.63	.1735	1965.03	.1905
	1968.25	.1598	1967.83	.1718
	1970.65	.1550	1970.40	.1607
	1972.82	.1353	1972.70	.1342
	1974.65	.1377	1974.63	.1285
1977–1978 WFS	1963.82	.1795	1962.98	.2017
	1966.66	.1577	1966.08	.1737
	1969.22	.1579	1968.82	.1696
	1971.56	.1547	1971.31	.1602
	1973.66	.1562	1973.55	.1556
	1975.45	.1643	1975.44	.1556
1979 census	1964.77	.1893	1963.87	.2129
	1967.67	.1773	1967.01	.1953
	1970.43	.1641	1969.96	.1770
	1973.01	.1601	1972.73	.1666
	1975.33	.1506	1975.21	.1502
	1977.29	.1589	1977.27	.1498
1983 national demographic survey	1968.58	.1519	1967.71	.1733
	1971.47	.1427	1970.85	.1583
	1974.15	.1330	1973.72	.1440
	1976.63	.1290	1976.37	.1339
	1978.85	.1201	1978.74	.1186
	1980.71	.1275	1980.70	.1183

	Coale-Demeny North Model		Coale-Demeny South Model	
Data Set	Reference Date	Probability of Dying Before Age 5	Reference Date	Probability of Dying Before Age 5
1989 DHS	1975.58	.1071	1974.79	.1252
	1978.42	.0953	1977.88	.1069
	1980.89	.0969	1980.53	.1051
	1983.11	.1039	1982.89	.1072
	1985.11	.0888	1985.01	.0871
	1986.79	.1131	1986.78	.1043
	Reference Date		Equivalent Value of $q5$	
1989 DHS	1974–1978		.1055	
Direct data	1979–1983	.0931		
	1984–1989[a]	.0892		
1977–1978	1958–1963	.201		
WFS	1963–1968	.167		
Direct data	1968–1973	.164		
	1973–1978	.142		

[a]Includes calendar year 1989 up to the month preceding the date of interview.

SOURCES: 1962 census (Kenya, 1962); 1969 census (Kenya, 1969); 1977 National Demographic Survey (NDS) (Kenya, 1980); 1977–1978 World Fertility Survey (WFS-indirect) (Kenya, 1980); World Fertility Survey (WFS-direct) (Rutstein, 1983); 1979 census (unpublished data); 1983 National Demographic Survey (NDS) (unpublished data); 1989 Demographic and Health Survey (DHS) (Kenya, 1989).

TABLE 5–B.10 Child Survival Analysis Results, Sudan

	Coale-Demeny North Model		Coale-Demeny South Model	
Data Set	Reference Date	Probability of Dying Before Age 5	Reference Date	Probability of Dying Before Age 5
1973 census, national	1958.22	.2016	1957.31	.2256
	1961.09	.2009	1960.42	.2203
	1963.82	.1886	1963.35	.2030
	1966.40	.1966	1966.10	.2051
	1968.73	.2036	1968.60	.2048
	1970.72	.2310	1970.70	.2230
1973 census, northern Sudan	1958.52	.1807	1957.63	.2036
	1961.38	.1815	1960.73	.1997
	1964.04	.1675	1963.59	.1804
	1966.54	.1701	1966.26	.1771
	1968.80	.1713	1968.67	.1717
	1970.73	.1946	1970.71	.1859
1979 WFS[a] household survey	1965.15	.1303	1964.32	.1502
	1968.07	.1529	1967.48	.1687
	1970.72	.1386	1970.32	.1493
	1973.13	.1534	1972.90	.1584
	1975.26	.1502	1975.17	.1486
	1977.01	.1782	1977.01	.1685
1979 WFS[a] individual survey	1964.53	.1380	1963.64	.1588
	1967.49	.1360	1966.84	.1516
	1970.30	.1369	1969.86	.1482
	1972.92	.1381	1972.66	.1430
	1975.22	.1348	1975.12	.1328
	1977.10	.2178	1977.10	.2075
1983 census	1969.84	.1469	1969.07	.1671
	1972.70	.1540	1972.18	.1690
	1975.16	.1383	1974.81	.1484
	1977.35	.1417	1977.14	.1458
	1979.29	.1438	1979.21	.1420
	1980.92	.1585	1980.91	.1494
1989–1990 DHS[a]	1977.66	.1212	1977.02	.1391
	1980.16	.1527	1979.80	.1662
	1981.91	.1332	1981.64	.1424
	1983.39	.1467	1983.18	.1519
	1984.87	.1384	1984.71	.1398
	1986.36	.1102	1986.30	.1046

	Coale-Demeny North Model		Coale-Demeny South Model	
Data Set	Reference Date	Probability of Dying Before Age 5	Reference Date	Probability of Dying Before Age 5
	Reference Date		Equivalent Value of *q*5	
1989–1990 DHS[a]	1975–1979		.1431	
Direct data	1980–1984		.1468	
	1985–1990[b]		.1234	
1978–1979 WFS[a]	1965–1969		.1428	
Direct data	1970–1974		.1359	
	1975–1979		.1473	

[a]WFS and DHS data for Sudan refer only to northern Sudan.
[b]Includes calendar year 1990 up to the month preceding the date of interview.
SOURCES: 1973 census (Sudan, n.d.); 1979 World Fertility Survey (WFS) (Sudan, 1982); 1989 Demographic and Health Survey (DHS) (Sudan, 1991).

TABLE 5–B.11 Child Survival Analysis Results, Senegal

	Coale-Demeny North Model		Coale-Demeny South Model	
Data Set	Reference Date	Probability of Dying Before Age 5	Reference Date	Probability of Dying Before Age 5
1960 survey	1945.58	.3472	1944.71	.3733
	1948.33	.3513	1947.71	.3728
	1950.83	.3300	1950.38	.3471
	1953.17	.3243	1952.88	.3389
	1955.35	.2984	1955.19	.3061
	1957.29	.2881	1957.25	.2865
1978 WFS	1965.98	.2548	1965.28	.2769
	1968.75	.2865	1968.31	.3034
	1970.97	.2751	1970.68	.2872
	1972.91	.2583	1972.72	.2656
	1974.66	.2736	1974.56	.2754
	1976.18	.2735	1976.16	.2689
1986 DHS	1972.15	.2282	1971.31	.2519
	1974.99	.2356	1974.39	.2547
	1977.56	.2438	1977.14	.2585
	1979.92	.2107	1979.67	.2187
	1982.06	.2172	1981.95	.2180
	1983.90	.2170	1983.88	.2085
	Reference Date		Equivalent Value of $q5$	
1986 DHS	1971–1975		.2870	
Direct data	1976–1980	.2363		
	1981–1985[a]	.1908		
1978 WFS	1950–1954	.292		
Direct data	1955–1959	.277		
	1960–1964	.282		
	1965–1969	.284		
	1970–1974	.264		
	1975–1977	.167		

[a]The survey year, 1986, is included.

SOURCES: 1960 National Demographic Survey (NDS) (Verrière, n.d.); 1978 World Fertility Survey (WFS-direct) (Rutstein, 1983); World Fertility Survey (WFS-indirect) (Ewbank, 1985); 1986 Demographic and Health Survey (DHS) (Ndiaye et al., 1988).

TABLE 5–B.12 Child Survival Analysis Results, Mali

	Coale-Demeny North Model		Coale-Demeny South Model	
Data Set	Reference Date	Probability of Dying Before Age 5	Reference Date	Probability of Dying Before Age 5
1960–1961 NDS	1946.49	.3454	1945.65	.3709
	1949.23	.3611	1948.64	.3819
	1951.67	.3651	1951.24	.3820
	1953.93	.3635	1953.65	.3792
	1956.04	.3643	1955.89	.3750
	1957.91	.3481	1957.88	.3505
1987 DHS	1973.88	.3184	1973.12	.3417
	1976.54	.3131	1976.04	.3311
	1978.70	.3014	1978.35	.3151
	1980.65	.2880	1980.40	.2991
	1982.49	.2588	1982.34	.2639
	1984.19	.2786	1984.15	.2778
1987 census	1972.63	.2800	1971.76	.3050
	1975.44	.2917	1974.81	.3122
	1978.00	.3008	1977.56	.3171
	1980.41	.2981	1980.12	.3108
	1982.61	.2892	1982.47	.2949
	1984.52	.2980	1984.50	.2957
	Reference Date		Equivalent Value of $q5$	
1987 DHS Direct data	1972–1976		.360	
	1977–1981		.311	
	1982–1986[a]		.249	

[a]The survey year, 1987, is included.

SOURCES: 1960–1961 National Demographic Survey (NDS) (Mali, n.d.); 1987 Demographic and Health Survey (DHS) (Traoré et al., 1989); 1987 census (unpublished data).

TABLE 5–B.13 Child Survival Analysis Results, Burkina Faso

	Coale-Demeny North Model		Coale-Demeny South Model	
Data Set	Reference Date	Probability of Dying Before Age 5	Reference Date	Probability of Dying Before Age 5
1960–1961 rural national demographic survey	1946.36	.3933	1945.47	.4204
	1949.22	.4063	1948.59	.4288
	1951.90	.4060	1951.45	.4238
	1954.39	.4025	1954.12	.4185
	1956.64	.4210	1956.52	.4311
	1958.55	.4307	1958.53	.4346
1961 Ougadougou survey	1947.99	.2561	1947.22	.2790
	1950.55	.2591	1950.04	.2771
	1952.61	.2588	1952.23	.2732
	1954.49	.2618	1954.21	.2736
	1956.33	.2279	1956.15	.2342
	1958.12	.1900	1958.06	.1864
1975 census PES[a]	1961.61	.2856	1960.74	.3108
	1964.44	.2804	1963.81	.3010
	1967.04	.2718	1966.59	.2878
	1969.46	.2754	1969.18	.2868
	1971.67	.2687	1971.54	.2728
	1973.58	.2700	1973.56	.2650
1985 census	1971.00	.2503	1970.09	.2755
	1973.89	.2504	1973.22	.2712
	1976.64	.2309	1976.17	.2466
	1979.23	.2034	1978.95	.2119
	1981.57	.2114	1981.44	.2123
	1983.54	.2204	1983.52	.2116

[a]Postenumeration survey.

SOURCES: 1960–1961 rural survey and 1975 census (Burkina Faso, 1981); 1961 Ougadougou (Burkina Faso, n.d.); 1985 census (unpublished data).

TABLE 5–B.14 Child Survival Analysis Results, The Gambia

	Coale-Demeny North Model		Coale-Demeny South Model	
Data Set	Reference Date	Probability of Dying Before Age 5	Reference Date	Probability of Dying Before Age 5
1973 census	1958.55	.3232	1957.68	.3489
	1961.31	.3344	1960.69	.3556
	1963.81	.3256	1963.36	.3425
	1966.15	.3367	1965.85	.3518
	1968.32	.3296	1968.17	.3387
	1970.26	.3363	1970.23	.3377
1983 census	1968.70	.2605	1967.84	.2849
	1971.43	.2740	1970.82	.2941
	1973.87	.2555	1973.43	.2712
	1976.15	.2581	1975.86	.2697
	1978.29	.2445	1978.13	.2495
	1980.20	.2356	1980.17	.2305

SOURCES: 1973 census (The Gambia, 1976); 1983 census (The Gambia, 1987).

TABLE 5–B.15 Child Survival Analysis Results, Ghana

	Coale-Demeny North Model		Coale-Demeny South Model	
Data Set	Reference Date	Probability of Dying Before Age 5	Reference Date	Probability of Dying Before Age 5
1948 census	1934.00	.3555	1933.21	.3800
	1936.64	.3432	1936.10	.3624
	1938.84	.3543	1938.45	.3700
	1940.86	.3321	1940.58	.3467
	1942.80	.2915	1942.63	.3004
	1944.61	.2483	1944.56	.2460
1960 census	1945.99	.2632	1945.14	.2876
PES[a]	1948.75	.3242	1948.16	.3446
	1951.22	.2541	1950.80	.2693
	1953.52	.2453	1953.24	.2555
	1955.63	.2391	1955.49	.2426
	1957.50	.2310	1957.47	.2247
1970 census	1957.02	.2196	1956.14	.2436
PES[a]	1959.91	.2141	1959.28	.2333
	1962.61	.2076	1962.17	.2219
	1965.13	.2082	1964.86	.2162
	1967.38	.1981	1967.26	.1982
	1969.27	.1918	1969.26	.1826
1979–1980 WFS	1964.98	.1488	1964.09	.1702
	1967.87	.1369	1967.22	.1524
	1970.58	.1232	1970.13	.1341
	1973.11	.1280	1972.84	.1331
	1975.38	.1254	1975.27	.1242
	1977.30	.1507	1977.29	.1417
1988 DHS	1974.34	.1679	1973.52	.1895
	1977.20	.1513	1976.63	.1668
	1979.75	.1499	1979.36	.1611
	1982.07	.1613	1981.83	.1668
	1984.15	.1613	1984.04	.1605
	1985.90	.1751	1985.89	.1662
	Reference Date		Equivalent Value of $q5$	
1988 DHS Direct data	1973–1977		.1872	
	1978–1982		.1524	
	1983–1987[b]		.1547	

	Coale-Demeny North Model		Coale-Demeny South Model	
Data Set	Reference Date	Probability of Dying Before Age 5	Reference Date	Probability of Dying Before Age 5
1979–1980 WFS	1949–1953		.213	
Direct data	1954–1958		.172	
	1959–1963		.145	
	1964–1968		.148	
	1969–1973		.118	
	1974–1978		–	

[a]Postenumeration survey.
[b]Includes exposure during 1988 up to the month preceding the interview.
SOURCES: 1948 census (Ghana, 1948); 1960 census postenumeration survey (PES) (Gaisie, 1969); 1970 census postenumeration survey (PES) (Ramachandran, 1979); 1979–1980 World Fertility Survey (WFS) (Owusu, 1984); 1988 Demographic and Health Survey (DHS) (Ghana, 1989).

TABLE 5–B.16 Child Survival Analysis Results, Togo

	Coale-Demeny North Model		Coale-Demeny South Model	
Data Set	Reference Date	Probability of Dying Before Age 5	Reference Date	Probability of Dying Before Age 5
1961 census	1947.82	.3334	1947.01	.3582
PES[a]	1950.64	.3188	1950.08	.3383
	1953.12	.3282	1952.73	.3431
	1955.37	.3249	1955.13	.3365
	1957.42	.3271	1957.30	.3325
	1959.18	.3171	1959.16	.3150
1971 census	1957.18	.2759	1956.34	.3003
PES[a]	1960.04	.2636	1959.45	.2832
	1962.64	.2596	1962.23	.2743
	1965.02	.2414	1964.77	.2501
	1967.16	.2423	1967.05	.2433
	1968.96	.2190	1968.95	.2101
1988 DHS	1974.72	.1781	1973.90	.2001
	1977.57	.1875	1977.00	.2047
	1980.09	.1717	1979.70	.1837
	1982.39	.1808	1982.15	.1870
	1984.46	.1558	1984.36	.1551
	1986.22	.1560	1986.21	.1473
	Reference Date		Equivalent Value of $q5$	
1988 DHS	1973–1977		.2056	
Direct data	1978–1982		.1590	
	1983–1988		.1582	

[a]Postenumeration survey.

SOURCES: 1961 census postenumeration survey (PES) (United Nations, 1978); 1971 census postenumeration survey (PES) (Adognon, 1980); 1988 Demographic and Health Survey (DHS) (Agounké et al., 1989).

TABLE 5–B.17 Child Survival Analysis Results, Côte d'Ivoire

	Coale-Demeny North Model		Coale-Demeny South Model	
Data Set	Reference Date	Probability of Dying Before Age 5	Reference Date	Probability of Dying Before Age 5
1978–1979 multiround NDS	1964.50	.2557	1963.70	.2790
	1967.19	.2513	1966.65	.2696
	1969.47	.2390	1969.09	.2531
	1971.55	.2773	1971.29	.2885
	1973.51	.2158	1973.36	.2187
	1975.28	.2016	1975.25	.1954
1980–1981 WFS	1966.21	.2433	1965.33	.2677
	1968.99	.2248	1968.37	.2441
	1971.53	.2127	1971.08	.2275
	1973.91	.2018	1973.62	.2107
	1976.10	.2018	1975.96	.2040
	1978.03	.1919	1978.00	.1843
1988 census	1973.75	.1859	1972.91	.2085
	1976.48	.1792	1975.89	.1963
	1978.91	.1612	1978.48	.1735
	1981.16	.1481	1980.87	.1545
	1983.26	.1394	1983.11	.1402
	1985.14	.1428	1985.11	.1355
	Reference Date		Equivalent Value of $q5$	
1980–1981 WFS Direct data	1960–1964		.287	
	1965–1969		.255	
	1970–1974		.243	
	1975–1979		.176	

SOURCES: 1978–1979 National Demographic Survey (NDS) (Côte d'Ivoire, n.d.); 1980–1981 World Fertility Survey (WFS) (Côte d'Ivoire, 1984); 1988 census (unpublished data).

TABLE 5–B.18 Child Survival Analysis Results, Liberia

	Coale-Demeny North Model		Coale-Demeny South Model	
Data Set	Reference Date	Probability of Dying Before Age 5	Reference Date	Probability of Dying Before Age 5
1970 NDS, round one	1953.72	.3089	1952.66	.3384
	1956.57	.2915	1955.75	.3169
	1959.56	.2622	1958.95	.2829
	1962.52	.2509	1962.12	.2660
	1965.23	.2638	1965.05	.2715
	1967.60	.2840	1967.57	.2809
1971 NDS, round two	1956.70	.3289	1955.81	.3550
	1959.46	.3029	1958.83	.3238
	1961.99	.2919	1961.54	.3085
	1964.37	.2953	1964.07	.3086
	1966.58	.2775	1966.42	.2839
	1968.53	.2802	1968.50	.2776
1974 census	1959.79	.2376	1958.91	.2620
	1962.48	.2400	1961.85	.2600
	1964.92	.2240	1964.45	.2397
	1967.23	.2234	1966.91	.2345
	1969.41	.2081	1969.23	.2127
	1971.41	.1777	1971.37	.1719
1986 DHS	1972.01	.2372	1971.17	.2610
	1974.76	.2211	1974.17	.2397
	1977.20	.2344	1976.78	.2491
	1979.45	.2194	1979.18	.2285
	1981.54	.2486	1981.40	.2526
	1983.40	.2501	1983.36	.2451
	Reference Date		Equivalent Value of $q5$	
1986 DHS Direct data	1971–1975		.275	
	1976–1980		.243	
	1981–1986		.220	

SOURCES: 1970–1971 National Demographic Survey (NDS) (Massalee, 1974; United Nations, 1978); 1974 census (Liberia, 1977); 1986 Demographic and Health Survey (DHS) (Cheih-Johnson et al., 1988).

TABLE 5–B.19 Child Survival Analysis Results, Nigeria

	Coale-Demeny North Model		Coale-Demeny South Model	
Data Set	Reference Date	Probability of Dying Before Age 5	Reference Date	Probability of Dying Before Age 5
1981–1982 WFS	1966.92	.1729	1965.97	.1961
	1969.81	.1778	1969.10	.1964
	1972.63	.1570	1972.12	.1703
	1975.31	.1427	1975.00	.1492
	1977.74	.1596	1977.60	.1601
	1979.80	.1876	1979.78	.1787
1990 DHS	1976.83	.1974	1976.04	.2197
	1979.64	.1972	1979.10	.2143
	1982.05	.1979	1981.68	.2105
	1984.23	.1862	1981.00	.1926
	1986.21	.1937	1986.10	.1939
	1987.92	.2228	1987.89	.2149
	Reference Date		Equivalent Value of $q5$	
1990 DHS Direct data	1975.5–1980.5		.2009	
	1980.5–1985.5		.1891	
	1985.5–1990.5		.1924	

SOURCES: 1981–1982 World Fertility Survey (WFS) (unpublished data); 1990 Demographic and Health Survey (DHS) (Nigeria, 1992).

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6

Adult Mortality

Ian M.Timæus

INTRODUCTION

The aim of this chapter is to provide a largely descriptive account of levels, trends, and patterns of adult mortality in sub-Saharan Africa. A very incomplete picture emerges. Both the coverage and the accuracy of the data on which the chapter draws are far more limited than those for other components of African population dynamics such as child mortality or fertility. No data at all exist for most of the population of the region, and representative information on causes of death in adulthood is available from only a handful of studies of relatively small populations. Furthermore, very little information about the effect of the AIDS epidemic on national populations is yet available.

The shortage of data on adult mortality in sub-Saharan Africa largely reflects the inadequacy of vital registration systems, combined with the technical limitations of the methods that can be used to investigate the subject retrospectively (Timæus, 1991a). In addition, a substantial proportion of what we know about the demography of Africa derives from fertility surveys or from longitudinal studies mounted to investigate child health. Both types of inquiry usually cover too small a sample to be used to mea

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sure adult mortality directly, and many of them have failed to collect data that can be used to estimate adult mortality indirectly.

Adults tend to die of different diseases from children, and evidence has accumulated that neither the level of—nor the trend in—adult mortality is closely associated with child mortality (Murray et al., 1992). Thus, it is necessary to investigate adult mortality in Africa to provide a sound basis for the population estimates and projections that underlie planning in any sector. Evidence that adult mortality has stagnated at a high level in some countries (e.g., Timæus, 1984) further suggests that adult ill health is not an issue that can be left to look after itself. Equity and efficiency in health planning require consideration of the health problems of the poor throughout their lives.

Against this background, this chapter attempts, to examine adult mortality in sub-Saharan Africa and the extent of the public health problem that such mortality poses. Given the limited knowledge of the subject, three questions seem of central interest. First, how does adult mortality in sub-Saharan Africa compare with other continents? Second, how does the mortality of adults compare with that of children? Third, are there distinctive variations in adult mortality patterns across Africa that raise issues for further investigation?

SOURCES OF DATA

The difficulties involved in measuring adult mortality in developing countries and the deficiencies of the data available on sub-Saharan Africa are well known to most demographers. The only mainland country south of the Sahara that has a civil registration system with sufficient deaths reported for it to be possible to use the national data to estimate adult mortality is South Africa. Even in this country the statistics exclude the four nominally independent “homelands” and are incomplete (though amenable to adjustment) for that part of the rest of the population that is not “White.”[1] Although registration of adult deaths is more complete locally, particularly in some major cities, few such data have been published. Thus, nearly all of the estimates of adult mortality that can be made for sub-Saharan Africa derive from census or survey data.

Useful information can be culled from a variety of sources, including national censuses, the Population Growth Estimation surveys of the early 1970s, the World Fertility Surveys (WFS), and the Demographic and Health Surveys (DHS), as well as other inquiries mounted by the statistical organi

[1]“White,” “Colored,” “Asian,” and “Black” are legal statuses defined in South African apartheid legislation and used in South African official statistics.

zations of particular countries. Unfortunately, there has been little growth in the availability of reasonably up-to-date information on adult mortality in sub-Saharan Africa during the last 15 years. Information from the 1980 round of censuses and from Phase I of the DHS is available for about the same number of countries as from the 1970 round of censuses and the WFS. Moreover, although the core questionnaire for Phase I of the DHS program included pertinent questions about survival of parents, these have been left out of the Phase II questionnaire. Similarly, a few countries that collected data about adult mortality in their 1980-round census failed to do so in their 1990-round census. Such decisions not to build on earlier efforts are regrettable. Even if the data on adult mortality obtained in an initial inquiry proved difficult to interpret, those on orphanhood, in particular, become much more useful once they have been collected repeatedly.

A second limitation of the available information is that even in those countries that collect adult mortality data in their censuses, processing and publication of the results often take an inordinate length of time. Almost no information is available from the 1990 round of censuses at present, and some data collected in the 1980 round of censuses, including the orphanhood data from the 1985 census of Sierra Leone and 1986 census of Lesotho, could not be obtained for this study. Thus, although data have been collected to update—by a decade—many of the estimates presented here for the mid-1970s, it may be impossible to do the actual updating for several more years.

Lack of data means that it is impossible to arrive at well-founded national estimates of adult mortality in many countries for any point during the 1970s or 1980s. All the different forms of information that can be used to measure adult mortality were considered during the preparation of this chapter, and some of the estimates presented are based on very inadequate data. Even with this catholic approach, the results cover only 24 countries and exclude several populous nations such as Nigeria, Ethiopia, and Zaire. In total, they refer to only about 40 percent of sub-Saharan Africa's population.

METHODS OF ANALYSIS

The methods that can be used to estimate adult mortality in the absence of adequate vital registration have been reviewed in detail recently (Timæus, 1991a) and are discussed only briefly here. Examples illustrating these methods are supplied in the appendix to this chapter.

The main source of direct estimates is retrospective questions about recent deaths in the household posed in censuses and single-round surveys. Such data are the primary source of information used to produce estimates for nine of the countries listed in Table 6–1: Mali, Togo, Cameroon, Congo, Madagascar, Rwanda, Tanzania, Botswana, and Lesotho. Such questions have been included in many more national inquiries, but the results have frequently been disappointing. Often it is manifest that only a small minority of deaths have been reported. The data appear complete in only a few instances. Nevertheless, a range of techniques exists that can be used to assess such data and, in favorable circumstances, to adjust them for underreporting. The crucial assumption is that the degree of underreporting is the same at all adult ages. Of these techniques, those proposed by Brass (1975), Preston et al. (1980), and Bennett and Horiuchi (1981) were used to evaluate the data presented in this chapter. On this basis, reporting is taken as complete in six countries.[2] In Mali, only about half the deaths, and in Togo slightly more than half, were reported. In Congo, only about one-third of men's deaths and one-fifth of women's deaths seem to have been reported.

A second source of direct estimates of adult mortality is the multiround demographic surveys that have been conducted in several sub-Saharan countries. The results of many of these studies are now rather out-of-date, but they are the main sources used for three of the countries in Table 6–1—Côte d'Ivoire, Liberia, and Senegal. In all three, reporting has been accepted as complete.[3]

An additional source of adult mortality estimates for Africa is the information obtained from retrospective questions about the survival of respondents' mothers, fathers (Brass and Hill, 1973), and spouses (Hill, 1977). Information on orphanhood has been collected more frequently than that on widowhood and has usually yielded better results. The estimates that result are somewhat out-of-date and, like direct estimates, can be biased by reporting errors. Such data are the primary basis for the remaining 11 sets of national estimates presented here (Benin, The Gambia, Ghana, Mauritania, Sierra Leone, Burundi, Kenya, Malawi, northern Sudan, Zimbabwe, and Swaziland) and provide important support for estimates based on recent deaths in five other countries, namely, Mali, Cameroon, Congo, Tanzania, and Lesotho. The basic orphanhood estimates were calculated by using the variant of the method proposed by Timæus (1992). Brass and Bamgboye's (1981) method was used to determine the time reference of the results.

[2]Some of these data exhibit signs of having been adjusted already, without it being documented in the sources from which they were obtained for this study.

[3]Only summary measures of e_{15}—the number of years that a person who survives to age 15 can expect to live—have been published for Senegal, so reevaluation of the data was impossible and ${}_{45}p_{15}$—the probability of surviving from exact age 15 to exact age 60—had to be inferred from a model life table. It has been suggested that, if anything, the level of adult mortality is overstated (Cantrelle et al., 1986). In Côte d'Ivoire, the original survey study (Ahonzo et al., 1984) concluded that the reports of adult deaths were incomplete. My reevaluation of the results leads to a different conclusion.

TABLE 6–1 Survivorship from Age 15 to Age 60 by Sex, 1970s and 1980s

		$_{45}P_{15}$				
Region and Country	Date	Males	Females	Both Sexes	Reliability	Source
Western						
Benin	1978	.749	.779	.764	Very low	Orphanhood
Côte d'Ivoire	1978–1979	.646	.741	.694	Fair	Multiround survey
The Gambia	1978	.773	.812	.793	Fair	Intercensal orphanhood
Ghana	1982	.778	.880	.830	Low	Orphanhood since marriage
Liberia	1970–1971	.550	.584	.567	Fair	Multiround survey
Mali	1986	.579	.541	.560	Low	Recent deaths and orphanhood
Mauritania	1980	.782	.823	.803	Fair	Orphanhood and recent deaths
Senegal	1978	.652	.710	.682	Fair	Multiround surveys
Sierra Leone	1974	.466	.510	.488	Very low	Orphanhood
Togo	1981	.704	.760	.733	Very low	Recent deaths
Middle						
Cameroon	1976	.644	.666	.654	Low	Recent deaths and orphanhood
Congo	1984	.656	.703	.680	Very low	Recent deaths and orphanhood
Eastern						
Burundi	1981	.622	.699	.661	Low	Orphanhood since marriage
Kenya	1974	.714	.769	.742	Fair	Intercensal orphanhood
Madagascar	1974–1975	.487	.551	.518	Very low	Recent deaths
Malawi	1977	.741	.706	.723	Low	Intersurvey orphanhood
Rwanda	1978	.584	.629	.607	Low	Recent deaths
Tanzania	1988	.656	.675	.666	Very low	Recent deaths and orphanhood
Zimbabwe	1978	.801	.863	.833	Very low	Orphanhood

Southern						
Botswana	1980	.555	.732	.646	Low	Recent deaths
Lesotho	1976	.503	.749	.627	Fair	Recent deaths and orphanhood
South Africa	1985	.638	.766	.702	Fair	Vital registration
Swaziland	1981	.561	.761	.663	Fair	Intercensal orphanhood
Northern						
Sudan (northern)	1975	.695	.768	.732	Fair	Orphanhood and widowhood

SOURCES: Data from Benin (Benin, n.d.); Côte d'Ivoire (Ahonzo et al., 1984); The Gambia (Blacker and Mukiza-Gapere, 1988); Ghana and Senegal (Timæus, 1991d); Liberia, Madagascar and Rwanda (Waltisperger and Rabetsitonta, 1988b); Mali (Mali, 1980 and provisional 1987 census tables); Mauritania (Timæus, 1987); Sierra Leone (Okoye, 1980); Togo (Togo, 1985); Cameroon (Cameroon, 1978, 1983); Congo (Congo, 1978, 1987); Burundi (Timæus, 1991c); Kenya (Mukiza-Gapere, 1989); Malawi (Timæus, 1991b); northern Sudan (Sudan, 1982); Tanzania (Tanzania, 1982 and provisional 1988 census tables); Zimbabwe (Zimbabwe, 1985); Botswana (Botswana, 1972, 1983); Lesotho (Timæus, 1984); South Africa (South Africa, 1988); Swaziland (Swaziland, 1980 and unpublished 1986 census tables).

In countries where more than one set of orphanhood data exists, it is possible to calculate more recent and reliable estimates by basing them on changes in orphanhood in adulthood between two inquiries (Timæus, 1991b). This approach was adopted in four countries: The Gambia, Kenya, Malawi, and Swaziland. In addition, several recent DHS surveys have asked whether deceased parents died before or after the respondent married. This information can also be used to produce more recent and reliable results than are obtained from the basic orphanhood method (Timæus, 1991c). The technique was used to produce the estimates for Ghana and Burundi, and to confirm the results of the multiround surveys in Senegal.

One set of techniques for estimating adult mortality that could not be used to produce any estimates represents those based on intercensal survival and growth. In an attempt to increase the scope of the results, the integrated intercensal growth method (Preston, 1983) was applied to data from several countries. It yielded very erratic and implausible results. As one might expect, poor age reporting, high levels of international migration, and changes in census coverage combine to render such techniques useless in most African countries.

Estimating adult mortality from African data involves a large element of judgment. Most of the results presented are based on data that have been subjected to some form of smoothing and adjustment. Decisions not to adjust certain data are to some extent arbitrary.[4] Moreover, on the principle that estimates that are largely guesses are to be preferred to those that are complete guesses, results have been presented even for countries where the data are very difficult to interpret. Thus, none of the results is definitely accurate. The estimates obtained from the registration data for South Africa, multiround surveys, and several different sources of data that yield reasonably consistent results are assumed to be fairly reliable. The estimates are judged of low reliability in countries where different sources of data yield less consistent results; where only a single set of recent data on deaths exists, but it appears reasonably complete; or where the partitioning of the data on orphanhood into deaths before and after the respondent's marriage provides a partial check on the results. Finally, the reliability of the estimates for countries in which only a single set of incomplete recent death data or orphanhood data is available must be considered very low. This category of estimates also includes those for Congo and Tanzania. Several sources of data exist for these two countries, but they yield inconsistent results and are difficult to interpret.

[4]The mortality rates obtained from direct data on adult deaths were smoothed by fitting a two-parameter logit model life table based on the general standard (Brass, 1971) to observed survivorship from age 15. Time series of indirect estimates were smoothed by fitting regression lines, excluding any obviously discrepant points for extreme age groups.

ADULT MORTALITY LEVELS

Estimates of adult mortality in the 24 countries for which information is available are shown in Table 6–1. Only data for 1970 or later are presented and the figures are the most recent available. Four of the estimates refer to the first half of the 1970s, ten to the late 1970s, and ten to the 1980s. The index presented is life table survivorship from exact age 15 years to exact age 60 years (${}_{45}p_{15}$). It can be interpreted as the probability of surviving to old age, subject to surviving childhood, at the prevailing level of mortality. Unlike measures of life expectancy, survivorship from 15 to 60 years can be calculated without making assumptions about old-age mortality. It is the complement of the probability of dying between ages 15 and 60 (${}_{45}q_{15}$), which has been adopted in a recent World Bank volume as the preferred index of adult mortality (Feachem et al., 1992).

Perhaps the most striking feature of the results shown in Table 6–1 is that large differences exist in the level of adult mortality between different African countries. These estimates suggest that in Benin and The Gambia, more than 75 percent of those aged 15 would survive to their 60th birthday at the levels of mortality prevailing around 1980. In Ghana, Mauritania, and Zimbabwe, the equivalent figure is more than 80 percent. These figures represent moderate adult mortality by world standards. For example, survivorship from 15 to 60 years in Sri Lanka or in Trinidad and Tobago is similar to that in these lower-mortality countries of sub-Saharan Africa. Moreover, adult male survivorship is much lower in several East European countries. The apparently low level of adult mortality in these countries is somewhat surprising. Although it is possible that the orphanhood method has produced underestimates of adult mortality in all of these countries, the results for The Gambia, at least (see appendix), and Ghana (Timaeus, 1991d) exhibit a high degree of internal consistency. In Zimbabwe, adjusted registration data for Harare yield an estimate of adult survivorship for 1982–1986 that is almost identical to that in Table 6–1 (Moyo, 1991). Thus, the national estimate of survivorship may be somewhat too high but is unlikely to be grossly inaccurate.

In contrast, in many African countries for which we have data, adult mortality is high. The estimated probability of surviving from age 15 to age 60 falls to less than 70 percent in half of these countries, and to less than 60 percent in Liberia, Sierra Leone, Mali, and Madagascar. Except in Mali, the highest estimates refer to the 1970s. They seem plausible: Some intensive, longitudinal studies of rural populations in Africa have documented even more severe levels of adult mortality. For example, in Bandafassi, Senegal, the probability of dying between 15 and 60 years of age still exceeded 50 percent during the 1970s (Pison and Langaney, 1985). Such elevated levels of adult mortality have been eliminated in most other parts of the world since the Second World War. World Bank estimates suggest that outside sub-Saharan Africa, ${}_{45}q_{15}$ exceeds 30 percent in only nine countries (Feachem et al., 1992). In few, if any, countries outside sub-Saharan Africa is ${}_{45}q_{15}$ as high as 40 percent.

These estimates of adult mortality do not follow an obvious regional pattern. Hill (1991) and Blacker (1991) suggest that child mortality is higher in western than eastern Africa. An earlier study, based on fewer countries, suggested that this differential was also true of adult mortality (Timæus, 1991e). However, the estimates in Table 6–1, apart from those for the four southern African countries, which form a fairly homogeneous group, suggest that high adult mortality and low adult mortality are to be found on both the western and the eastern sides of the continent. This change in interpretation reflects, in part, differing definitions of the regions used and, in part, incorporation into the analysis of additional data that support a gloomier view of eastern African mortality. In addition, evidence presented later in this chapter suggests that the disappearance of this broad geographical contrast to some extent reflects differential mortality trends: The estimates presented here are centered on the late 1970s, about six years later than those in the earlier study.

Gender Differentials

There are extensive data indicating that gender differentials in child mortality in sub-Saharan Africa are small but usually favor girls slightly (e.g., Rutstein, 1984). Less is known about gender differentials in adult mortality. The subject is of particular interest because of the high maternal mortality that has been documented recently in many parts of the continent (Graham, 1991). Figure 6–1 compares the male and female estimates from Table 6–1.

Given the range of different data sources and methods used to make these estimates, the results are remarkably consistent.[5] They suggest that female survivorship in adulthood is slightly higher than male survivorship in most of sub-Saharan Africa. In the majority of this sample of countries, the gender differential in adult mortality is similar to that found in most other parts of the developing world and in the United Nations' (1982a) Latin American and general families of model life tables and the four families of Princeton model life tables (Coale and Demeny, 1983).

Only in two countries is there any evidence of excess female adult

[5]When making the estimates, I attempted to consider each set of data for men and women on its own merits and not to look for patterns in the results until they were all available. Despite this precaution, my preconceptions have probably influenced somewhat the results shown in Figure 6–1.

mortality. The country with higher mortality is Mali. The estimates used here are based on census reports of recent deaths, and it is possible that the adjustments made for underreporting have led to the overestimation of female mortality. Orphanhood data collected at the same time suggest a more usual gender differential in adult mortality in Mali. The other country that apparently has excess female mortality in adulthood is Malawi. There is stronger evidence that this country is genuinely anomalous because both the results of the 1970–1971 multiround survey and the more recent orphanhood estimates shown in Table 6–1 support this conclusion.

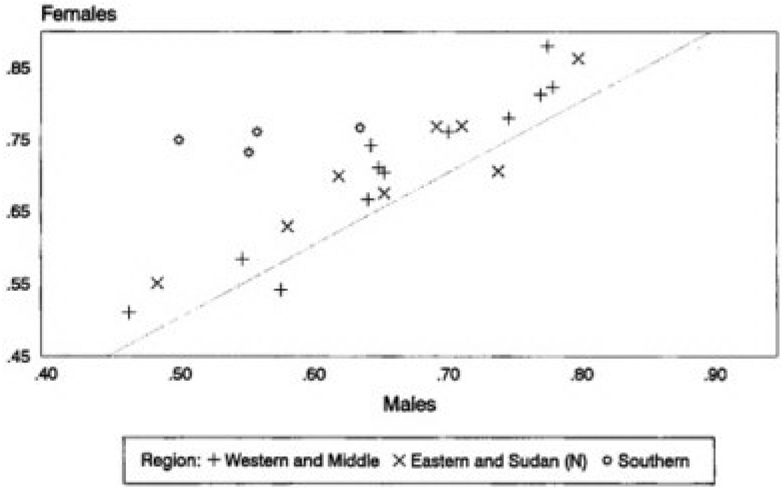

FIGURE 6–1 Gender differentials in survivorship from age 15 to age 60. SOURCE: Table 1.

The four southern African countries included in Figure 6–1 stand out as having high mortality among adult men. The differential is somewhat attenuated in South Africa due to the more usual mortality patterns among the "White" population. Among the "Black" majority, however, the differential between male and female mortality is as large as in Swaziland or Botswana. These southern African countries are exceptional, not just within sub-Saharan Africa, but compared with the rest of the world. The absolute difference between adult male and female death rates in Lesotho is probably larger than in any other national population. The high mortality of adult men in southern Africa is almost certainly related to the importance of labor migration, particularly to the mines, in the economy of this part of the continent. Mining is in itself a hazardous occupation; the lifestyle associated with prolonged absences from home encourages heavy smoking and drinking; and the region suffers from an "epidemic" of tuberculosis that originated in the mining industry (Packard, 1990).

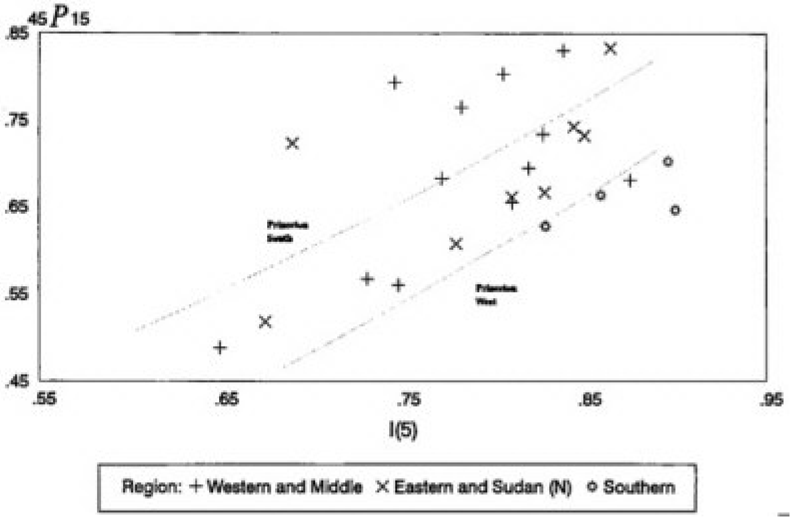

FIGURE 6–2 Survivorship in childhood and adulthood. SOURCES: Sources cited in footnote 6.

Age Patterns of Mortality

Figure 6–2 compares the estimates of adult survivorship from Table 6–1 with corresponding estimates of the probability of surviving to age 5, *l*(5).[6] In many sub-Saharan African countries the relationship between the overall levels of child and adult mortality falls within the range of experience of the developed world during its mortality transition as encapsulated in the Coale and Demeny (1983) regional model life tables. In particular, in all the countries with high adult mortality, the relationship between survivorship to age 5 and survivorship from 15 to 60 years lies between those in the Coale and Demeny South and West families of models.

In contrast, the five countries in which adult survivorship had risen to more than 75 percent by the end of the 1970s still had much higher child mortality than one would expect based on the Coale-Demeny models. The pattern is most extreme in The Gambia, where the estimate of adult survivorship is probably somewhat too high. However, as the section on mortality levels argues, it seems unlikely that adult survivorship has been overestimated in all five countries by as much as the 5 to 10 percentage points required to

[6] For most countries the estimates of child survivorship made by the United Nations (1988) have been used, supplemented by those of Hill (1991). In a few countries, estimates based on information that has become available recently are used but no systematic search for such data was attempted.

bring them into line with the South models. It is also unlikely that child survival has been underestimated by a large amount. Yet, it is not the failure of these countries to improve child survival that differentiates them. They have all experienced a substantial fall in child mortality since the 1950s. The decline in adult mortality, however, appears to have outpaced the decline in child mortality.

One high-mortality country in eastern Africa also stands out as extreme on the left-hand side of the plot: Malawi. Quite a lot of data are available for this country, and although they exhibit some inconsistencies for both adults and children, the general pattern of the results is clear. It is Malawi's unusually high child mortality, compared to other eastern African countries, that is distinctive (Blacker, 1991), rather than its adult mortality.

The countries of southern Africa again stand out as exceptional, having high adult mortality, relative to that of children, compared with the Princeton models. This is accounted for largely by the excess mortality of adult males. Even for women, however, adult mortality in these populations is relatively high compared with the pattern in most of sub-Saharan Africa. The only other population that lies on the right-hand side of the plot is the Congo. The incomplete information on recent deaths that provides the basis for the adult mortality estimates is particularly difficult to interpret, and it is possible that adult mortality is considerably lower in the Congo than is suggested here.

Figure 6–2 suggests that the age pattern of mortality is related to the overall level of mortality. An attempt was made to model this relationship to establish whether it obscures significant regional variation in the age pattern of mortality. By using the Coale and Demeny (1983) South family level 14 life tables for men and women as standards, a two-parameter relational logit model life table was fitted to sex-specific estimates of $l(5)$ and ${}_{45}p_{15}$ in each population.[7] The β parameter of the fitted life tables measures the relationship between adult and early child mortality, and the β parameter measures the overall level of mortality.[8] In an initial model β was regressed on α, by weighting each life table by an estimate of annual births in the population concerned. The residuals are generally negative (observed β less than predicted) in western Africa and positive (observed β greater than predicted) in eastern and middle Africa. They are strongly negative in Malawi and strongly positive in southern Africa. Therefore, dummy vari

[7]Subnational data from Ondo State, Nigeria, are included in this analysis to provide some indication of the age pattern of mortality in this important country.

[8]In the standard life table, α=0 and β=1. Values of α less than zero imply that mortality is lighter than in the standard, whereas values of β less than 1 imply relatively high child mortality, compared with adult mortality (Brass, 1971)

ables representing these areas were introduced into the regression equations.

TABLE 6–2 Relationship Between Adult and Early Child Mortality (β), Predicted from Overall Mortality (α) and Region

Variable	Males (standard error)	Females (standard error)
Constant	1.156 (0.023)	1.143 (0.028)
α	0.459 (0.085)	0.697 (0.086)
Western Africa	–0.129 (0.037)	–0.152 (0.047)
Southern Africa	0.436 (0.049)	0.282 (0.064)
Malawi	–0.520 (0.079)	–0.408 (0.100)
R^2	.897	.821

SOURCES: Based on data in Table 6–1 and footnote 6.

The final models are shown in Table 6–2. The reference region is eastern and middle Africa. All the coefficients are highly significant. The positive coefficients for α confirm that African populations with low overall mortality have particularly low adult mortality, compared to the pattern in higher-mortality African populations. The effect is stronger for women than for men. Further modeling suggests that it does not vary significantly between the regions of sub-Saharan Africa. When controlling for the overall level of mortality, the estimated values of β for southern Africa are very high, which implies relatively heavy adult mortality. The effect is largest for men, but is also substantial for women. In contrast, Malawi has relatively low adult mortality. These effects have been discussed with reference to Figure 6–2. In addition, the regression model suggests that, when controlling for the overall level of mortality, western Africa is characterized by lower adult and higher child mortality than eastern and middle Africa. On average, South models represent the relationship between child and adult mortality well in western African populations with a life expectancy at birth of about 50 years. A typical eastern or middle African population with this life expectancy at birth, however, has higher adult, and lower child, mortality than the corresponding South model.

Trends in Female Mortality

Figure 6–3 portrays the improvement in adult female survivorship over time in a subset of 15 mainland sub-Saharan African countries. Some of the trends are estimated from two inquiries conducted at different dates, others from series of orphanhood estimates that have been located in time and smoothed by fitting a regression line. Unfortunately, the countries for which we can estimate the trend in mortality include only one of those in Table 6– 1 with very high adult mortality: Sierra Leone.

The uniformity of the rate of improvement in adult female survivorship between different countries and in different decades is striking. Although some of the trends may be distorted by errors in the data, there is certainly no evidence of general stagnation in adult mortality during the 1970s. In

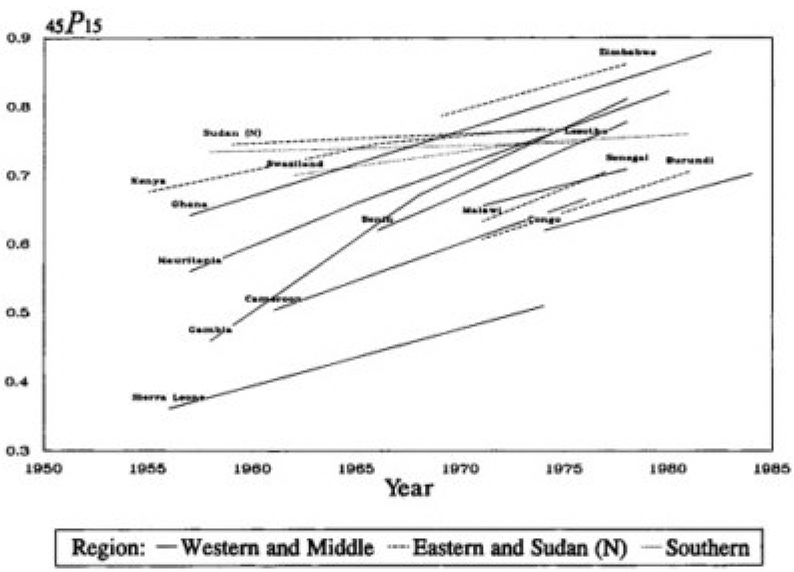

FIGURE 6–3 Trends in female survivorship from age 15 to age 60. SOURCES: Data from Benin (Benin, n.d.); Côte d'Ivoire (Ahonzo et al., 1984); The Gambia (Blacker and Mukiza-Gapere, 1988); Ghana and Senegal (Timæus, 1991d); Liberia, Madagascar and Rwanda (Waltisperger and Rabetsitonta, 1988b); Mali (Mali, 1980 and provisional 1987 census tables); Mauritania (Timæus, 1987); Sierra Leone (Okoye, 1980); Togo (Togo, 1985); Cameroon (Cameroon, 1978, 1983); Congo (Congo, 1978, 1987); Burundi (Timæus, 1991c); Kenya (Mukiza-Gapere, 1989); Malawi (Timæus, 1991b); northern Sudan (Sudan, 1982); Tanzania (Tanzania, 1982 and provisional 1988 census tables); Zimbabwe (Zimbabwe, 1985); Botswana (Botswana, 1972, 1983); Lesotho (Timæus, 1984); South Africa (South Africa, 1988); Swaziland (Swaziland, 1980 and unpublished 1986 census tables).

the few countries for which data are available, moreover, improvements in adult survivorship seem to have continued until at least the early 1980s.

All the western and middle African countries included in Figure 6–3 have experienced a rapid decline in adult female mortality. Thus, except for Ghana, the western African countries in which the time series of estimates extends back to 1965 had very high adult mortality at that time. This finding accords with the results of a series of surveys conducted in francophone Africa between the mid-1950s and mid-1960s. The quality of these data varies, but modern techniques of evaluation suggest that many of them are plausible (Condé et al., 1980; Waltisperger and Rabetsitonta, 1988a,b). The surveys conducted in Guinea (1955) and Chad (1962) indicate that survivorship from 15 to 60 years was as low as 27 percent, corresponding to a life expectancy at age 15 of about 30 years. It is unclear whether the persistence of such elevated levels of adult mortality into the second half of this century was widespread. The surveys in Burkina Faso (1960), Central African Republic (1960), Côte d'Ivoire (1963), and Togo (1961) all yield somewhat higher probabilities of surviving from 15 to 60 years of about 40 percent. We lack recent data for Burkina Faso, the Central African Republic, and Chad, but the estimates for Côte d'Ivoire and Togo in Table 6–1, together with those for countries such as Mali and Sierra Leone, suggest that sufficient progress had been made everywhere by 1980 to increase the probability of surviving from age 15 to 60 to more than 50 percent.

The experience of other regions of Africa seems to have been more diverse. The four populations in Figure 6–3 that experienced little improvement in adult female survivorship during the 1960s and 1970s comprise the two southern African states for which data are available (Lesotho and Swaziland), northern Sudan, and Kenya in eastern Africa. Of the countries for which estimates extend back to the early 1960s, they are the four that then had the lowest mortality.[9] In other eastern African countries, adult mortality has declined more rapidly. Many of these countries had rather high mortality in the 1960s. In Zimbabwe, however, adult survivorship seems to have risen rapidly during the 1970s, although, at the start of the decade, it already had lower mortality than any other African country for which data are available.

Figure 6–4 compares the absolute annual improvement in female adult survivorship with that in child survivorship in each of these 15 countries over the period for which data are available. Whether or not one ignores the outliers, there is, as one would expect, some association between the

[9]The data available for Kenya and northern Sudan exhibit inconsistencies, and it is possible that their adult mortality decline has been underestimated. The evidence that adult mortality has stagnated in Lesotho (Timæus, 1984) and Swaziland, on the other hand, is compelling.

rates of improvement in child and adult survivorship. The relationship is much clearer in western and middle Africa than in other regions of Africa, particularly Kenya and northern Sudan, where the slow declines in adult mortality again stand out as anomalous. In addition, the increase in adult survivorship in The Gambia of nearly 2 percent per year seems implausibly rapid. Even if one allows for errors in the estimates of both child and adult mortality, however, the relationship between mortality trends in these two age ranges is clearly rather loose. This suggests that the effect on mortality of health care programs, economic advances, social development, and other factors may differ between these age ranges.

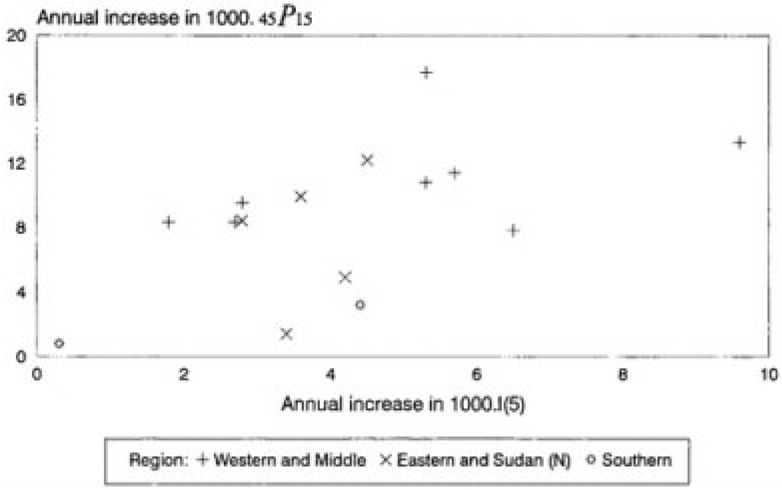

FIGURE 6–4 Annual increases in child and adult female survivorship. SOURCES: Based on data in Table 6–1 and footnote 5.

Socioeconomic and Areal Differentials

Although inequalities in adult mortality in developed countries have been a major focus of research, very little is known about the size of such differentials in developing country populations. The topic is particularly difficult to investigate. Very large sample sizes are required to measure such differentials by using direct data. Indirect data, on the other hand, can usually be analyzed only according to the characteristics of the respondents, not those of their dead relatives. Indirect methods are valuable for the study of areal differentials in adult mortality and can provide detailed estimates when the necessary data have been collected in national censuses.

One of the main difficulties in interpreting the results is allowing for the migration of respondents or parents away from the areas where their parents lived.

Figure 6–5 presents estimates of adult mortality by district for Kenya. They were provided by John Blacker and are based on the orphanhood data collected in the 1969 and 1979 censuses. Each bar represents the range of values of ${}_{45}p_{15}$ for districts within a province, with outliers represented by crosses. The figure emphasizes that in at least some countries, the national estimates presented in Table 6–1 may well conceal massive differences in the level of adult mortality between areas of a country. In much of Central Province, adult mortality in the 1970s was even lower than in Ghana or Zimbabwe. On the other hand, in parts of the sparsely populated north and east of the country, adult mortality was nearly as high as in the least healthy African countries for which we have data. Figure 6–5 also reveals that variation in the level of adult mortality is not restricted to the provincial level. There are also large differences between districts within many provinces.

A second axis of variation in adult mortality that can be examined in several countries is type of place of residence. Some of the direct estimates

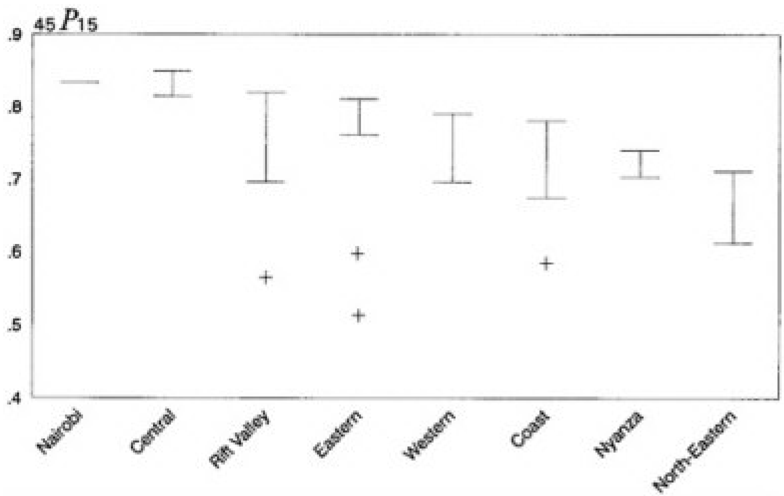

FIGURE 6–5 District-level variation in adult survivorship by province, Kenya, 1970s. NOTE: Each bar represents the range of values of ${}_{45}p_{15}$ for districts within a province, with outliers represented by crosses. SOURCE: Unpublished analysis by John Blacker.

of adult mortality in Table 6–1 can be broken down into estimates for urban and rural areas. In addition, in certain countries, registration data for the capital city can be compared with national estimates from other sources.[10] Both types of comparison are shown in Table 6–3. The results are presented in terms of life expectancy at age 15, rather than ${}_{45}p_{15}$, to maximize the number of countries that can be considered. These data suggest that adult mortality is lower in urban Africa than in the countryside. If they can be relied upon, the differential is larger in the high-mortality countries, indicating that the advantage of urban areas is eroded as overall mortality declines. Thus, the national and rural adult mortality estimates vary far more between countries than those of urban mortality.

TABLE 6–3 Life Expectancy at Age 15 According to Residence, Both Sexes

		Life Expectancy at 15 Years			
Country	Date	Capital City	Urban	Rural	National
Côte d'Ivoire	Late 1970s		52.1	49.0	50.0
Liberia	Early 1970s		47.5	43.7	45.0
Mali	Late 1970s	47.6			44.6
	Early 1980s	50.8	44.2		
Senegal	Late 1970s	51.8	50.0		
Sierra Leone	Early 1970s	47.5	41.0		
Zimbabwe	Late 1970s		56.9		
	Early 1980s	57.0			
Botswana	Early 1980s		53.4	46.9	48.3

SOURCES: For capital cities: Bamako (Fargues and Nassour, 1988); Dakar (Cantrelle et al., 1986); Freetown (Wurrie, 1979); Harare (Moyo, 1991). Otherwise as in Table 6–1.

Little is known about differentials in adult mortality in Africa according to factors such as occupation and income that have received attention in the literature on mortality in developed countries and child mortality in the developing world. Table 6–4 presents indirect estimates of adult mortality in Lesotho according to the level of education of the respondent answering the questions about the survival of relatives. In this analysis, level of education probably should be interpreted as a proxy for socioeconomic status. One would not normally expect the education of young adults to have a large direct effect on the mortality of their parents. Moreover, since the

[10]Differential errors in the two sources of data are potentially a major problem with such comparisons.

cells in each row of the table are based on different respondents, one should not expect them to agree exactly. Nevertheless, the data on orphanhood supplied by men and women, as well as those on widowhood, all suggest that adult survivorship rises monotonically with increases in the education of the individual making the reports. The differentials are large, being broadly equivalent to those between Kenya and Zimbabwe for women and those between Liberia and Côte d'Ivoire for men. They suggest that the tenth of adults whose relatives went to secondary school have considerably lower mortality than the rest of the population.

TABLE 6–4 Survivorship from Age 15 to Age 60 by Sex, According to Education of One's Close Relatives, Lesotho, Late 1960s

	Relative		
Level of Education	Sons	Daughters	Spouses
Men's survivorship			
None	.54	.50	.53
Lower primary	.58	.53	.57
Upper primary	.60	.67	.62
Secondary+	.62	.57	.68
Women's survivorship			
None	.76	.65	.77
Lower primary	.80	.74	.77
Upper primary	.82	.77	.79
Secondary+	.87	.85	.88

SOURCE: Timæus (1984).

Given the shortage of individual-level data that can be used to study the influence of socioeconomic factors on adult mortality, another approach is to examine the association between mortality and indicators of development at the national level. In sub-Saharan Africa, Feachem et al. (1991) find the probability of dying by age 5 to be significantly related to both gross national product (GNP) per capita and secondary-school enrollment. Timæus (1991e) suggests that adult survivorship in sub-Saharan Africa is also related to GNP per capita. Figures 6–6 and 6–7 compare estimates of adult female survivorship in the mid-1970s for 21 mainland countries with GNP per capita and secondary-school enrollments at the same date (World Bank, 1988). The fitted regression lines indicate that a relationship exists in both cases, but neither index of development is closely associated with adult survivorship in the sample of countries considered in this analysis. Similar plots of survivorship against other indices of social and economic development and multiple regression modeling yield no other significant associa

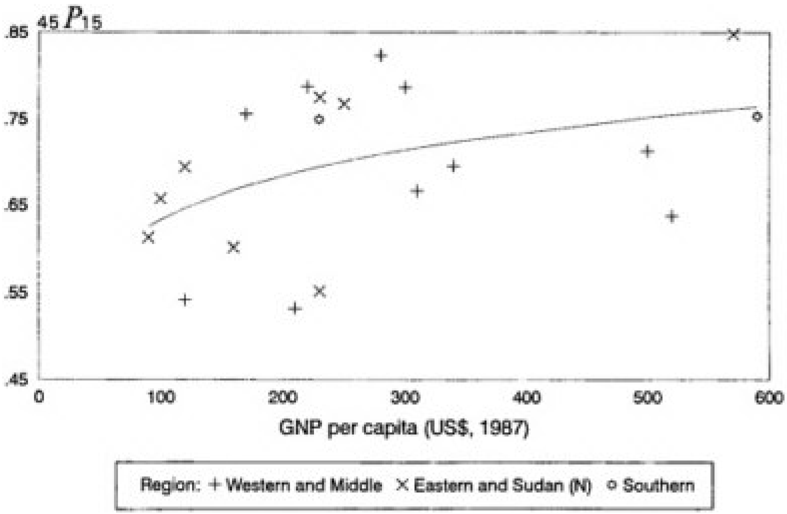

FIGURE 6–6 Income levels and female survivorship in adulthood, mid-1970s. NOTE: R=.4376. SOURCE: World Bank (1988).

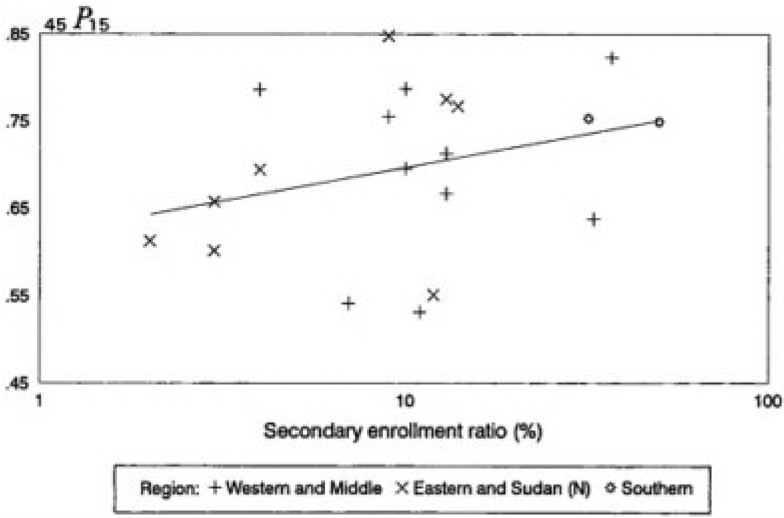

FIGURE 6–7 Secondary schooling and female survivorship in adulthood, mid-1970s. NOTE: R=.3115. SOURCE: World Bank (1988).

tions. Thus, broad indicators of development are not very helpful in understanding variation in adult mortality across the continent.

CAUSES OF DEATH

One reason it may be difficult to interpret the differences in adult mortality levels between countries is because fragmentary evidence suggests that the cause-of-death patterns underlying them vary widely. Unfortunately, representative data on the causes of adult deaths are very rare in sub-Saharan Africa. The few studies that exist tend to be based on differing measures and classifications of cause-specific mortality. Moreover, the samples of deaths involved are often small (Omondi-Odhiambo et al., 1990).

In Table 6–5, cause-specific probabilities of dying (per 1,000) in four sub-Saharan African populations are presented for two broad age groups. Unfortunately, eastern Africa is not represented, and none of these populations is drawn from rural, tropical mainland sub-Saharan Africa.[11] The classification of causes of death adopted is that used by Feachem et al. (1992). To minimize the effect of errors in the coding of causes of death, only broad categories are used. For example, the classification fails to distinguish coronary heart disease, which is believed to be rather unimportant in sub-Saharan Africa (Hutt, 1991), from other forms of cardiac disease and cerebrovascular disease.

Even these statistics should be interpreted with caution. Only about 80 percent of adult deaths were registered in Bamako and western Sierra Leone, and unregistered deaths have been distributed by cause in proportion to registered ones, rather than assigned wholly to the ill-defined category. In addition, not all the registered deaths were medically certified at the time of death, and even clinicians' diagnoses of causes of death are subject to considerable error unless confirmed by autopsy. The basic data were also compiled by using several different versions of the International Classification of Diseases and are not detailed enough in either Bamako or western Sierra Leone to be grouped exactly into Feachem et al.'s (1992) classification. Thus, only consistent features of the results should be accorded much significance.

The first aspect of Table 6–5 that deserves emphasis is that although communicable disease and reproductive mortality are more important than in lower-mortality populations elsewhere in the world, they still account for only a minority of adult deaths in these four populations. The proportion of such deaths ranges from about one-fifth in Cape Verde to slightly more than

[11]Western Sierra Leone is the area around Freetown, which represented about two-thirds of the area's population in the early 1970s.

one-third in western Sierra Leone. If the category "senile or ill-defined" is excluded, cardiovascular disease is universally the leading cause of death in middle age (ages 45–64), followed in most instances by neoplasms and respiratory infections.

Cardiovascular disease is also one of the three most important causes of death among young men and women. In this age group, injuries are the leading cause of death for men in Cape Verde and for the "Colored" (including "Asian") population of South Africa. Maternal mortality is the leading cause of death for young women in Sierra Leone and the second most important in Bamako, excluding those deaths coded as senile or ill defined. It is worth noting, however, that maternal mortality accounts only for between 6 and 13 percent of deaths of women of childbearing age, though it might be proportionally more important in isolated rural areas. Diseases of the digestive system are an important cause of death in Bamako, especially among men. This is accounted for primarily by liver disease, which is the leading cause of loss of life among adults aged less than 60 in this population (Fargues and Nassour, 1988).[12]

Gender differentials in cause-specific mortality are generally small, particularly in the age group 15–44 years and for noncommunicable disease. Such small differentials suggest that certain lifestyle factors that are important determinants of adult mortality differentials in other parts of the world may not yet play a major role in their explanation in this region. The two consistent exceptions are mortality from diseases of the digestive system, which is typically about twice as common among men as women, and mortality from injuries, which is about three times as high among men as women. Among young adults, deaths from external causes account for most of the gender differential in overall mortality, offset to a considerable degree by maternal deaths. In the age group 45 to 64 years, deaths from injuries decline in both absolute and relative importance, and two further diseases make a significant contribution to the gender differential in overall mortality: tuberculosis and respiratory infections. Both are responsible for about twice as many deaths in middle-aged men as middle-aged women.

With the exception of injuries, the population of Cape Verde has low mortality rates in adulthood from all cause categories. The island's advantage is least marked with respect to cardiovascular disease. Not only the overall level of mortality, but the level of noncommunicable disease mortality, is broadly similar in the other three populations. In other respects, the cause of death structure experienced by "Colored" adults in South Africa is

[12]The prevalence of liver disease appears to vary greatly across Africa. It is thought to be linked to infection with hepatitis B virus and to the contamination of foodstuffs with aflatoxin (Hutt, 1991).

TABLE 6–5 Cause-Specific Probabilities of Dying by Broad Age Group and Sex

	Cape Verde 1980		Bamako, Mali 1974–1985		Western Sierra Leone 1972–1975		South Africa "Colored" and "Asian," 1971	
Cause of Death	15–44	45–64	15–44	45–64	15–44	45–64	15–44	45–64
Males								
Communicable/reproductive	10.3	35.1	46.5	118.1	64.1	137.3	33.1	86.5
Diarrheal	0.6	1.3	7.2	19.3	6.7	24.5	1.9	3.1
Tuberculosis	4.8	12.9	10.9	30.0	13.6	19.5	15.3	31.7
Malaria	–	0.0	6.5	9.5	–	–	–	0.1
Respiratory	4.2	19.3	8.3[a]	39.0[a]	22.3[a]	53.5[a]	13.5	47.6
Noncommunicable	20.5	123.0	89.3	263.4	76.5	248.5	65.5	303.3
Neoplasms	3.5	27.5	9.5	38.7	1.6	18.5	11.3	67.8
Cardiovascular	7.9	63.7	11.8	55.1	13.8	69.0	25.1	157.1
Digestive	1.7	8.1	19.1	45.1	11.5[b]	29.0[b]	5.6	19.9
Senile/ill-defined	2.1	7.3	27.7	75.8	–	–	6.7	17.9
Injuries	29.2	17.9	21.1	19.5	16.4	12.3	93.5	44.2
Unintentional	18.7	13.1	–	–	–	–	60.0	32.4
Suicide	1.6	1.1	–	–	–	–	5.1	2.8
Homicide and war	8.9	3.7	–	–	–	–	28.4	9.1
Total	60.0	176.0	157.0	401.0	157.0	398.0	192.0	434.0
Females								
Communicable/reproductive	13.2	14.4	45.2	75.6	72.4	108.5	36.8	36.9
Diarrheal	0.4	0.8	5.8	17.7	7.3	23.4	1.2	2.1
Tuberculosis	4.2	3.4	4.8	11.7	8.5	9.3	11.7	8.7
Malaria	–	–	4.2	9.1	–	–	–	–
Respiratory	4.8	8.8	6.1[a]	21.0[a]	15.0[a]	30.0[a]	13.5	22.5
Maternal	2.8	0.2	11.4	0.7	19.8	0.6	7.7	0.6

Noncommunicable	24.4	80.5	72.9	220.5	68.7	272.6	67.9	206.1
Neoplasms	4.6	14.6	7.1	36.0	2.4	26.2	12.9	37.4
Cardiovascular	9.4	48.5	15.9	61.5	10.4	85.1	26.2	124.1
Digestive	0.8	2.5	10.2	21.7	5.6[b]	20.7[b]	2.2	6.4
Senile/ill-defined	2.6	3.7	21.3	62.4	–	–	7.4	9.4
Injuries	9.4	5.1	6.8	11.0	5.9	4.9	26.2	13.0
Unintentional	5.9	3.8	–	–	–	–	16.5	9.8
Suicide	0.8	0.3	–	–	–	–	2.2	0.7
Homicide and war	2.8	1.0	–	–	–	–	7.7	2.6
Total	47.0	100.0	125.0	307.0	147.0	386.0	131.0	256.0
Number of deaths	432		15,801		4,542		11,384	
Deaths registered (%)	90+		77[c]		80		90+	
Medically certified (%)	–		60[c]		56		42+[d]	

[a]Includes chronic respiratory disease.

[b]Category comprises diabetes mellitus, peptic ulcer, cirrhosis, nephritis, and nephrosis.

[c]All ages 5 years and over.

[d]Not known, but 42 percent of deaths at all ages occurred in hospitals.

SOURCES: Cape Verde (United Nations, 1987); Bamako (Fargues and Nassour, 1988); Western Sierra Leone (Wurrie, 1979); South Africa (United Nations, 1982b).

distinctive. They have higher death rates from cardiovascular disease and neoplasms than populations further north, but lower death rates from most other noncommunicable diseases. Except for tuberculosis, the South African population also experiences fairly low communicable disease mortality. Its overall mortality is maintained at a high level by deaths from both accidents and violence.

One way of relating these data on the causes of adult mortality in sub-Saharan Africa to those from other regions is to compare them with the predicted cause-of-death structures presented by Murray et al. (1992) for different levels of ${}_{45}q_{15}$. These predictions are based on data from 56 non-African populations, including 23 from the developing world. Although the results are presented for levels of adult mortality comparable with those in Africa, all the data used to generate the predictions are from populations with lower mortality than that in Bamako, Western Sierra Leone, or South Africa.

The comparison suggests that adults in the three tropical populations included in Table 6–5 experience unusually high communicable disease mortality. However, although it remains an important cause of death, tuberculosis mortality is only about half as common in these four populations as one would expect based on the experience of other parts of the world. Mortality from diarrheal disease and the infectious and parasitic diseases is particularly high. Second, "Colored" men and women in South Africa are about two-thirds more likely to die of cardiovascular disease than one would expect from the predicted figures. Cape Verde also has slightly higher cardiovascular disease mortality than one would expect, given its fairly low overall mortality, but reported mortality from this group of diseases is moderate in the other two populations. Third, diseases of the digestive system appear to be relatively unimportant causes of adult death in sub-Saharan Africa. Except in Bamako, where such deaths are about three-quarters as common as predicted, the reported death rate from this group of diseases lies between 20 and 50 percent of the expected level. Finally, male, but not female, death rates from injuries in Bamako and western Sierra Leone are low for such high-mortality populations. In South Africa, however, mortality from injuries is relatively high, reaching more than three times the predicted level for women.

It is important to note that most of the data in Table 6–5 are rather out-of-date. Information on particular diseases indicates that patterns of causes of death among adults in Africa may be undergoing a rapid evolution. For example, hypertension appears to be a health problem of growing importance in populations where it was previously rare (Hutt, 1991). It is associated with urbanization and the adoption of more "Western" diets and lifestyles. The growing AIDS epidemic is also, of course, of particular importance.

CONCLUSIONS

The statistics presented in the previous sections are based on very imperfect data. Nevertheless, with some exceptions, they suggest a coherent and plausible, though sometimes surprising, picture of adult mortality patterns across sub-Saharan Africa. Future work undoubtedly will prove that some of the estimates are wrong. Nevertheless, in concentrating on the overall pattern of the findings, rather than on results for particular countries, several general conclusions seem justified.

First, the average level of adult mortality in sub-Saharan Africa is high, compared to the rest of the world, but the experience of different countries is very heterogeneous. By the late 1970s, adult mortality was fairly low in some countries but remained high in others. Second, offsetting this rather depressing picture were the considerable reductions in adult mortality achieved in Africa during the 1960s and 1970s, particularly in western Africa. Many sub-Saharan African countries entered the second half of this century with extremely high adult mortality. There is no evidence that this persists anywhere. Moreover, in those countries that succeeded in reducing overall mortality to a moderate level by about 1980, adults tended to benefit more, and children less, than one would expect based on the historical experience of the developed world. Third, and of significance for health planning at the national level, the limited information available suggests that large areal, residential, and socioeconomic differentials in adult mortality exist in at least some African countries. Fourth, only in southern Africa do neighboring countries appear to have closely linked levels, trends, and patterns of mortality. In this region, adult mortality appears to have stagnated at a high level, while that of children has declined further than in most of Africa. Adult men suffer particularly high mortality. If cause-of-death data for South Africa's "Colored" population are of relevance to the rest of the region, this pattern may be accounted for by high mortality from cardiovascular disease and injuries. Fifth, women's mortality is also lower than men's mortality in most other parts of Africa, but the differential is usually small. It may be accounted for largely by higher male death rates from injuries, tuberculosis, and respiratory disease, offset to some extent among younger adults by maternal mortality. Sixth, when controlling for the overall level of mortality, adult mortality is on average lower in western Africa than in middle or eastern Africa, compared with the mortality of children. Finally, although infectious disease mortality appears of greater absolute and relative importance for adults in sub-Saharan Africa than in other regions of the world, it still accounts for only a minority of adult deaths. Tuberculosis and diseases of the digestive system remain important causes of death in adulthood, but may be relatively less important in sub-Saharan Africa than in other parts of the developing world.

Several intriguing exceptions to the general pattern of the results have been mentioned in the previous sections. The apparently high level of adult mortality in the Congo, despite the favorable indicators of social and economic development and the relatively low childhood mortality, deserves mention. To take a contrasting example, adult mortality in The Gambia may have fallen to a low level despite the country's rather high child mortality. Other notable findings include the relatively slow decline in adult mortality in Kenya and northern Sudan, and the distinctive pattern of mortality in Malawi. Although plausible explanations for some of these findings could readily be suggested, they may reflect no more than errors in the data.

It has been emphasized throughout this chapter that even the basic descriptive knowledge of levels and trends in adult mortality across sub-Saharan Africa is incomplete. Nevertheless, to return to the questions posed in the introduction, adult mortality patterns in sub-Saharan Africa are distinctive. They also seem to vary across the continent. Neither knowledge of adult mortality in other regions of the world, nor knowledge of child mortality in Africa, is a particularly good guide to the health problems of adults in this region. Valuable advances in methods for estimating adult mortality in countries with limited and defective data have been made since the 1970s. In sub-Saharan Africa, however, relatively few countries have collected the data needed to apply them. Very little is known about differentials in adult mortality or causes of death in adulthood, and even less about the underlying determinants of adult mortality patterns. Ignorance about the mortality baseline against which the AIDS epidemic in sub-Saharan Africa is unfolding, and about the distribution within the population of other diseases, such as tuberculosis and venereal disease, with which human immunodeficiency virus (HIV) infection is known to interact, is particularly disturbing.

Despite progress made during the 1960s and 1970s, many adults were still dying before age 60 in Africa even prior to the spread of HIV. For adults, as for children, sub-Saharan Africa is undoubtedly the region of the world with the poorest health. Until 1980, adults usually benefited more than children in those African countries that managed to reduce overall mortality to a moderate level. During the 1980s, vigorous promotion of universal immunization and other measures to improve child survival, together with the AIDS epidemic, may have begun to reverse this pattern. In considering the efforts being made to improve the survival of Africa's children, it is notable how little is known about what would constitute a corresponding strategy to maintain their health when they grow up.

APPENDIX

As the body of this chapter emphasizes, only limited and defective data on adult mortality exist for sub-Saharan Africa. Analysis of this information is far from straightforward. To illustrate the procedures involved and the difficulties that arise in interpretation of the results, this appendix presents applications of various methods of estimation for some of the data analyzed in this chapter and explains how the summary indices presented in Table 6–1 were derived.

The first important form of data is on deaths by age during a specified period. Such data are collected by registration systems or by asking direct questions in censuses and single- or multiround household surveys. Reporting may be incomplete or, with retrospectively collected data, may refer to the wrong reference period. In addition, inaccurate reporting of either ages at death or ages of the living population used as a denominator to calculate rates may bias the estimates.

Several methods exist for evaluating such data. Most of them are based on the relationship between the number of people of any age and the number of deaths above that age. If one adjusts for population growth, these numbers should be the same because nobody can live forever. To exploit this identity, one has to assume that reporting is equally incomplete at all adult ages. On this basis, various approaches can be used to compare the two quantities and assess the shortfall in reported deaths (Brass, 1975; Preston et al., 1980; Bennett and Horiuchi, 1981). Sampling errors, deviations from the assumption of constant underreporting of deaths by age, the distorting effect of past mortality change and migration on the population's age structure, and age misreporting can all make such comparisons difficult to interpret.

Such methods of evaluation have been applied to all the direct data used in this chapter for which sufficiently detailed tabulations are available. Figure 6–A.1 illustrates the application of Preston et al.'s (1980) method to registration data on male deaths among "Blacks" in South Africa in 1985. It compares the estimated population between each age and age 75, calculated from deaths adjusted for growth at 2.6 percent per annum, with the enumerated population in the same age range according to the 1985 population census. If all the assumptions held and reporting was perfectly accurate, apart from being incomplete, the plot would be a horizontal straight line. Although it is not, the assumptions involved appear to have held up reasonably well until about age 55. Thus, the analysis provides rather convincing evidence that relative to the census, only about 72 percent of adult male deaths were reported. In fact, in absolute terms, the registration of deaths of "Black" men is certainly worse than this because the 1985 census enumeration was also incomplete. It is, however, only relative in consistencies between the two sources that bias the estimated death rates. A similar analysis for "Black" South African women suggests that relative to the census, about 59 percent of adult female deaths were registered in 1985. Once the degree to which reports of adult deaths are incomplete is known, it is a straightforward matter to adjust them upward before calculating age-specific death rates and life table measures of mortality and survivorship.

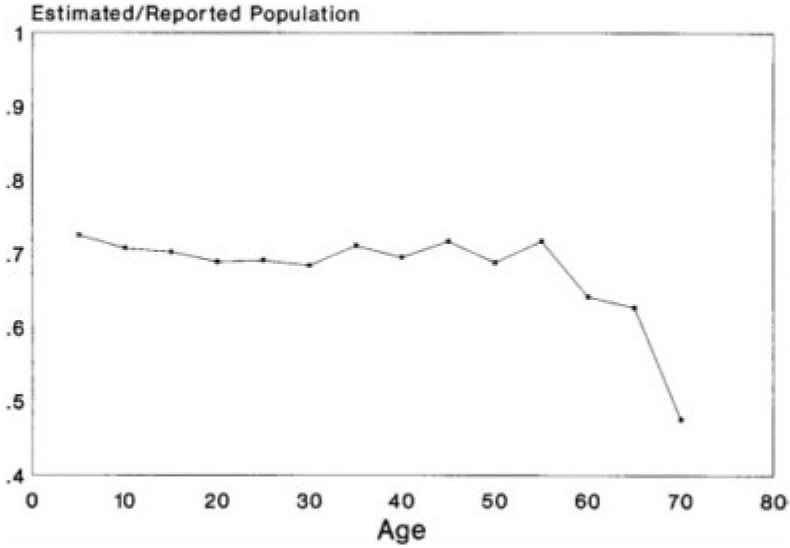

FIGURE 6–A.1 Ratio of estimated to reported population, "Black" men, South Africa. SOURCE: South Africa (1988).

Besides the problem of incomplete death reporting, life tables calculated from developing country data tend to be distorted by age reporting, sampling, and other errors. To reduce the effect of such problems, the life tables were smoothed prior to extracting the final estimates of ${}_{45}p_{15}$. The approach adopted is to fit a two-parameter logit relational model life table based on the general standard (Brass, 1971). These models exploit the fact that after the logistic transformation is applied, the differences between any two life table survivorship functions, *l(x),* are approximately linear. Thus, plotting the logits, *Y (x),* of the observed survivorship function against those of the standard, $Y_s(x)$, one can fit a line to the points for ages at which the data seem reliable and extrapolate from them to age ranges in which the observed data are clearly biased. Figure 6–A.2 illustrates the procedure with data on "Black" female deaths in South Africa in 1985. The radix of the life table is at age 15 years, and reported deaths were multiplied by a factor of 1.695 before calculating death rates and measures of survivorship.

Inspection of Figure 6–A.2 reveals that the line representing the observed data bends downward for the oldest ages on the right-hand side of the plot. This deviation indicates that the reported mortality of elderly women is lower than one would expect based on the data for younger age groups and the age pattern of mortality in the general standard. It is likely that reporting of deaths of elderly women is particularly incomplete or that their ages at death tend to be exaggerated. Therefore, the last three points were discarded and a model life table was fit to the points for ages 20 to 60 years. This procedure yields a line with an intercept of –0.34, implying an overall level of adult mortality among "Black" women in South Africa that is a little lower than in the standard, and a slope of 1.26, implying relatively heavy mortality in middle age compared with early adulthood. The prob

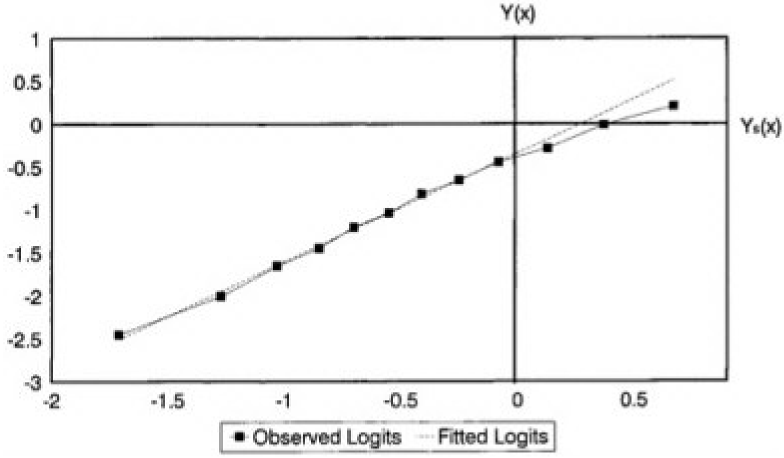

FIGURE 6–A.2 Logit survivorship, compared with standard, "Black" women, South Africa. SOURCE: Figure 6–A.1.

ability of surviving from 15 to 60 years (${}_{45}p_{15}$) is 70.4 percent in the fitted life table, as opposed to 70.8 percent according to the unsmoothed data.

The final estimates for South Africa presented in Table 6–1 are based on similar analyses for the "Colored" and "Asian" populations. These were combined with the unadjusted life table for the "White" population, weighting by each group's share in the total population. Because the official statistics do not cover the four so-called independent homelands, the mortality of the adult population of these areas was assumed to be the same as that of the "Black" population in the rest of South Africa. This assumption may be unjustified but is unlikely to bias the national estimates appreciably.

The second important form of information used to estimate adult mortality is that on the survival of respondents' mothers and fathers. The questions required are simply, Is your mother alive? and Is your father alive? They can be administered in censuses and single-round household surveys. No attempt is made to collect the ages at death of parents. Instead, these ages are implicitly assumed from respondents' ages by using demographic models. The information used is the proportion of respondents in each 5-year age group with a living mother (or father). This proportion is closely related to the life table probability of surviving from about the average age at which women (or men) have children to that age plus the current age of the respondents. By using this fact, regression-based procedures have been developed for estimating life table survivorship from data on orphanhood (e.g., Timæus, 1992). Each 5-year age group yields a separate estimate of adult mortality. Although the estimates refer to different age ranges, they can all be converted to ${}_{45}p_{15}$ by using any one-parameter system of model life tables, without reducing their precision greatly.

The younger the age group of respondents, the more recently did their parents die, on average. If it is assumed that the level of mortality has changed steadily, it becomes possible to estimate the date at which the mortality of the cohort of parents reported on by an age group of respondents equaled the level of mortality prevailing in the population (e.g., Brass and Bamgboye, 1981). In this way, the series of estimates obtained from respondents aged 5 to 55 years in a single inquiry can be used to infer the past trend in the level of adult mortality over a decade or more.

The kind of results obtained from the orphanhood method of estimating adult mortality are illustrated in Figure 6–A.3 by using data from Swaziland. Questions about the survival of mothers and of fathers were asked in both the 1976 and the 1986 censuses, yielding the four lines shown in the figure. Swaziland illustrates a common problem with estimates of adult mortality obtained from orphanhood data. Each of the four sets of results suggests that adult mortality is declining. Because the questions have been asked twice, however, it is possible to compare estimates from the two sources for the early 1970s. They are clearly inconsistent. The reports of younger respondents in the earlier census indicate lower mortality than the reports of older respondents in the later census. Similar inconsistencies characterize the data on several other eastern African countries that have asked about orphanhood more than once. They include Kenya, Malawi, northern Sudan, and Tanzania. Elsewhere in Africa, however, successive surveys have yielded much more consistent results, permitting one to have reasonable confidence in the accuracy of the data. Results for one such country, The Gambia, are shown in Figure 6–A.4 (only maternal orphanhood data are available from both censuses). Others include Cameroon, Lesotho, and Mauritania.

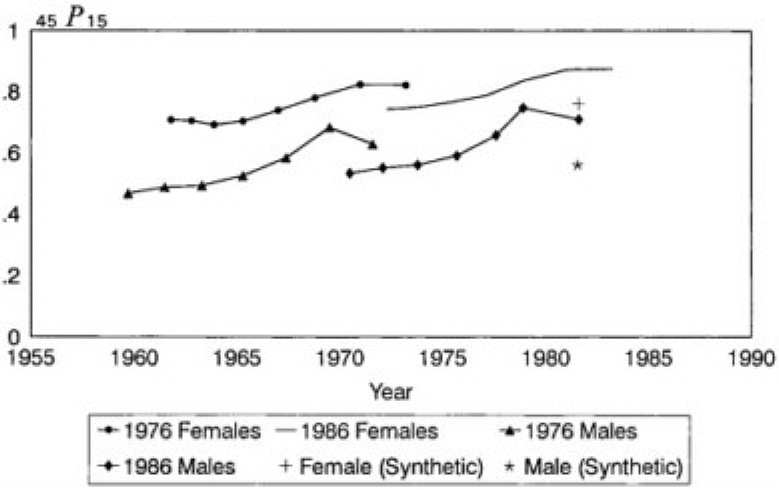

FIGURE 6–A.3 Adult survivorship estimated from orphanhood, Swaziland.
SOURCE: Data from Swaziland (1980) and unpublished 1986 census tables.

Accumulated experience makes it clear that when such inconsistencies between two sets of data arise, they stem from underreporting of orphanhood at early ages (e.g., Timæus, 1991a,b). Data supplied about young orphans often refer to a foster parent or stepparent, rather than to a dead natural parent. Each set of estimates exaggerates the decline in mortality, and the most recent estimates of adult mortality from both inquiries are probably too low.

In Swaziland at least, it remains likely that adult mortality has declined somewhat. Every age group of respondents reported more living parents in

1986 than in 1976. If questions about orphanhood have been asked more than once, the effect of underreporting of orphanhood in childhood can be reduced by analyzing data on the incidence of orphanhood between the two inquiries among young adults. This analysis is done by using the two sets of proportions to construct a synthetic cohort based at age 20. Life table survivorship is estimated from the proportion of each age group in this synthetic cohort with a living mother (or father) by using regression coefficients developed for the purpose (Timæus, 1991b). All the estimates refer to the same intersurvey period, but they tend to differ somewhat because of sampling and age reporting errors. Averaging the results for different age groups, produces point estimates such as those shown in Figures 6–A.3 and 6–A.4.

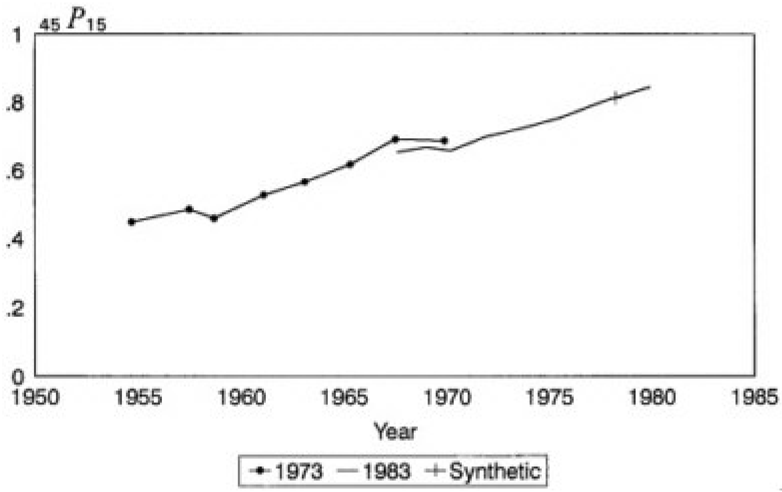

FIGURE 6–A.4 Adult female survivorship estimated from orphanhood, The Gambia. SOURCE: Blacker and Mukiza-Gapere (1988).

In The Gambia, the synthetic cohort estimate for the 1973–1983 intercensal period emphasizes the consistency of the two sets of orphanhood results. In contrast, in Swaziland the intercensal estimates for both men and women indicate much higher mortality than estimates for 1981 made from 1986 data on children. They do, however, fall in line with the earlier estimates from each census, which are obtained from respondents aged 25 to 45 years. These results suggest that a fairly slow decline in adult mortality has oc curred in Swaziland. Moreover, the trends for men and women are fairly consistent. Thus the intercensal results seem plausible. The results from applying this approach to Kenya and Malawi are similar to those for Swaziland (Timæus, 1991b). Therefore, intercensal and intersurvey orphanhood estimates of ${}_{45}p_{15}$ were also adopted for these countries. Unfortunately, in northern Sudan and Tanzania the method worked less well, probably because the accuracy of the reports changed markedly between inquiries.

In several countries the only information available on adult mortality is a single set of orphanhood data. In Burundi, Ghana, and Senegal, such data were obtained in a DHS survey that also asked women whether they were orphaned before or after they were first married. Data from a single survey on orphanhood since first marriage share the advantages of synthetic cohort data computed for countries that have asked about orphanhood repeatedly. They reflect the recent incidence of orphanhood among young adults and are unaffected by underreporting of orphanhood in childhood. The information analyzed for each five-year age group is the proportion of women with a living mother (or father) among those women whose mother (or father) was alive when the woman first married. Regression methods exist for estimating life table survivorship from these data (Timæus, 1991c). The results for different age groups refer to similar dates. Therefore, like synthetic cohort data, they are usually averaged to produce a single recent estimate. In the three countries with this form of data, underreporting of orphanhood in childhood does not seem to be a problem. Estimates from orphanhood since marriage are consistent with the trend estimated from lifetime orphanhood but are more up-to-date (see Timæus, 1991c,d). They are judged moderately reliable and presented in Table 6–1.

Finally, in several countries, only one set of orphanhood data was available for this study and the supplementary question on whether respondents were orphaned before or after marriage was not asked. In some of them, useful data on recent deaths were available, but in Benin, Sierra Leone, and Zimbabwe they were not. This circumstance makes it impossible to determine whether orphanhood among young children is underreported or not. Thus, the most recent estimates cannot be trusted. In such countries, most significance was accorded to the results obtained from respondents aged 15 to 40 years. Data about children were discarded if they suggested an accelerating decline in the level of adult mortality. Similarly, discrepant data obtained from respondents aged 40 to 55 years were ignored. The estimation methods are less reliable for these age groups, and the respondents are likely to exaggerate their own ages, thereby biasing the results. To smooth out the effects of imprecision in the data and estimation methods, the remaining estimates were regressed on the dates to which they apply. The predicted values of ${}_{45}p_{15}$ for the most recent date at which the data seem reliable are presented in Table 6–1.

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7

Internal Migration, Urbanization, and Population Distribution

John O.Oucho and William T.S.Gould

INTRODUCTION

In the three decades since the main period of independence in Africa, population distribution and redistribution through migration have remained important and widely recognized features of the population dynamics of the continent. Despite the continuing importance of the phenomenon, its status in the late 1980s and into the 1990s has largely remained as it was described by Prothero in 1968: the "Cinderella" of population studies. It is still not completely accepted as part of the inner family in demography (largely because of its "inferior" data and its variable and technically "soft" techniques); it is still starved for resources in comparison with the attention given to fertility and mortality data collection and analysis; and it still plays

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a marginal role in national population policies. Progress in migration studies in Africa has been substantial in quantity, addressing a wide range of empirical, theoretical, and policy issues, and these have generated a large literature. However, they have not coalesced into any consensus on approaches or theoretical baselines. There have been contributions to major and long-standing theoretical debates, such as on the existence of a mobility transition to mirror the demographic transition (Zelinsky, 1971) and whether or not migration is a force for development at both source and destination (Gould, 1988; Oucho, 1990a), but the research agenda has moved away from questions associated with general global models to those arising explicitly out of the African experience. The systems framework of Mabogunje (1970) is perhaps the most widely cited model of this type.

Even in the area of models of African experience, however, there has been a general weakening of theoretical work in the face of a growing complexity of what is known about the migration experience throughout sub-Saharan Africa. To some extent it could be argued that migration studies lost their way in the 1980s, overshadowed by major developments in fertility and mortality studies. Yet migration remains important and needs to be considered not only in its own right, but also in the context of asserting its importance alongside fertility and mortality as a component of population dynamics. It has recently been argued, for example, that in Ghana, “migration may worsen the population pressure by undermining traditional demographic controls, and this supports and even increases high fertility rates” (Cleveland, 1991:238; see also Diop, 1985, on Senegal). Mabogunje (1990), on the other hand, implies that this loosening of demographic controls would lead to increased nucleation in family relationships that would, in turn, lead to reduced fertility. Much work remains to be done in this area.

This chapter describes the major characteristics, trends, and differentials, as well as the determinants of internal migration, urbanization, and population distribution, in sub-Saharan Africa by using available data and estimates for at least the last two decades (1970–1980 and 1980–1990) and projections for 1990–2000 and into the twenty-first century. The United Nations classification of sub-Saharan Africa into four subregions—eastern, middle, southern, and western—is used throughout. Because there are many countries and because data vary greatly in quantity and quality, it is inappropriate to give an exhaustive treatment to all countries in equal detail or to focus on all aspects of migration, urbanization, and population distribution. Rather, the discussion is directed to the three major features in separate sections. The first of these examines the typology and patterns of internal migration, migration differentials, and determinants of migration; the second reviews the magnitude, trends, and determinants of urbanization;

and the third discusses aspects of distribution, redistribution, and population density.

INTERNAL MIGRATION

Conceptual Issues and the State of the Art

Migration is the movement of people in space, often involving a change in the usual place of residence; internal migration is such a movement within national boundaries (International Union for the Scientific Study of Population, 1982:92–93). Because migration is a continuous, often repeated process rather than a single event, it is difficult to measure. Furthermore, because it is studied by researchers in all the social sciences, it lacks a standard data source or uniform approach.

The typology of African population mobility described in Table 7–1 differentiates the main types of movement in space (in a fourfold classification of rural and urban sources and destinations) and in time. The principal distinction made is between circulation (i.e., involving repetitive, nonpermanent moves—daily commuting and other short-term mobility have been excluded in this case) and definitive migration (Gould and Prothero, 1975). Circulation is subdivided in the table into three categories according to the length of the period of absence. Periodic movements are mostly short term. Seasonal movements, prominent in interior West Africa and among pastoralists, have a regular annual rhythm. Long-term circulation involves an absence of more than 1 year, but an expectation of return. Definitive migration, by contrast, is essentially a creation of the data collection methodology, when the individual migrant is recorded as being at a different place from one recorded at an earlier time (whether in a previous enumeration or as a result of some retrospective question, such as place of birth or place of previous residence). In practice it is very difficult to establish permanency, for the exact timing or direction of subsequent moves cannot be known—although probabilities of further movement may be estimated. Definitive migration may be further subdivided into irregular movements, where neither the timing nor the destination of the next move is known (characteristically in the case of refugees), and permanent movement, where the moves are considered by those involved to imply a permanent commitment to the new area of residence. This differentiation is not made in Table 7–1.

Many of these issues have been addressed in the rapidly growing literature on African migration—a literature that has been composed largely of empirical studies, often addressing only implicitly the larger theoretical questions on the causes and implications of the moves; many of these questions remain unresolved (Gould, 1992a). Important collections of empirical work from the early 1980s include the analysis of West African censuses of the

TABLE 7–1 Typology of Internal Migration with African Examples

	Circulation			
Direction	Periodic	Seasonal	Long Term	Definitive Migration
Rural-rural	Movement of dealers in produce and livestock	Pastoral displacement due to environmental hazards	Labor migration to agriculture wage sector, mining, and other rural	Agricultural land colonization, resettlement economic nodes and land consolidations; overspill into marginal of spontaneous migrants from population pressure areas
Rural-urban	Movement of dealers in agricultural produce		Movement of employed and underemployed persons	Spontaneous migrant in slums, shantytowns and suburbs
Urban-rural	Movement of dealers in urban manufactures (e.g., soap, foods, medicines)	Return migration of urbanites during "peak" agricultural seasons	"Repatriation" of unemployed persons; labor migration to rural agroindustrial and mining modes	Return migration of retired persons and unsuccessful urban migrants (the latter can be rural-urban migrants later)
Urban-urban	Movement of self-employed persons		Movement of transferred workers; self-employed persons (traders and business people relocating elsewhere)	Prospective migration of second- or later-generation migrants out of touch with ancestral home

NOTE: Excludes daily movements such as cultivating, vacationing, and commuting.

SOURCES: Adapted in modified form from Bernard (1982:154, Table 21.1), and Gould and Prothero (1975).

1970 round (Zachariah and Condé, 1981) and two volumes derived from the work of the Commission on Population Geography of the International Geographical Union on population distribution and associated policies (Clarke and Kosinski, 1982; Clarke et al., 1985). In the mid-1980s, the United Nations Regional Institute for Population Studies in Ghana produced a wideranging collection (1987), and there were several formal and informal sessions on aspects of migration at the IUSSP African Population Conference in Dakar in 1988 (International Union for the Scientific Study of Population, 1988). In 1990, in association with the Nairobi Conference of the Union for African Population Studies (UAPS), three volumes including papers by many African scholars and a large bibliography, were published (Union for African Population Studies, 1990a,b,c). Table 7–2 summarizes the bibliographical material under various headings and provides a snapshot of areas of predominant interest and strength.

Data and Data Collection Methods

One critical technical issue that is immediately apparent in this literature concerns the long-standing problem of data for migration analysis, in the sense of both poor quality data and a reduced availability and use even of traditional sources. The recent literature offers a very distinct shift from systematic national analysis based on census sources to more specific and localized survey-based studies. In the African census rounds of the 1960s and 1970s, there was a great improvement in migration questions, with a shift from questions about ethnicity to questions about birthplace. Extensive use was made of these data in the form of place-of-birth/place-of-residence matrices (Masser and Gould, 1975). In addition, many African countries included a time-specific question in the 1980-round of censuses (e.g., Where were you living one year ago?). In theory, these changes and additions represented an important improvement in the quality of migration data, but in practice the results have been most disappointing and the resulting tabulations little used by analysts. The official report of the Kenya census of 1979 (Kenya, 1982:64), for example, concluded that

> the data on place of residence in 1978 was bedevilled by the biases that are liable to afflict all questions involving dating and reference periods in Africa…. It cannot be recommended for inclusion in future censuses in Kenya.

Nevertheless, a 1-year retrospective question was included in the 1989 Kenya schedule, but it will probably also produce unusable data. It is too early to offer systematic consideration of the results of the 1990 census round, but it is unlikely to generate many new insights into migration.

Because census analysis based on place-of-birth data no longer adds

TABLE 7–2 Literature Sources on Migration in Africa by Theme

Theme	Number of Studies Cited	Major Issues Addressed, Papers Presented
Data, methodology	128 (8.5%)	Data sources, scope, and limitations Conceptual issues and problems
Labor migration	202 (13.4%)	Internal: rural-rural to wage sector and rural-urban migration International: direction, types (especially brain drain), and effects
Resettlement/spatial distribution	153 (10.2%)	Postindependence resettlement process, types, results, and problems Demographic and socioeconomic challenges of resettled areas
Urban system/ urbanization	219 (14.5%)	Migrants' adjustment in urban milieu Relationship between migration and urbanization
Linkages to migration system	100 (6.6%)	Networks and linkages of internal and international migrants with areas of origins Indices of linkages: visits, remittances, sociocultural ties
Female migration	37 (2.5%)	Lack of studies on female migration and gender roles
Refugees	103 (6.8%)	Sources and destinations of refugees Causes and consequences of refugeeism and displacements
Nomadism	25 (1.7%)	Nomadism in Sahelian countries and Kenya Process, determinants, and consequences of nomadism
Migration and regional integration	34 (2.3%)	International migration in the context of regional integration/cooperation institutions in African national subregional economies
Migration and basic needs	53 (3.5%)	Migration and provision of food, shelter, education, health, etc.
General interrelationships and policies	453 (30.1%)	General internal and international migration studies Migration-influencing and migration-responsive policies
All themes	1,507	

SOURCE: Compiled from Union for African Population Studies (1990c).

significantly to what is known of patterns and differentials in movement, this source has been rather neglected in the search for information that will address the most interesting policy and research issues (e.g., circulation and return migration, household migration strategies, women as independent or family migrants). These data are much more likely to come from surveys, which have mostly been small scale. In only two cases—the National Migration Survey in Botswana (1978–1979) and the National Retrospective Survey in Burkina Faso (1974–1975) —have there been major innovations on the national scale directed to improvements in migration data. The Botswana multiround survey was based on a 3 percent national sample and four rounds of survey within 18 months, so that it was able to identify seasonal mobility, rural-urban interactions, the mobility of individuals in the context of the household, etc. The three-volume report of the Botswana migration survey offers a glimpse into what is possible with more innovative data collection methodologies (Botswana, 1982). The Burkina Faso study used a retrospective approach to the collection of individual migration-history data (Piché, 1990). It was able, for example, to record subsequent migration probabilities of various subgroups in the population by number of previous moves. Whereas 77 percent of men who moved once had a second move recorded in the 5-year period, the proportion was only 32 percent for women (Piché, 1990:307). However, the experience of these two innovative cases has not been repeated in the 1980s in any other African country.

Thus, for most countries, there has been an increase in the quantity, but not the quality, of material available, and there has simultaneously been a widening range of approaches. However, these have not been accompanied by equivalent improvements in or agreement about the most appropriate techniques of analysis. In particular, migration model building, so favored by economists and others in the 1970s, is no longer common. None of the migration papers at the International Union for the Scientific Study of Population (1988) African Population Conference or in the Union for African Population Studies (1990a,b) papers is based on spatial models of migration, such as the gravity model, or econometric models derivative of the Todaro model that was so widely discussed a decade earlier. An exception in the 1980s, however, is Mazur (1984) on labor migration in Mali. In a more strictly demographic perspective, however, some further possibilities do exist for exploration of multiregional methods for migration estimates (Bah, 1990).

The following section explores major trends and differentials in sub-Saharan Africa. It first adopts an essentially spatial perspective in summarizing the geographical patterning of movement, emphasizing the mix of rural and urban sources and destinations, and then explores migration selectivity, in particular through sex, educational, and occupational differentials. Explanations for these patterns and differentials are sought at different spa rial scales, from the factors operating at a global scale to those operating at the household scale.

Spatial Patterns

Rural-Rural Migration

Given that most people continue to live in rural areas, and that there is in all countries continuous and complex movement within rural societies, even at subsistence levels of development, intrarural movements continue to be the most common of the four major directional types of movement high-lighted in Table 7–1. They are of many types and include movements of nomads as well as those of agriculturalists. They may be seasonal, as in movements between the dry savannas and better-watered areas, or more long term into the commercial rural sector. They may be permanent moves for agricultural colonization or into formal resettlement schemes.

Nomadism is a feature of Sahelian Africa in the Horn of Africa (including northern Kenya, northern mainland Tanzania, and northeastern Uganda) and in southwestern Africa (Botswana and Namibia). Recent studies of nomadic pastoralists have emphasized the increasing impetus on the part of governments for sedentarization, as in Sudan and in the Sahel in general. Sedentarization involves the permanent settlement of once seasonally mobile communities. It requires year-round provision of water and pasture for animals, and cultivation has been increasingly incorporated into these economies with implications for the sustainability of the environment as well as for mobility. The Turkana, a typical example of nomads in Kenya, have their lives hanging in the balance as a result of the encroachment by modern life styles and the vagaries of climate, as well as other factors (Odegi-Awuondo, 1990; see also Ayiemba, 1990). Such is also the case elsewhere in sub-Saharan Africa, for example, in Somalia (Maro, 1990), Niger (Wright, 1990), and Mauritania (Traoré, 1990). In each of these cases, government schemes have sought to mitigate the disastrous effects of drought and, in some cases, civil war by facilitating the restocking of herds and flocks in association with settlement projects that ensure permanent water and pasture. However, the number of animals has tended quickly to outstrip the carrying capacity of the local environment, however enhanced, and environmental deterioration has often been the result.

More generally, migration within rural areas involves farmers moving spontaneously in search of new land or in formally organized resettlement programs. The significance of spontaneous migration is probably falling as suitable land is increasingly in short supply. However, spontaneous migration is still important in the general drift southward in West Africa and in movements to marginal lands, to the dry margins as in Kenya (Dietz, 1986), and to lower altitudes and therefore more disease-prone margins as in Ethiopia (Woldemeskel, 1989).

Much more widely discussed and much more obviously within the ambit of government policies are movements into government rural development schemes (Maro, 1990). Land transfer from the colonial to independent sub-Saharan African governments at or immediately after independence facilitated resettlement of the former "squatters" on the foreign-owned farms. Resettlement has also involved landless citizens and, in the case of Zimbabwe after 1980, combatants in the independence struggle. The Kenyan land settlement program in the highlands had largely ended by the 1980s (Leo, 1985), although it continued into the semiarid marginal lands. Resettlement in revolutionary Ethiopia (Wood, 1982, 1985), the *ujamaa* settlements in Tanzania (Thomas, 1982), and the "regrouping" of population in Botswana (Silitshena, 1982) are examples of politically inspired local redistribution and settlement. In the most recent experience in Zimbabwe, there remain deep-seated political and economic conflicts over the extent, type, and speed of resettlement. At independence in 1980, the government proposed a resettlement program of 18,000 households on former European-owned land. In 1981, this target was tripled to 54,000, and it increased again to 162,000 in 1982 with a completion goal of 1984. However, by 1989, only 52,000 households had been resettled, some 32 percent of the target, and most of these were in the poorer areas of the country and on individual farms rather than in cooperative schemes (Palmer, 1990).

Rural-Urban Migration

Although rural-urban migrants are not the largest group of internal migrants in sub-Saharan African countries, rural-urban movement, whether circulation and for a temporary sojourn in town or for permanent urban residence, is by far the most significant form of movement for the long-term trend of spatial redistribution, and as Table 7–2 suggests, it has attracted much study. To many governments, planners, and policymakers in sub-Saharan Africa, rural-urban migration is seen as the general case that all internal migration embodies. They have tended to overemphasize the importance of migration to the primate cities. Findings on urbanization as a migration phenomenon are discussed in detail below. Suffice it to say at this stage that the attraction of urban areas is largely, but not entirely, economic (Adepoju, 1990) and that rural-urban income and quality of life differentials remain large. The availability of jobs is critical, and rural-urban labor migration is dominant. However, the better availability of superior health care and educational opportunities (Gould, 1990), as well as housing (Ohadike and Teklu, 1990), can be additional attractions.

Urban-Rural and Interurban Migration

Two forms of migration are discussed together and rather briefly because of their relative unimportance, at least numerically, in sub-Saharan Africa. Urban-rural circulation consists of both periodic return migration synchronized with the peak agricultural seasons (notably weeding and harvesting) and labor migration to rural agro-industrial or mining complexes. Urban-rural migration is characterized by irregular “repatriation” not only of unemployed persons but also of criminals, and the relatively permanent return migration of both retirees and unsuccessful urban migrants. The Botswana National Migration Survey of 1978–1979 was able to show that 36 percent of all people surveyed in the four largest towns were rural-urban migrants; it was also able to show that 6 percent of those recorded had left town as urban-rural migrants (Case, 1982:117). Some urban-rural migration is already gathering momentum as sub-Saharan African governments continue to lower workers’ minimum retirement ages from 60 to 55 years and, in some cases, from 55 to 50 or even 45 years, and also as a result of retrenchment in public sector employment due to structural adjustment programs. Peil et al. (1988), for example, write of the Nigerian experience of workers “going home” after a career in urban employment.

Interurban movements are still minimal in sub-Saharan African countries, except in a large country such as Nigeria where they occur vertically within the urban hierarchy and horizontally among urban centers of the same size order. A survey of migrants in the mid-1970s to three of the largest towns in Nigeria—Benin, Kano, and Ibadan—recorded 21 percent coming from large cities (more than 100,000 inhabitants) and 18 percent from medium-sized cities (20,000–99,999). Another 18 percent of those recorded were intraurban migrants, from elsewhere in these three surveyed cities, but 43 percent were from rural areas or small towns of less than 20,000 (Lacey, 1985:697; see also Adepoju, 1983). The migrants include the self-employed, prospecting for profitable ventures and often moving frequently. Stepwise movement of migrants from smaller to larger urban centers includes public as well private sector workers transferred from one urban center to another.

Return Migration

Given their strong attachment to home areas and transient residence at the career destination, whether rural or urban, African workers tend to visit or migrate back to their homes after a period away.[1] Return migration

[1] A return “visit” is by implication temporary, with further outmigration expected, though its exact timing is not known. Return “migration,” by contrast implies a longer period at the origin, and perhaps no further migration.

remains seriously understudied in sub-Saharan Africa, yet it has important demographic and developmental implications in the migrants' home areas. Persistence of return migration is an African phenomenon that continental literature surveys (Oucho, 1985b, 1990a) as well as some local studies, for example, in Zambia (Chilivumbo, 1985) and Kenya (Oucho, 1988), have confirmed. Oucho (1990a) reports that in all parts of sub-Saharan Africa, more than two-thirds of migrants visit home at least once a year. Related to the issue of return migration is the remittance that migrants send or bring back to their home of origin. These remittances help to ensure that the migrants will be accepted back into the home should they need or want to return at some point in the future. In southwest Nigeria about 60 percent of migrant heads of households in rural areas were remitting to their home areas at least once a year. In Kenya, in the early 1980s, more than 70 percent of urban households were remitting income at least once a year (Oucho, 1990a:121).

Migration Selectivity and Differentials

An important feature of any form of voluntary internal migration is the selectivity of migrants by demographic and socioeconomic characteristics from the general population. In this section, attention is directed to the most discussed differentials that are of particular interest to population analysts: age, sex, education, and occupational status.

Age Selectivity

Age differentials are well documented. Table 7–3 reports the peak age of internal migration based on census and survey data for 1964–1984 in selected countries. The majority of the studies identified in Table 7–3 indicate 20–24 as the modal age group. As a result of rapidly accelerating numbers of primary and secondary school graduates, for example, in Kenya (Gould, 1985), who are younger than their counterparts of two or three decades ago, the peak age at outmigration is probably falling, but migration still affects people throughout their economically active lives. The decline in the average age of migrants, however, has created a widespread desire on the part of governments to stem rural-urban migration of young, able-bodied, better-educated, and more development-conscious people, and to encourage them to be more active in development in the rural areas.

Sex Differentials

There was a very marked sex differential in both forced and voluntary labor recruitment during the colonial period. Males were recruited for ardu ous tasks in the agricultural wage sector as well as in the mines. They also occupied blue-collar and white-collar jobs in urban areas, but were often prohibited from bringing their wives or families. The use of sex ratios to distinguish between outmigration and inmigration areas is made possible by the continuing sex differentials in migration. Estimates of sex ratios from censuses and surveys reveal high sex ratios (i.e., more men than women) in destination areas and low sex ratios in areas of origin. With the major exception of Ethiopia, sex ratios are generally higher in urban areas than for nations as a whole, but that differential is being reduced in most cases (Table 7–4). Institutional constraints in rural areas (notably gender bias in allocation of land in resettlement schemes) and in urban areas (notably the use of educational qualifications for job selection) have kept women out of the migration system. The National Migration Survey of Botswana in 1978– 1979 showed that although equal numbers of males and females were recorded as intrarural (intervillage) movers in the multiround sample, many more males (69 percent) than females (29 percent) migrated to towns, mines, and commercial farms (Case, 1982:144). By the 1980s, however, conditions in rural and urban areas had changed, and more women were migrating, either with their husbands in family or associative migrations, or as individual women on their own account. One survey in Dakar, Senegal, for example, has disaggregated migrants by sex and cause of migration, and found that only one-third of women migrants were involved in household migration primarily, but nearly 30 percent of women were looking for formal employment (Badiane, 1990:249). The variability of national experiences, however, is again considerable. A survey in Nairobi, Kenya, at about the same time as the study in Senegal found that the majority of women migrants were involved in household-related moves (Omogi, 1992).

Zachariah and Condé (1981) concluded that for West Africa the sex composition of migration streams varied considerably in the 1960s and 1970s, but that the proportion of women in the migration streams was increasing in that period. This conclusion was likely to be as true for other major regions of the continent. The UAPS-commissioned overview of female migration in sub-Saharan Africa reaches five major conclusions: (1) female migrations are on the increase; (2) women migrants are motivated by much the same economic and sociopsychological reasons as male migrants; (3) women are more likely to migrate from areas where there has been a slackening of control on gender-ascribed roles; (4) women's life cycles affect the nature of the migrations they are involved in; but (5) "in spite of economic gains to a significant proportion, women's status is not much enhanced after migration" (Makinwa-Adebusoye, 1990:208). Overall, autonomous migration is now more important than associational migration of women.

TABLE 7–3 Peak Age of Internal Migrants in Selected Sub-Saharan African Countries

			Peak Age Group of Migrants		
Region and Country	Year of Census/Survey	Migration Type	Author and Date of Publication	Years	Percentage of Total Migrants
Western					
Burkina Faso		Rural-urban	Coulibaly et al. (1980)	20–24	40.0
Ghana	1964–1965	Rural-urban	Caldwell (1969)	15–19	11.0 (M) 10.0 (F)
	1970[a]	Rural-urban			
	1970[a]	Rural-urban	Gaisie and de Graft-Johnson (1976)	15–19	N.S.
	1972–1973	Internal	Nabila (1979)	20–24	34.5 (M)
Liberia	1974[a]	Internal	Campbell (1987)	25–34	58.8 (M) 33.4 (F)
Mali	1978–1979	Internal	Mazur (1984)	20–24	35.2
		Labor		38.8	20–24
Nigeria	1954–1965	Rural-urban	Ejiogu (1968)	15–24	34.2 (M)
				25–34	28.7 (F)
	1976–1977	Rural-urban	Makinwa (1981)	20–29	47.5
	1979	Rural out-migration	Adepoju (1986)	15–29	39.5
Eastern					
Ethiopia	1984[a]	Rural-urban (to Addis Ababa)	Ethiopia (1987)	15–49	70.4

Kenya	1968–1969	Rural-urban (M)	Rempel and Todaro (1972)	20–24	40.9
	1978–1979	Rural-rural	Oucho (1981)	25–29	29.3
	1973–1974	Rural-rural	Migot-Adholla (1975)	31–35	14.5
	1979	Internal	Kenya (1982)	20–24	14.5
	1979	Rural-urban	Kenya (1982)	15–29	42.1
	1981–1982	Rural-rural	Odallo (1985)	25–29	30.2
		Rural-rural	Oucho (1985a)	25–29	
Tanzania	1971	Rural-urban	Barnum and Sabot (1976)	20–24	9.2
Zambia	1980	Rural-rural and rural-urban (to Copperbelt)	Zambia (1985)	15–24	20.6
Southern					
Lesotho	1978–1979	Rural-urban	Lesotho (1982)	20–24	44.0 (M) 56.0 (F)
Botswana	1977–1982	Rural-urban	Botswana (1982)	15–34	65.0
		Rural-rural		15–34	43.0
Internal	Cobbe (1990)	25–34	68.5		

NOTES: M: males; F; females. N.S.: not stated.

[a]Census data; otherwise survey.

SOURCE: Data from Union for African Population Studies (1990a).

TABLE 7–4 Urban Sex Ratios, Sub-Saharan Africa, 1963–1985

	Sex Ratio: Males per 1,000 Females			
Region and Country	Year	National	Urban	Adjusted Urban[a]
Western				
Cameroon	1976	960	1,077	1,122
Côte d'Ivoire	1975	1,074	1,177	1,096
Ghana	1960	1,022	1,062	1,039
	1970	985	996	1,011
	1984	973	949	976
Nigeria	1963	1,020	1,149	1,127
Middle				
Zaire	1984	988	992	1,004
Eastern				
Ethiopia	1968	1,025	903	881
	1984	994	867	872
Kenya	1969	1,004	1,386	1,380
	1979	985	1,216	1,234
Mozambique	1980	945	1,097	1,161
Tanzania	1967	955	1,180	1,236[b]
	1973	969	1,078	1,112
	1978	962	1,075	1,117
Uganda	1969	1,019	1,191	1,169
Zimbabwe	1969	1,012	1,412	1,395
	1982	960	1,140	1,188
Southern				
South Africa	1951	1,031	1,192	1,156
	1960	1,010	1,150	1,138
	1970	973	1,119	1,151
	1980	1,035	1,068	1,032
	1985	975	1,007	1,032[c]
Northern				
Sudan	1973	1,023	1,131	1,105
	1983	1,031	1,133	1,098

NOTE: Ratios are calculated from national censuses and estimates for the 1950s, 1960s, and 1970s compiled by the United Nations.

[a]The adjusted urban sex ratio is the urban figure divided by the national figure, and multiplied by 1,000; slight divergences are due to rounding.

[b]Tanganyika only.

[c]Excluding Bophuthatswana, Ciskei, Transkei, and Venda.

SOURCE: Gilbert and Gugler (1992:76,77). By permission of Oxford University Press.

Educational Differentials

Many studies have established the positive relationship between migration and education (Gould, 1982). As early as the 1960s, Caldwell showed in Ghana that "what education does, more than anything else, is to promote long-term rural-urban migration" (Caldwell, 1969:62). In the colonial period the majority of the educated—almost invariably males—migrated to urban areas, and the uneducated gravitated toward areas of mining and agricultural wage employment. Lipton (1980:6) concluded that the movement was "educated to the big city, illiterate to rural areas." Because fewer females than males in any age cohort had received formal education, their propensity to migrate was low, but over the last few years the picture has changed dramatically with rising female enrollment ratios in the majority of countries.

Generally migrants have higher educational attainment than nonmigrants. Even in Ghana where great strides were made in educational expansion, migrants recorded higher levels of school attainment than nonmigrants in the 1960 and 1970 censuses (Zachariah and Condé, 1981:70–71). This differential is consistent with rural areas having poorer prospects because they continue to lose the educated to urban areas. In Tanzania, it was found that "when educated workers are in surplus relative to the number of skilled jobs, urban expected income for the educated declines from the skilled to the unskilled wage" (Barnum and Sabot, 1976:37–38), but that because the unskilled wage still exceeds rural income, educated workers continue to migrate to urban areas. Increasingly, however, the educated are becoming involved in rural-rural migration streams to jobs that they had previously scorned, or else they are migrating into low-income or informal-sector activities in urban areas. School leavers may be prepared to take up any job in order to survive, as in Kenya in the tea and sugar industries (Odallo, 1985; Oucho 1985a).

Occupational Characteristics

Rural-urban migration studies in Africa and elsewhere have confirmed that relatively wealthy households are more able than the poorer ones to sponsor outmigration of some of their members. Thus, household income is positively related to outmigration, as it is to the expected income at destination. Skilled persons, or those with some education and potential for skill training, tend to prefer rural-urban migration, but the unskilled and poorly educated are found in rural-rural migration streams. In West and Central Africa, an increasing number of rural-urban and urban-urban flows consists of self-employed persons or of persons in formal employment with some informal sources of income.

Data from two West African countries illustrate occupational differentials of migrants. In Ghana, in 1970, substantial proportions of intraregional and interregional migrants of both sexes—63 and 44 percent, respectively, were employed in agriculture, followed by commerce as a distant second. In neighboring Togo, in 1970, 45 percent of intraregional male migrants and 42 percent of interregional male migrants were classified as production workers, transport equipment operators, and laborers; corresponding proportions for migrants in agro-industry including hunting and fishing, were 38 and 41 percent, respectively (Zachariah and Condé, 1981:76–77). Both cases reflect the importance of unskilled migrants as well as the self-employed, and the fact that migrants move into the informal as well as the formal sector (Lubell, 1991).

Determinants of Migration

Nearly all migration studies recognize that economic motives are necessary but not sufficient to explain population movements, and much of the recent work has sought to identify causation on different scales—from the macroscale, based on broad and generalized inferences from structuralist analyses, to the microscale, based on behavioral studies. However, no single study can claim an exhaustive inventory of all possible causes. This section identifies five major types of explanation, each of which has important current relevance to the policy context in which the components of population change are assessed.

External Factors

The global economic and political order increasingly dictates internal conditions and policies of African governments, whether indirectly through prices of exports, for example, or directly through structural adjustment policies. These, in turn, may affect patterns and types of internal movements. However, the process is not one in which crude economic determinism provides the outcome. One general aim of structural adjustment policies has been to narrow the income gap between rural and urban areas by offering greater incentives through higher prices to rural producers and by squeezing urban income earners. The normal migration expectation from such policies would be to reduce the rate of rural-urban movement. However, as Jamal and Weeks (1988) have amply demonstrated, rural-urban migration has not stopped, despite the narrowing of the income gap between rural and urban areas. It is clear that much more attention needs to be directed to these effects, particularly to supply-side rather than demand-side factors in rural-urban migration.

Government Policies and Programs

Administrative and structural arrangements have a direct and pervasive influence on migration. Development plans designed by individual governments often incorporate policies that explicitly address migration though, normally, consideration of migration is much less strongly emphasized than fertility or mortality. These include rural development programs and resource development programs for river or lake basins (e.g., the Niger River Authority, the Lake Victoria Development Authority in Kenya). These stimulate outmigration from some areas and inmigration to others (Maro, 1990). The experience of the majority of countries underscores the relationship between migration and development at national, regional, community, and household levels, because migration is both a cause and a consequence of development. Specifically, migration has been seen as both a function and a cause of uneven development in Zambia (Chilivumbo, 1985). Several papers in the UAPS volumes (Union for African Population Studies, 1990a,b,c) and most in the collection *Population and Development Projects in Africa* (Clarke et al., 1985) directly address the role of government in the migration process. The most obvious general conclusion of these studies is that governments have been able to exercise some control, which is most usefully directed to particular projects. However, governments generally have been able to exercise relatively little control, whether directly or indirectly—certainly less than they would have wished.

There are a number of countries in which government policies have caused migration very directly. A rice-growing effort in northern Cameroon has modified demographic behavior including migration patterns (Audibert, 1985). Similarly, the Cross River plantation projects in Nigeria have stimulated inmigration (Uyanga, 1985). In Ghana, north-south population movements to the cocoa and mining areas, as well as the coastal towns, and migration from the eastern part of the country to the same areas are stimulated and sustained by resource endowments and labor demand (Addo, 1987). Adepoju (1987) has shown how the Fourth National Development plan of Nigeria spelled out both migration-influencing and migration-responsive policies. Ejionye (1988) further suggests that Nigeria should guide migration and regional planning, adopt a meaningful industrial policy, and set up a national planned population movement commission or perhaps incorporate migration in a more comprehensive population policy. In Togo, migration is considered a rational response to collective needs related to systems of production, notably the need for diversifying cash income (Vignikin, 1986).

Community-Level Variables

Outmigration and inmigration are both affected by factors operating at the level of the community (e.g., transportation systems, community facili ties (mainly social), institutional factors, agriculture, researchers' impressions of the economy, and modernization). One example comes from a study of migration from the Tshopo area to the city of Kisangani in Zaire, which found that push factors, such as the abuse of power by village elders, witchcraft, and the lack of infrastructure at the village of origin have a stronger influence than the city's pull (Streiffeler and Mbaya, 1986). In Mazur's (1984:248) village-level analysis of Mali, village characteristics supersede or interact with particular characteristics of individuals and households to determine labor allocation and migration.

Moreover, in sub-Saharan Africa, there exist strong sociocultural bonds and networks among migrants, as well as sustained linkages between migrants and stayers, that determine and sustain migration (Oucho, 1990a). The presence of relatives at a destination is sometimes more important than economic motives because prospective migrants must start from a base before being self-reliant. So, chain migration may be sustained within ethnic or kinship structures.

Household Decisions and Considerations

Some migration-influencing or migration-responsive policies are aimed at relocation of families (e.g., land settlement) and, accordingly, involve household decisions and all or part of a household moving in the process. In the case of rural-urban migration it has been recognized that the migration process may create the phenomenon of "one family, two households" (Weisner, 1972). This situation of a family geographically separated into two households as a result of migration is familiar throughout sub-Saharan Africa, and explains the compatibility of urban employment and job search with the rural linkages of migrants in towns (Oucho, 1985a, 1988, 1990a). These and other studies suggest that individual migration behavior may be due more to family or household obligations and considerations than to individual economic decisions. The Burkina Faso National Retrospective Survey in 1974–1975 showed a positive relationship between the proportion of households with absentees and the size of the household. For example, whereas slightly more than 15 percent of households that have one member residing at home have other members who are absent, more than one-third of households with five residents have absentee members, and more than half of the households with ten residents have absentee members (Piché, 1990). The dynamics of the household and the new home economics, currently major issues for fertility studies in sub-Saharan Africa, are also highly relevant to migration analysis.

Environmental and Resource Factors

The environment has a significant effect on population movements. The case of nomadic pastoralists and their seasonal or shorter-term mobility in search of pasture for their animals is the most obvious example, but where there has been sedentarization of pastoralists the environment needs to be managed to ensure survival. More generally, however, migrants move from hostile to less hostile environments or into environments recently freed of environmentally conditioned disease infestation (e.g., malaria; Prothero, 1965) or onchocerciasis, as in the current major program in the West African savanna. Labor migration may take place to extremely inhospitable areas, where settled agriculture is almost impossible, for the exploitation of mineral deposits (e.g., Mauritania or the Orapa diamond mine in Botswana). More typically, however, rural-rural resettlement has been into benign agricultural environments, such as the resettlement lands of Kenya and Zimbabwe or riverine areas in West Africa.

The environmental factor in migration has not been given much prominence in recent years, as is evident in the lack of concern shown in the Nairobi conference papers and migration literature (see Table 2). However, the African environment and its management in the face of global and more local environmental change have emerged as key factors in development, and there is often a presumption in the nonmigration literature that these factors will lead to major permanent migrations within, and even out of, the continent. It is clear from the discussion in this chapter that permanent migration is not the only response to change, and that various forms of circulation and other nonpermanent moves are the likely migration response to environmental change in the short and medium term. Mortimore's (1988) study of farmers' responses to drought in northern Nigeria illustrates the range of responses, including both circulation and permanent migration, that allow a population to be resilient in the face of environmental deterioration. His approach may be a model for a great deal of migration analysis on this theme that may be needed in the coming years.

URBANIZATION

Conceptual and Measurement Issues

In sub-Saharan Africa, rapid urbanization has preceded industrialization; indeed, the African experience seems to imply that it is completely independent of it. Growth of the urban population can be looked at in two ways: on its own, in which it is described as urban growth, and as a proportion of the national population, in which the term urbanization is used. Urban growth, strictly speaking, refers to the growth rate of urban areas themselves (annual net additions to urban population divided by the size of the urban population), and urbanization is the process of growth in the proportion of the national population living in urban areas (Preston, 1982:650).

The urban population is typically measured on the basis of "localities," which are spatially defined population conglomerations. Localities are defined as urban or rural generally on the basis of a size criterion, though other criteria such as the nature of the locality are sometimes used. Changes in definitions can lead to large changes in urban population, without any corresponding difference in residence or function.

Cross-national comparisons are difficult because the population threshold of urban localities differs from country to country such that even simple comparison of urban populations can be problematic. In sub-Saharan Africa the urban population threshold ranges from settlements of 20,000 to as few as 500 inhabitants, as in South Africa and Zimbabwe, which have townships of 500 or more inhabitants. In Kenya and Zaire, an urban area is a settlement with 2,000 or more inhabitants; in Ghana, the threshold is 5,000 inhabitants (Ajaegbu, 1979:87). According to the United Nations classification, any settlement with a population of 2,000 or more is considered urban, but the United Nations Economic Commission for Africa (1975) recommends the following classification of urban localities, which is used in the discussion below: rural locality, less than 20,000 and therefore including many small towns; urban locality, 20,000–99,999; city, 100,000– 499,999; big city, 500,000 or more.

Urbanization Levels and Trends

Sub-Saharan Africa is characterized both by a small proportion of its population in urban areas and, at the same time, by rapid urban growth.

Urban Population Size

In 1970, 32 million people in sub-Saharan Africa lived in urban areas with populations of more than 20,000:32.5 percent in urban localities, 42.3 percent in cities, and 25.2 percent in big cities (Ajaegbu, 1979:88). Thus, about three-quarters of the urban population lived in urban centers of 20,000 to 500,000 people. Of the 339 urban centers then recording populations of 20,000 or more, 184, or 54.3 percent, were in the size class of 20,000– 50,000, mainly in western Africa. Only two, Johannesburg in South Africa and Kinshasa in Zaire, had assumed the status of cities with populations of more than a million. The number of cities with more than 500,000 inhabitants rapidly increased from 3 in 1960 to 28 by 1980. By 1990, only four sub-Saharan African urban agglomerations—Johannesburg (4.6 million), Lagos

(4.0 million), Kinshasa (3.2 million), and Cape Town (2.4 million) —ranked among the 100 largest metropolitan areas of the world (Population Crisis Committee, 1990). The least urbanized areas of sub-Saharan Africa include the Sahel zone from Senegal to the Horn of Africa and south from there through the East African highlands and Zambia into Namibia (Escallier, 1988).

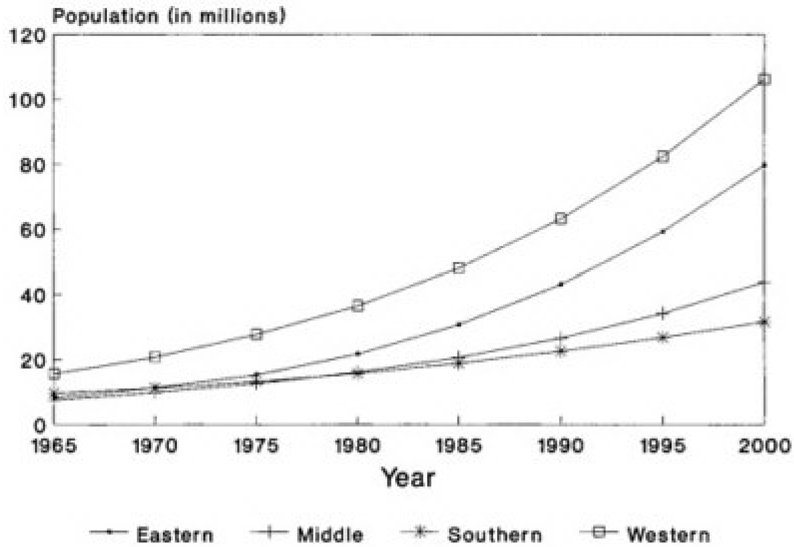

FIGURE 7–1 Total urban population in sub-Saharan Africa, 1965–2000. SOURCE: United Nations (1991:118–128, Table A–2).

Though the total urban population in all four regions has increased substantially (see Figure 7–1), the average growth rates have not; in fact, according to United Nations estimates and projections, growth rates throughout Africa are expected to decrease (see Figure 7–2).

Urban primacy, the dominance of a single city, generally the national capital, as the main administrative, economic, and financial center, is the rule rather than the exception (Adepoju, 1988:126). Overall, primate cities in sub-Saharan Africa account for 30–40 percent of the national urban populations (Hill, 1990). In some countries, however, there is a dual dominance—Yaoundé and Douala in Cameroon, Brazzaville and Pointe Noire in Congo, and Harare and Bulawayo in Zimbabwe. Nigeria is an outstanding exception because there are several large cities, with Lagos, Kano, and Ibadan all having more than 1.5 million people, and Port Harcourt, Kaduna, and Ilorin about 1.0 million in 1990. In other cases, though, the dominance of the primate capital is not only large, but seems to be increasing. In Table 7–5 the size of the four largest cities at a range of dates is given for five countries, with indices of primacy.[2] Nigeria is clearly the most diversified and has stable indices of primacy over time. Ethiopia, Mali, and Senegal, by contrast, all have capital cities that are at least three times the size of the second largest city, and the indices of primacy have increased over time. Zambia has a lower level of primacy, but the primacy indices are rising (Antoine and Savané, 1990).

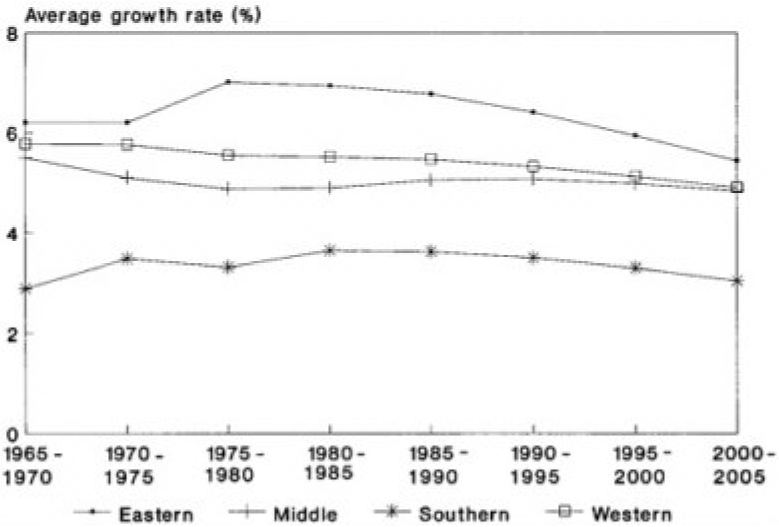

FIGURE 7–2 Average growth rates of urban population in sub-Saharan Africa, 1965–2000. SOURCE: United Nations (1991:154, Table A.5).

Many countries have also experienced the growth of smaller centers, often as a result of administrative decentralization, as in the state capitals in Nigeria and, to a lesser extent, the regional capitals in Tanzania. In Kenya, concern for the structure of the urban hierarchy and the need to develop a mature pattern of lower-order centers have been central to national development plans since the mid-1970s. Although Nairobi continues to dominate, the number of smaller centers and the proportion of the urban population

[2]The indices of primacy are the ratio of the largest city to the second largest city and the ratio of the largest city to the sum of the second, third, and fourth largest cities.

living in them have risen consistently. Nairobi contained 43, 40, and 47 percent of the urban population recorded in the 1948, 1962, and 1969 censuses, respectively, but its proportion fell to 36 percent in 1979, and urban areas with fewer than 10,000 people had 12 percent of the national urban population by that date; see Table 7–6 (Obudho, 1990).

Rate of Urban Growth

There is a diversity of regional experience of rates of urban growth in the period since independence (Figure 7–2). The overall rate of urban population growth rose slightly, from 4.6 percent a year for 1965–1970 to 5.0 percent a year for 1985–1990, and it is expected to remain at about that level or slightly less to the end of the century. Projections of declining growth rates of urban populations in western and eastern Africa defy the popular notion of expected accelerated rates about which national governments often warn their citizens, and which the international media tend to assume.

Proportion of Urban Population

Trends in the urban proportion show striking subregional differentials, as can be seen in Figure 7–3. Between 1965 and 1985, the proportion of the total population living in urban areas in southern Africa rose from 43 to more than 50 percent; in middle Africa, from 21 to almost 35 percent; and in western Africa, from 17 to 29 percent. The least urbanized subregion, eastern Africa, has experienced increased urbanization, though the urban proportion has stayed less than 20 percent, rising from less than 10 percent in 1965. By the year 2000, the projected proportions are expected to exceed one-third of the national populations in all regions except eastern Africa. Four eastern African countries (and all but three in middle Africa), Namibia and South Africa (whose urban populations had already exceeded one-half by 1985), and four western African countries are expected to be 50 percent urban by the turn of the century. However, the extent to which the proportion of the population in urban areas can be expected to rise is likely to be highly variable, dependent on local cultural and land use considerations that affect the persistence of circulation of urban migrants.

Components of Urban Population Growth

Demographic Components

Although rural-urban migration has generally been identified by national governments and scholars of migration as a principal cause of urban ization in sub-Saharan Africa, it is by no means the only one. Migration combines with natural increase in urban areas, as well as administrative reclassification of former rural territories into urban territories.[3] These three components of urbanization, the first two demographic and the third nondemographic, may be influenced by urban and industrialization policies and by national development policies (Makannah, 1990).

TABLE 7–5 Population (in thousands) of the Four Largest Cities and Urban Rank Indices, Selected Countries

	Nigeria			Zambia		
	1963	1972	1984	1963	1969	1980
Population						
First city	665	1,569	4,486	123	262	536
Second city	627	1,479	4,230	123	200	264
Third city	295	578	1,654	93	160	250
Fourth city	209	409	1,157	81	107	139
Rank Indices						
First and second cities	1.06	1.06	1.06	1.00	1.31	2.03
First through fourth cities	0.59	0.64	0.64	0.41	0.56	0.82

SOURCE: Antoine and Savané (1990:65).

In the first postindependence decade (1960–1970), a period during which national governments relaxed the restrictive rural-urban migration laws of the colonial period, 12 of the 16 cities of more than 100,000 grew mainly as a result of inmigration. Migration was particularly significant to Conakry, Freetown, and Lagos in western Africa, and to Kinshasa and Luanda in middle Africa. The greater contribution of migration persisted into the decade, 1980–1990, but is projected to decrease in the last decade of the century in a majority of cities. Makannah (1990:16) has estimated for 14 cities that between 1960–1970 and 1970–1985 there were declining trends in

[3]The discrepancies between, and changes in, administrative and census definitions of urban areas continue to adversely affect the statistical analysis of the urbanization process in sub-Saharan Africa.

the contribution of migration to their growth (Figure 7–4). These data show considerable consistency in the relationship between the declining overall rate of growth and the declining contribution of migration to that growth. In all subregions the contribution of migration to urban growth has been declining, despite the fact that natural growth rates in towns have been lower than in rural areas.

Ethiopia		Mali			Senegal		
1967	1984	1960	1976	1987	1950	1976	1988
644	1,413	128	419	646	375	813	1,309
179	275	28	65	89	70	115	175
51	98	28	53	74	70	104	152
43	76	20	49	73	50	92	137
3.60	5.14	4.57	6.45	7.26	5.36	7.07	7.48
2.36	3.15	1.68	2.51	2.73	1.97	1.61	2.82

POPULATION DISTRIBUTION AND DENSITY

Conceptual and Measurement Issues

Both migration and urbanization involve the redistribution of population. There are parts of sub-Saharan Africa that contain large numbers of population and others that are virtually uninhabited, but as a result of the mobility described in previous sections there is continuous redistribution. Yet the distribution at least of the rural population remains seriously constrained by environmental considerations and carrying capacities at prevailing levels of agricultural technology and organization. The concept of carrying capacity is a controversial one, as are implications of population pressure (Mabogunje, 1990), but both of these relate to the ratio of popula

TABLE 7–6 Urban Centers by Size of Urban Population: Kenya, 1948, 1969, and 1979

	1948			1962			1969			1979		
Size of Settlement	Population	%	*N*	Population	%	*N*	Population	%	*N*	Population	%	*N*
100,000+	119,000	43.1	1	447,000	66.0	2	756,000	68.6	2	1,322,000	56.9	3
20,000–99,000	85,000	30.8	1	62,000	9.2	2	80,000	7.3	2	586,000	25.2	13
10,000–19,999	29,000	10.5	2	43,000	6.3	3	91,000	8.3	7	140,0000	6.0	11
5,000–9,999	20,000	7.2	3	76,000	11.2	11	92,000	8.3	11	154,000	6.6	22
2,000–4,999	23,000	8.3	10	49,000	7.2	6	83,000	7.5	25	123,000	5.3	42
Total	276,000		17	677,000		24	1,102,000		47	2,325,000		91
Urban(%)		5.9			7.8			9.9			15.1	

NOTE: *N*=number of cities.

SOURCE: From Obudho (1990:216, 217).

tion to land resources, and therefore to the population distribution and density. Both crude and more refined indices of population density need to be considered. Crude or arithmetic population density (population per unit of area) in subnational units often reported in censuses needs to be supplemented by physiological (population per area of arable land) or nutritional (potential calorie production per unit of land) density. Hance (1972) cautioned about the "crudeness of crude density" approach, which on a continental scale gives the impression of an empty continent yearning for a bigger population. It is only on a smaller scale, however, that the effect of population densities and issues arising out of the relationships between rising population densities and environmental sustainability can be usefully approached.

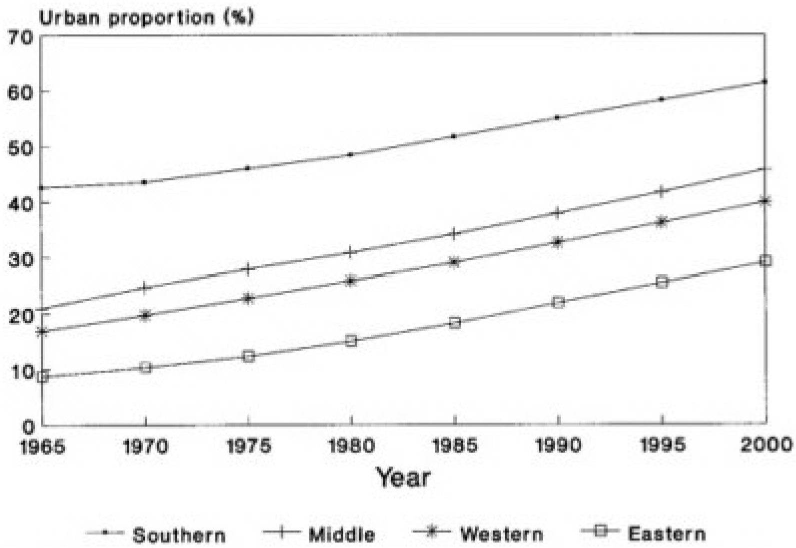

FIGURE 7–3 Proportions of total population living in urban areas in sub-Saharan Africa, 1965–2000. SOURCE: United Nations (1991:106–116, Table A.1).

Population Density

Table 7–7 presents national estimates of crude population density for the majority of sub-Saharan Africa in 1975 and 1985. These are national averages and therefore need to be treated with some caution because they obscure the local variations that in most countries are substantial. In a country such as Kenya, for example, 90 percent of the population lives on only 20 percent of the land area, and locally the population density is a function of both economic and environmental conditions (Bernard, 1982; Gould, 1992b). The physiological densities, measured by population per square kilometer of arable land, are also shown on Table 7–7;[4] these take environmental conditions into account.

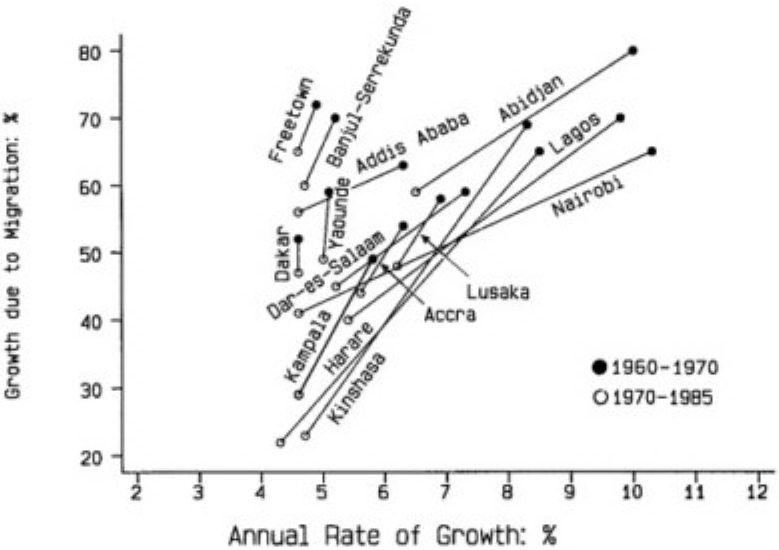

FIGURE 7–4 Urban population growth and the contribution of migration: selected cities, 1960–1985. SOURCE: Makannah (1990:86).

It should be noted at this point that increases in population density on the national scale are due primarily to population growth rather than to redistribution. Even in countries with very considerable population move

[4]According to the Food and Agricultural Organization Production Yearbook 1976 and 1986 (Food and Agricultural Organization, 1976:3, 1986:ix), "Arable land refers to land under temporary crops (double-cropped areas are counted only once), temporary meadows for mowing or pasture, land under market and kitchen gardens (including cultivation under glass), and land temporarily fallow or lying idle." In addition, in 1986, the yearbook stated that "[t]he reader will notice significant changes in the arable land of some African countries. This is due to the exclusion of large areas of what is considered by these countries as fallow land resulting from shifting cultivation" (Food and Agricultural Organization, 1986:ix).

ment, as described in this chapter, rising densities occur in most rural areas, even those with net outmigration, because the extent of outmigration seldom exceeds the rate of natural growth. Only in a few areas (e.g., parts of the Niger Delta in Nigeria, coastal Sierra Leone) have absolute population declines been recorded in areas of settled agriculture (Gould, 1992a:303).

As can be seen from Table 7–7, the population densities of countries in sub-Saharan Africa vary widely. In 1985, they ranged from 2 people per square kilometer in Botswana and Mauritania to 232 people per square kilometer in Rwanda. A cursory look at the data indicates that, on average, population densities tend to be the lowest in middle Africa, where they range from 4 to 21.

Between 1975 and 1985, the crude population density increased in every country for which data are presented. These data indicate that the percentage increase was greatest in Somalia, Gabon, Botswana, and Mauritania, where it increased by 100 percent. The smallest percentage increase took place in Madagascar, 21.4 percent.

As mentioned above, these crude measures conceal local variations in density that are related, in part, to environmental conditions. Physiological density provides one way to control for environmental differences. In 1985, the physiological densities ranged from 79 in Botswana to 1,675 in Liberia. Again, by using this criterion, middle Africa is somewhat less dense than the rest of Africa, though there is considerable overlap. Like crude densities, most physiological densities increased between 1975 and 1985. The largest percentage increases were in Mali, Mauritania, and Niger, whereas there were actually declines in physiological density in Angola, Gabon, Botswana, and Senegal, probably due, for the most part, to a reestimation of the amount of land that is arable.

Population Redistribution

As cited in the earlier discussion of migration, a large volume of literature on population redistribution in sub-Saharan African countries has appeared during the postindependence era. Overall settlement concentration, through urbanization as well as villagization programs in rural areas of Ethiopia, Tanzania, Mozambique, Zimbabwe, and Botswana, has been characteristic on the national scale. The literature addresses diverse forms of redistribution that have taken place, including agricultural resettlement that characterized these countries in the process of land transfers from foreign settlers to the indigenous people, as well as redistribution of population from areas of population pressure to either the newly acquired lands or other less densely settled parts.

Population redistribution in sub-Saharan Africa may be classified into five main types: (1) resource- or development-induced redistribution; (2)

TABLE 7–7 Arithmetic and Physiological Population Densities per Square Kilometer in Sub-Saharan Africa by Subregion and Country, 1975 and 1985

	Crude		Physiological		Change, 1975–1985 (%)	
Region and Country	1975	1985	1975	1985	Crude	Physiological
Western						
Benin	28	36	106	291	28.6	174.5
Burkina Faso	22	29	108	301	31.8	178.7
Côte d'Ivoire	21	32	83	355	52.4	327.7
Ghana	41	54	940	1,146	31.7	21.9
Guinea	18	25	108	405	38.9	275.0
Guinea-Bissau	15	25	208	307	66.7	47.6
Liberia	15	20	1,221	1,675	33.3	37.2
Mali	5	7	49	390	40.0	695.9
Mauritania	1	2	132	929	100.0	603.8
Niger	4	5	31	164	25.0	429.0
Nigeria	68	103	276	334	51.5	21.0
Senegal	21	33	173	123	57.1	–28.9
Sierra Leone	41	51	74	223	24.4	201.4
Togo	40	52	100	218	30.0	118.0
Middle						
Angola	5	7	496	297	40.0	–40.1
Cameroon	13	21	95	167	61.5	75.8
Central African Republic	3	4	31	136	33.3	338.7
Chad	3	4	58	159	33.3	174.1
Congo	4	5	211	264	25.0	25.1
Gabon	2	4	421	340	100.0	–19.2
Zaire	11	13	342	512	18.2	49.7

Eastern						
Burundi	134	170	351	422	26.9	20.2
Ethiopia	23	35	215	320	52.2	48.8
Kenya	23	35	848	1,083	52.2	27.7
Madagascar	14	17	311	404	21.4	29.9
Malawi	43	60	223	304	39.5	36.3
Mozambique	12	17	324	480	41.7	48.1
Rwanda	162	232	612	848	43.2	38.6
Somalia	5	10	305	604	100.0	98.0
Tanzania	16	24	306	551	50.0	80.1
Uganda	49	66	296	316	34.7	6.8
Zambia	7	9	100	135	28.6	35.0
Zimbabwe	16	21	256	313	31.3	22.3
Southern						
Botswana	1	2	135	79	100.0	–41.5
Lesotho	35	51	293	513	45.7	75.1
Namibia	1	–	137	–	–	–
South Africa	21	–	190	–	–	–

NOTES: Crude, or arithmetic, population density is the population per unit of area. Physiological population density is the population per area of arable land (see footnote 3 for the definition of arable land). —: not available.

SOURCE: Data from United Nations Economic Commission for Africa (1978: Table 4, pp. 17; 1988: Table 4, pp. 17–20).

government-induced population transfers and resettlement; (3) spatial redistribution due to migration and urbanization; (4) relocation resulting from environmental hazards and catastrophes; and (5) spontaneous settlement/ resettlement (Clarke and Kosinski, 1982; Clarke et al., 1985; Maro, 1990). The first, third, and fifth categories are found in almost all sub-Saharan African countries, which suggests the importance of resource and development endowments in attracting large numbers of redistributed populations. Government policies based on bargains between the departed colonial powers and the incoming independent government, as in Kenya and Zimbabwe, triggered redistribution not only of the landless population but also of progressive farmers lured by commercial agriculture. In Ethiopia and Tanzania, socialist political ideology resulted in large-scale population resettlement and villagization in the 1970s and 1980s. These political policies have been relaxed only recently in light of new realities in these countries' political economies. It should be cautioned, however, that the five types of population redistribution are not mutually exclusive, and most if not all can be found in any one country. Combinations of the five exist, triggered by varying factors and having different effects on national populations and in different regions.

In the longer term, though, into the twenty-first century, there remains some uncertainty over the extent of possible population redistribution in sub-Saharan Africa. Almost certainly there is likely to be further concentration in the better-favored areas over areas likely to be affected by environmental decline, but the extent of such migration will vary from country to country, and probably from region to region within each country.

CONCLUSION

Internal migration is an important component of the demography of sub-Saharan Africa. Unfortunately, its study has not kept pace with the study of the two other demographic components, fertility and mortality. Though questions dealing with place of birth and place of residence in the past have been asked on recent censuses, the data have been largely useless because of problems with dating and reference periods. Attempts have been made in some countries, namely, Botswana and Burkina Faso, to collect reliable survey data; however, in general, data quality is not good.

Despite the shortage of adequate data, some observations about migration within sub-Saharan African countries can be made. Although the focus of policymakers and the research community on rural-urban migration may seem to imply that this type of migration is the most prevalent, it is not; in fact, intrarural migration, which includes nomadism and movements due to resettlement programs, is the most common. Migration from urban areas to either rural or other urban areas is the least common.

Those who decide to migrate differ from those who do not in several ways. Migrants tend to be young adult males who have a higher level of educational attainment than those who do not migrate. Wealth is also related to migration: Being better able to sponsor migrants, more wealthy families tend to be more likely to have family members who migrate.

Factors external to families and individuals are also important in creating an atmosphere conducive to migration. The international community, through export pricing and structural adjustment activities, and domestic governments, through programs that directly or indirectly address migration, may influence internal migration flows. In addition, environmental and health factors may cause some people to move within their country.

Urbanization is becoming increasingly important within sub-Saharan Africa. Unlike much of the industrialized world, where urbanization followed industrialization, urbanization and industrialization in sub-Saharan Africa have largely taken place independently. The proportion of the population living in urban areas has increased in all regions of the continent. By the turn of the century, it is expected that aside from the countries of eastern Africa, one-third of the population in all sub-Saharan African countries will live in urban areas.

Internal migration in sub-Saharan Africa has ramifications for population density. Although it does not alter the density of an entire country, it does affect the distribution of population within a country's borders and, therefore, the density of regions within a country.

Because sub-Saharan African countries continue to be greatly affected by spatial dynamics of population, it is expedient that researchers, planners, and policymakers collaborate in research undertakings that are immediately responsive to development planning and policies.

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8

International Migration

Sharon Stanton Russell

INTRODUCTION

As of the late 1980s, international migrants of all types worldwide were estimated to number in the range of 80 million people, of whom approximately 35 million were in sub-Saharan Africa (Widgren, 1987; Ricca, 1989; United Nations, 1989b; Russell et al., 1990). If these figures are even nearly correct, then almost half of the world's migrants were in sub-Saharan Africa, although the region itself contained less than 10 percent of the world's population.

Of these 35 million sub-Saharan African migrants, approximately 5.4 million were officially recognized refugees; possibly an equal number were internally and externally displaced—in refugee-like circumstances but not officially recognized as refugees. In this study, migrants are defined as persons who have crossed international boundaries, regardless of their reasons for movement or length of stay abroad (both of which are difficult to discern from available data). International migrants include those seeking employment; family members accompanying or joining those who have migrated before them; people seeking refuge from drought, famine, political upheavals, or military conflicts (whether designated as official refugees or

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not); as well as pilgrims, temporary visitors, workers posted outside their countries of origin, and children migrating for school. The definition of official refugee differs slightly by designating institution. The 1951 United Nations Convention Relating to the Status of Refugees defines a refugee in part as a person who, "owing to a well-founded fear of being persecuted for reasons of race, religion, nationality…[etc.] is outside the country of his nationality, and is unable or…unwilling to avail himself of the protection of that country…." The Organization for African Unity Convention of 1969 expands this definition by adding the following: "The term refugee shall also apply to every person who, owing to external aggression, occupation, foreign domination or events seriously disturbing the public order… is compelled to leave…to seek refuge in another place" (United Nations High Commissioner for Refugees, 1979).

The purpose of this chapter is to provide an overview of international migration streams in sub-Saharan Africa: their scale, directions, and links to economic factors, and their effects on the size, structure, and composition of the region's populations. Demographic analysis is often complicated by international migration, especially in sub-Saharan Africa, where international population movements have been volatile and frequently unpredictable, as much for political as for economic reasons. Census data, which at best are slow to be published, are rapidly rendered outdated by migrations associated with sudden economic reversals (e.g., changes in oil or commodity prices) or political events. Despite the difficulties of studying the phenomenon, international migration can have striking consequences for the demographic profiles of both sending and the receiving areas, and the subject warrants attention in any comprehensive review of population dynamics.

DATA SOURCES

Statistical data on international migration in sub-Saharan Africa are of limited availability and often poor quality. Data on migration flows among countries are virtually nonexistent. To estimate the stocks of migrants in the region, their proportions in total population, and their age and sex composition, this chapter has drawn upon files compiled from country censuses reported to the United Nations Population Division, Trends and Structure Section. These data are from the 1970 and 1980 census rounds; results from the few countries that have conducted censuses in the 1990 round are not officially available, although preliminary results from Lesotho (not yet reported to the United Nations) are considered in the analysis below. Data on stocks of refugees in the region (and their changes in recent years) are derived from the *World Refugee Survey,* published annually by the U.S. Committee for Refugees. Data from both census and refugee survey sources were cross-tabulated by country of origin and destination during preparation of *International Migration in Sub-Saharan Africa,* published by the World Bank (Russell et al., 1990), and have been updated for this chapter (see Tables 8–1 through 8–14[1] for regional and country-level data on migration and refugee flows). When relevant, the analysis below also makes use of country-specific survey and detailed census results as well as findings from the extensive literature review conducted for the World Bank study.

Census data often do not allow clear distinctions to be drawn among types of migrants. Specifically, census results seldom indicate whether official refugees were included or excluded. For these and reasons cited above, the population estimates presented here must be considered approximations. Furthermore, some censuses report foreign nationality rather than foreign birth (see Tables 8–1 and 8–15). Generally, place of birth is a better datum than nationality for inferring migration, since nationality may or may not change as migrants settle and may or may not apply to the second generation. Even place of birth has its limitations, however: It reflects lifetime movement (without temporal reference) and does not give any information about multiple, staged, or circular migrations. In this chapter, the term "migrant" is used in reference to nonnationals identified by either or both classifications. The term "refugee" is reserved for those officially recognized as such by the United Nations or Organization of African Unity definitions.

REGIONAL PATTERNS

Despite the data limitations, important regional and subregional[2] patterns can be discerned. These patterns can be seen in the map on migration and in Tables 8–1 through 8–8. First, the vast majority (approximately 90 percent) of sub-Saharan African migrants are Africans. Non-African migrants include long-time residents originating from Lebanon, Syria, India, and Pakistan, as well as Europeans and some from the Western Hemisphere. The proportions of foreign born in total populations vary considerably, with the highest being in western Africa.

Second, labor migration has been a feature of all subregions, but especially notable in western Africa, and from the nations of southern Africa to the Republic of South Africa. Third, refugee migrations, on the other hand,

[1]For the readers' convenience, all tables appear at the end of this chapter.

[2]The classification of countries by subregion adopted here follows the groupings used by Adepoju (1988) which, in turn, are consistent with those of the *World Population Data Sheet* published annually by the Population Reference Bureau. These classifications may differ from those used by other sources; for example, Mozambique is here considered to be in East Africa.

have been predominant in eastern Africa. Fourth, clandestine migration is pervasive throughout the region and considered “routine” in western Africa, where seasonal migration also figures more prominently than elsewhere on the continent.

International migration in sub-Saharan Africa. SOURCE: Based on Ricca (1989).

Western Africa

The highest concentration of migrants is found in western Africa, a subregion that migrants have always considered as an economic unit where trade in goods and services flowed freely, as did people. Precolonial migrations were often group movements related to internecine warfare, slave raids, famine, drought, and the spread of religions—as well as trade. During the colonial period, the French pursued forced labor recruitment policies, while the British adopted agricultural production policies that attracted farm labor. The development of plantation agriculture helped to bring about a shift during this period from group migration to individual movement, differentiated by age, occupation, and sex.

In the postcolonial period, migration in western Africa has become largely spontaneous and includes levels of both seasonal and undocumented migration reportedly higher than elsewhere in sub-Saharan Africa. The levels and directions of migration in the region are notably volatile. Until the early 1970s, Ghana was the favored destination of western African migrants, and as of the 1960 census, migrants numbered more than 800,000 and made up 12 percent of Ghana's total population. By 1970, migrants numbered only 562,000 and comprised only 6.6 percent of total population (see Table 8–1).

Over the past two decades, Côte d'Ivoire has supplanted Ghana as a major pole of attraction for migrants from Burkina Faso, Mali, Guinea, Ghana, Niger, and elsewhere (see Table 8–2). Foreigners, who were 22 percent of the total population as of the 1975 census, are now reported to be nearly 30 percent, giving Côte d'Ivoire by far the highest concentration of foreigners in sub-Saharan Africa (see Table 8–1). The second highest concentration is in The Gambia, where migrants are about 11 percent of the total population and include significant numbers from Senegal, Guinea, Guinea-Bissau, and Mali (see Table 8–2).

Census data from Nigeria are not available, but it is well known that flows to that country increased substantially during the 1970s and early 1980s, as the combined result of Nigeria's oil boom and the protocol on freedom of movement signed in 1980 by members of the Economic Community of West African States (ECOWAS). The majority of migrants were from Ghana, Togo, Benin, Niger, and Chad. By 1982, there were estimated to be 2 to 2.5 million nonnationals in Nigeria, roughly 2.5 percent of total population. However, a 1983 survey of migrants in Nigeria found that only 23.3 percent of them were legal, so their numbers and proportions may have been even higher (Makinwa-Adebusoye, 1987; Adepoju, 1988; Orubuloye, 1988). Economic and political adversities since the early 1980s have dramatically changed international migration to Nigeria. Between 1983 and 1985, some 1.5 million nonnationals were expelled by government order (Afolayan, 1988:21–23). By the late 1980s, Nigeria had become an exporter of professionally and technically trained personnel.

According to the 1976 census, there were close to 119,000 migrants in Senegal (see Table 8–1); however, other estimates (Zachariah and Condé, 1981) put the number at that time in the range of 355,000 (with Guinea being the largest source country), and it is this latter figure that has led to the characterization of Senegal as having become a significant country of immigration. By taking the lower figure, migrants amount to nearly 2.4 percent of the total population; the higher figure is closer to 7 percent of the total population.

There is little quantitative evidence on the composition of migrants in western Africa. They are generally thought to be primarily young; male; illiterate or at least less well educated than the host country populations; and concentrated in low-status, temporary jobs, especially those in agriculture, mining, commerce, and services. On the other hand, they are also reported to have high levels of employment.

There are some exceptions to this characterization, however. Ghanians in Nigeria included large numbers of school teachers, professionals, and technicians; the 1983 survey of migrants found that nearly 53 percent had secondary, technical, or tertiary education. About 25 percent of those surveyed were in skilled occupations and another 14 percent in semiskilled activities. Only 37 percent were in unskilled jobs (Makinwa-Adebusoye, 1987:24; Adepoju 1988:68).

It has also been observed that more recent flows in western Africa (especially to Côte d'Ivoire) have included more women and children (Makinwa-Adebusoye, 1987), which may indicate a shift toward family migration or reflect movement of dependents for family reunification. Of the eleven western African countries for which data are available on the sex ratio of the foreign born, five have ratios very close to 1.00 (Table 8–15). Further, future censuses may confirm observations (see Russell et al., 1990) that implementation of the ECOWAS regional protocols on free circulation during the 1980s, along with rising levels of education, have led to more migration of skilled workers in western Africa.

There is also evidence of medium- to long-term migration, especially from Mali and Burkina Faso. Guineans are also noted to have longer average residence outside than other migrants (Adepoju, 1988). Although the majority (59 percent) of sub-Saharan African migrants over age 20 enumerated in Mauritania's 1977 census had been in the country less than five years, nearly 25 percent had been resident 10 years or more. For Sierra Leone as of 1974, 20 percent of all foreign nationals had been resident 10 years or more and another 19 percent had been born there.

The future of migration to Côte d'Ivoire is somewhat uncertain at present. Given historical trends and the continuing relative economic deprivation of neighboring source countries, there may be little significant reduction in flows. On the other hand, both economic and political conditions in Côte d'Ivoire are worsening, and there are reportedly high levels of unemployment among educated Ivoirians and a less welcoming response to migrants. Although the occupational concentrations of migrants and nationals are different, such circumstances have been known to result in nationals taking jobs they previously considered beneath their qualifications.

In the past several years, refugee flows have come to figure more prominently than heretofore in western Africa. In 1988, Guinea-Bissau and Ghana were the only countries in the subregion producing refugees; numbering only 5,500, these constituted less than 1 percent of all sub-Saharan African refugees. Similarly, the subregion's nine asylum countries hosted only 15,200 refugees (primarily from Chad in middle Africa) also less than 1 percent of the total (Russell et al., 1990). By 1990—only 2 years later—13 western African nations were providing asylum to more than 800,000 people (nearly 16 percent of all sub-Saharan African refugees) primarily from other western African countries, notably Liberia (nearly 730,000) and Mauritania (more than 60,000) (see Tables 8–9 and 8–10).

Middle Africa

Historical patterns of international migration in middle Africa were linked to religious factors, tribal expansion, the slave trade, migrations of nomads and pygmies, and movement across "artificial," colonial political boundaries by members of socioeconomic units thus divided.

Although migration in the subregion is often characterized as largely male and temporary, analysis of sex ratio data for various middle African countries suggests that types of migration vary considerably by nationality and country of destination. Migrants from Zaire in Cameroon had the highest sex ratio (number of males per female) of any foreign group enumerated in the Cameroon (1976) census (2.59), implying temporary migration largely by males. Zairois in the Congo as of 1984, on the other hand, had a sex ratio of 0.88, reflecting the existence of female migration, whereas Senegalese in the Congo had a sex ratio of 3.0.

Among the middle African countries for which census data are available, the largest migrant stocks (more than 600,000) are enumerated in Zaire (see Table 8–1), where mineral deposits and infusions of investment capital have created jobs for skilled and unskilled workers, and the foreign born represent slightly more than 2 percent of the total population. The second major country of destination is Cameroon, where nearly 220,000 migrants constituted about 3 percent of total population in the 1976 census. The great majority were palm plantation workers from Nigeria and, to a lesser extent, from Chad and the Central African Republic (CAR) (see Tables 8–3 and 8–6, note a).

The Congo has the highest proportion of migrants in middle Africa (more than 5 percent), mainly from Zaire, CAR, Angola, Mali, Senegal, and Cameroon (see Tables 8–1, 8–3, and 8–6, note a). Nearly three-quarters of the migrants to the Congo enumerated in 1984 had arrived within the preceding 10 years, and more than half had come within the preceding three years. At the other extreme, as may be seen in Table 8–1, the foreign born in Angola were less than 1 percent of the total population in 1983.

The total number of refugees from middle Africa increased slightly, from 490,000 in 1988 to 521,900 in 1990, but (because of even greater increases in other subregions) their proportion among all sub-Saharan African refugees declined from 12.5 to barely 10 percent. The absolute increase in middle African refugees resulted from greater numbers fleeing into Zaire, Zambia, and Namibia (see Tables 8–11 and 8–14) from drought-induced famine and continued hostilities in Angola, by far the major source country in the subregion, with about 436,000 refugees (see Table 8–16). The number of refugees from Zaire and Chad decreased slightly, despite a new outflow from Chad in 1989 associated with the overthrow of the government. Previously, during the late 1980s, many of the earlier Chadian refugees had been repatriated.

Eastern Africa

Eastern Africa is the principal geographical focus of African refugee movements, and these refugee flows dominate other types of migration in this subregion. As may be seen in Table 8–16, of the seven countries that generate more than 90 percent of the continent's refugees, four are in eastern Africa and one is neighboring Sudan; of the thirteen countries that receive more than 90 percent of the refugees (see Table 8–17), seven are in eastern Africa and one is again Sudan. Of these major source and asylum countries, three (Ethiopia, Sudan, and Somalia) are in both categories.

However, as of 1987, it was no longer accurate to characterize refugee movements as confined to the Horn.[3] The number of refugees originating from Mozambique increased dramatically (nearly 163 percent) between 1986 and 1987, and by 1990 Mozambique had surpassed Ethiopia as sub-Saharan Africa's major source country, accounting for 27 percent of the region's refugees. The countries of eastern Africa most affected by the Mozambican exodus—Malawi, Tanzania, Zambia, and Zimbabwe—were among the top 12 asylum countries, together receiving nearly 29 percent of Africa's refugees (Tables 8–12 and 8–17).

The predominance of refugees in eastern Africa does not mean, however, that other types of international migration are not found. Historically, migration in the subregion was affected by precolonial inflows of Arabs and Asians; the partition of the area into colonies; the development of export-oriented agriculture as well as mining and extractive industries; and restric

[3]The U.S. Committee for Refugees defines the Horn of Africa as comprising Ethiopia, Somalia, Djibouti, Kenya, and the Sudan (other sources may or may not include the latter two countries). With its independence from Ethiopia, Eritrea will be considered separately as part of the Horn.

tions on free population movements both following independence and, from time to time, as the result of interstate conflicts.

Since before independence, populations moved from Rwanda, Burundi, and Zaire to Uganda, Kenya, and elsewhere in eastern Africa, as contract labor replaced old East-West slave routes. There have also been labor flows from Malawi and Mozambique to South Africa, Zimbabwe, and Zambia (Adepoju, 1988:34,35). In the past, Tanzania received sizable inflows from other sub-Saharan African countries. Some were refugees or people in refugee-like circumstances, but Tanzania has been both a labor-sending and a labor-receiving country, with explicit policies to govern such movements. However, in the face of deteriorating economic conditions in the 1970s, the proportion of migrants in Tanzania's total population declined from 3.7 percent in 1968 to 2.4 percent in 1978.

Kenya has not been a major country of in-migration, and only 1 percent of its total population in 1979 was composed of migrants, largely from Tanzania, Uganda, Ethiopia, and Somalia. However, until recently, Kenya was a major receiver of educated Ugandans. During the 1980s, the increasing availability of skilled Kenyan graduates placed pressures on the Kenyan labor market, and as a result, skilled Ugandans moved to other locations within and outside Africa, including South Africa.

In addition to both hosting and producing refugees, Sudan has been an exporter of migrants to the oil-producing countries of the Middle East and elsewhere. An estimated 334,000 Sudanese were abroad as of 1983 (Choucri, 1985:5), and by 1985, some 500,000—including two-thirds of the country's technical and professional workers—lived abroad (United Nations Economic Commission for Africa (ECA), 1988:1). Some of the resulting manpower shortage in Sudan was attenuated by skilled Ethiopian refugees, who replaced trained Sudanese migrants to the Gulf (Adepoju, 1990:7). Although the oil price downturn in the 1980s prompted concerns about large-scale return migration, as of the late 1980s there was no evidence this had occurred. The full consequences of Sudan's support for Iraq in the 1990–1991 Gulf War have yet to be determined, however.

Southern Africa

Migration in southern Africa has generally been characterized as temporary and oscillatory, historically and in the present shaped by migration to the Republic of South Africa (RSA), principally from Botswana, Lesotho, and Swaziland (BLS) but also from Mozambique, Malawi, and Zimbabwe. In addition to migration of mine workers (organized through labor recruiters), there was—until 1963—a considerable amount of clandestine migration, which included accompanying women and children. In 1963, South Africa imposed strict immigration controls that curtailed both undocumented migration and family migration, and further prohibited BLS migration to South Africa except for work in mines and agriculture.

Changes in the national composition of migrant mine workers in South Africa began to appear in the mid-1970s. Several sending countries imposed their own restrictions on migration to RSA. Tanzania and Zambia enacted such restrictions shortly after independence, and Malawi withdrew its labor in 1974, although it reduced those strictures in 1978. As a result of these measures and a secular decline in mine migrants from Mozambique, there has been a shift toward increasing proportions from Lesotho (United Nations, 1989b).

A number of factors have combined to bring about these and other recent changes in southern African migration to South Africa (De Vletter 1988:5). First, after increases in the price of gold, the withdrawal of Malawian labor, and worsening relations with Mozambique, South Africa sought to stabilize the migrant work force and to attract more mine labor from within the country, with substantially increased wages and longer work contracts. Second, legislative changes have accompanied a policy shift toward "careers in mining." Mine companies are now permitted to construct housing for married workers, and black workers are permitted to occupy senior positions formerly reserved for whites.

Third, in response to periodic bans on migration by supplier countries, South Africa has sought to reduce its dependence on foreign labor and has used either threatened or actual expulsions as a disincentive to further political actions by remaining suppliers. Finally, with rising levels of education both in labor-supplying countries and within South Africa itself, the benefits of an educated work force have become more evident, and policies have emphasized establishment of a permanent, skilled labor force from domestic sources.

From Chamber of Mines of South Africa data, it is possible to discern some of the consequences of these factors. Although total employment in the mines increased and a growing proportion of official migrants have been concentrated in mining, the proportion of workers from foreign countries decreased from 78 percent in 1974 to about 40 percent in 1984–1986 (*Financial Mail,* 1987:33; United Nations, 1989b: Table 65).

The full impact of these changes on the labor-supplying countries of southern Africa is not yet clear. However, it has been noted that the supply of mine labor now far exceeds demand throughout southern Africa (De Vletter, 1985), and the International Labour Organization (ILO) has mounted a series of studies (under the "Assistance to Migrant Workers in Southern Africa Project") to inform planning in countries of the subregion bracing for effects of expected further declines in migration to South Africa. In Botswana alone, the number of mine labor recruits dropped from 40,390 in 1976 to 19,648 in 1986, and the proportion of novices (first-time workers) among all recruits dropped from 25 percent in 1976 to 1.6 percent in 1985 (Taylor, 1990).

Some will find new destinations outside their countries of origin. Migrants from Lesotho are already known to have begun taking work in "homeland" areas (which South Africa considers to be independent nations), and anecdotal reports suggest that other national groups (including Ghanians, and Ugandans formerly resident in Kenya) have begun doing so as well. Although official policies of source countries discourage this trend,[4] it may well continue as opportunities in South Africa decline further.

In the past, international migration among southern African nations has been overshadowed by the dominant flows to South Africa, but this too may change in future. In Swaziland, migrants already comprised more than 5 percent of the total population by the 1976 census, with most from South Africa and Mozambique. In Botswana, migrants were only 1.7 percent of the total population in 1981, but the range of source countries suggests the potential patterns of future migration: Migrants come from South Africa, Zimbabwe, Namibia, Lesotho, Angola, Malawi, Swaziland, and—in smaller numbers—from Nigeria and Ghana.

Generally in southern Africa, the female labor force is growing faster than the male labor force (3.0 versus 2.6 percent per year), and there is evidence of growing international migration for employment among women, linked to rising levels of female education, the elimination of legal restrictions on female migration, and changing norms in rural areas. The extent to which changing demand factors may have contributed to increasing female migration is not documented. In a 1978 survey of migrants in Lesotho, 23 percent of respondents who had worked in South Africa were women (Wilkinson in Momsen and Townsend, 1987), a finding roughly consistent with results of both the 1976 and the 1986 Lesotho censuses, in which females were about 18 percent of nationals absent at the time of enumeration. There is also evidence of primary female migration from Zambia and Tanzania and in western Africa (Russell et al., 1990).

The proportion of all sub-Saharan African refugees hosted by southern African countries has declined slightly, from 6.6 percent in 1988 to 5.3 percent in 1990 (see Table 8–9), largely as a result of the repatriation of Namibians prior to that country's attainment of independence from South Africa in March 1990. Southern Africa produces less than 1 percent of all sub-Saharan African refugees. South Africa, with less than 4 percent of all

[4] Other African governments view creation of the homeland areas as a manifestation of South Africa's apartheid system that they do not wish to legitimize by encouraging migration. As noted earlier, several countries (Tanzania, Zambia, Malawi) have in the past imposed outright restrictions on migration to South Africa in protest against that country's apartheid policies.

sub-Saharan African refugees (see Table 8–17), remains the major asylum country in the region, hosting an estimated 201,000—nearly all from Mozambique (see Tables 8–13 and 8–14, note g). However, South Africa itself is also the subregion's largest source of refugees, although their numbers declined from 24,900 in 1988 to 20,000 in 1990, as some returned from Angola and Swaziland. (See Tables 8–13, 8–14, and 8–16.)

MIGRATION OF THE HIGHLY SKILLED AND EMIGRATION FROM THE CONTINENT

In view of the importance to development in Africa of trained manpower, concern has been expressed about migration of the highly skilled. However, attitudes toward such movements have shifted over time, and have depended on the composition and destinations of skilled migrants. Emigration of trained Africans to developed countries of Western Europe and North America (the principal destinations until the late 1970s) has generally been characterized as "brain drain," a term implying exploitation of poor countries by rich ones.[5] However, skilled migration to other developing countries, which has emerged since the late 1970s, is more often described in international forums as "reverse technology transfer" or "cooperative exchange of skills between developing countries."

There is only fragmentary evidence as to the numbers of highly skilled Africans who have left the continent. As of 1987, the United Nations Conference on Trade and Development estimated that about 70,000 (30 percent of the high-level manpower stock[6] within the continent) officially resided in European Community (EC) countries (United Nations Economic Commission for Africa, 1988); this figure is undoubtedly an underestimate, however: more than 110,000 skilled Nigerians alone took jobs abroad between 1987 and 1989 (Adegbola, 1990).

Since the mid-1970s, there has been increasing migration of highly skilled Africans to destinations *within* Africa, although their aggregate numbers

[5]Generally, the term "brain drain" has not been applied to the emigration of skilled non-African (or expatriate) workers that occurred in many countries following independence, especially in the mid-1970s. In some cases, these numbers were large: Angola lost 90 percent of its European immigrants with the exodus of 300,000 settlers to Portugal by March 1975, while 230,000 Portuguese left Mozambique between 1974 and 1976. By 1979, Equatorial Guinea had lost almost half its population through emigration of Spaniards and others; about 120,000 Europeans (who controlled more than 80 percent of commercial production) left Zaire at independence (Russell et al., 1990:50).

[6]High-level manpower stock is defined by education, training, or by skill level (e.g., managerial and administrative and professional, technical, and kindred occupations).

remain to be estimated. Gould (1985) has identified three principal reasons for this trend: (1) The opportunities for migration to developed countries declined, and (with the exception of selected source countries[7]) there has been relatively little African migration to the Middle East. (2) There has been increased economic differentiation among African countries. (3) Educational output has expanded faster than the economies of many countries, leading to disparities between the supply of and demand for skilled workers and to the out-migration of those unable to find work at home.

Although migration of the highly skilled (to any destination) does not necessarily have negative effects on source countries, it can do so if the scale is large and critical sectors of the economy are affected. Skills short-ages have been reported in Ethiopia, as the result of insufficient output from higher education and the exodus of trained workers at the time of the revolution, and they are likely to have occurred in Somalia. Uganda lost more than half its high-level manpower during the regime of President Amin. Following the decline of oil revenues and the adoption of a structural adjustment program in the mid-1980s, Nigeria experienced significant emigration of skilled personnel, affecting particularly medicine, universities, and airlines. Similarly, as the result of economic crisis, poor working conditions, and more attractive salaries elsewhere, Zambia has lost a substantial number of university lecturers and public sector physicians, mainly to other countries of southern Africa.

In recent years, sub-Saharan Africans have become increasingly visible among growing numbers of official and undocumented migrants to Europe and among asylum seekers in member states of the Organisation for Economic Co-operation and Development (OECD). Although even aggregate data are virtually nonexistent[8] and skill composition is unknown, selected evidence confirms their presence. Of registered non-European foreign residents in Italy in 1990, nearly 12 percent (75,152) were from sub-Saharan Africa (SOPEMI, 1991:22, Tables 8,9). The share of sub-Saharan Africans among Italy's estimated 1.2 million illegal migrants in 1990 was also thought to be high. Growing numbers of migrants from all over the world are seeking to gain entrance to Europe, North America, and Australia by means of the asylum process, and those from sub-Saharan Africa are no exception.

[7]Sudan has been the major source of migrants to the Middle East, although Somalia, Djibouti, Mali, Mauritania, Ghana, and Nigeria have also been represented. As noted earlier, Sudanese emigrants included a large proportion of the country's skilled manpower.

[8]With the exception of Italy, as of 1990 the OECD's Continuous Reporting System on Migration, SOPEMI, did not distinguish sub-Saharan Africans from the large category of "other" non-EC migrants in either cross-national or individual country data.

[9]The six are Somalia, Ethiopia, Ghana, Nigeria, Zaire, and Senegal.

The number of asylum seekers from the six principal sub-Saharan African source countries[9] rose from 23,500 in 1988 to 62,450 in 1991. In 1991, sub-Saharan African countries (notably Somalia, Ethiopia, and Zaire) ranked among the top four or five sources of asylum seekers in nine out of sixteen reporting countries (Inter-governmental Consultations on Asylum, Refugee and Migration Policies in Europe, North America and Australia, personal communication, 1992).

EFFECTS OF INTERNATIONAL MIGRATION ON AGE AND SEX DISTRIBUTIONS

Data on the age and sex distributions of resident, absent, and foreign-born or foreign national populations are available only for selected countries, and discerning the effects of international migration on these aspects of population structure is further confounded by systematic misreporting of age and underenumeration of men in African census results (P.Rowe, personal communication, 1991). The limited data available illustrate migration's effects on age and sex distributions in one country with high emigration (Lesotho), one with low immigration (Mauritania), and two with moderate immigration (Malawi and Congo).

Lesotho

In the case of Lesotho, relatively high, predominantly male emigration has affected both the sex ratio of the population and the reported growth rates. Results from Lesotho's 1986 census do not contain age distributions by sex except for absentees, but do disaggregate total *de jure* and *de facto*[10] populations by sex for both the 1976 and the 1986 enumerations. As can be seen in Table 8–18, 12.5 percent of the total population was absent from the country at the time of the 1976 census. The sex ratio (males per female) of the *de jure* population was 0.93, whereas that of the *de facto* population was 0.76, reflecting substantial male migration to South African mine work. Indeed, the sex ratio of absentees was 5.48.

In 1986, by which time opportunities for labor migration to South Africa had contracted even more rapidly for males than for females, only 8.5 percent of the *de jure* population was absent. While the *de jure* sex ratio

[10] *De jure* population includes those present at the time of enumeration, plus those residents who were temporarily outside the country; *de facto* population includes only those present at enumeration. The difference between the two is the number of absentees, who are defined as persons away from Lesotho continuously for less than five years (Lesotho, 1987:1,2).

remained constant, that of the *de facto* population rose slightly to 0.81, and the sex ratio of absentees declined slightly to 5.29. The age and sex distribution of absentees shown in Figure 8–1 is characteristic of countries with high male emigration.

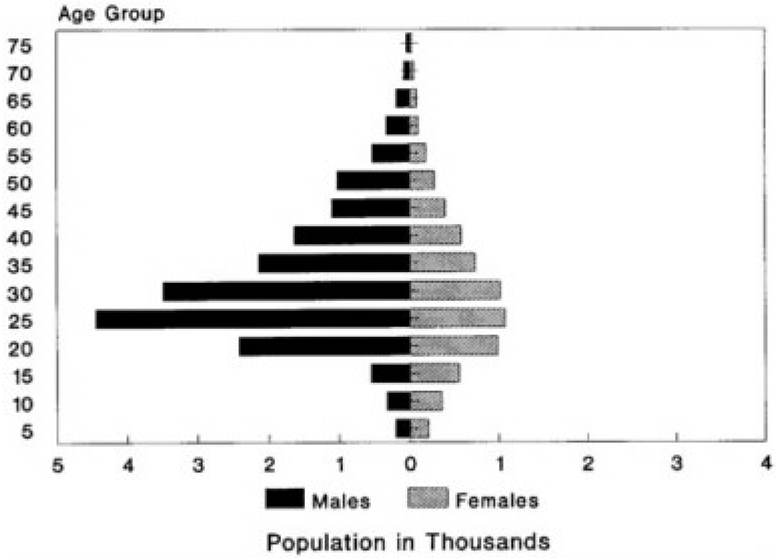

FIGURE 8–1 Age-sex distribution of absentees. SOURCE: Government of Lesotho (1989).

Changes in levels of emigration may also affect population growth rates. In Lesotho, the intercensal growth rate of the *de jure* population rose from 2.29 to 2.63 between 1976 and 1986, a pattern that the census report of preliminary results speculates “could be attributed to constant fertility over time, coupled with declining mortality” (Lesotho, 1987:3). However, although the reported total fertility rate (TFR) changed little between 1965 and 1988 (from 5.8 to 5.7), and infant mortality decreased (from 142 to 98 per 1,000 live births) (World Bank, 1990:230,232), the contribution of declining male migration to maintaining high fertility cannot be ruled out without further analysis. It is clear that published rates of population growth should be interpreted with caution in cases of substantial emigration. Calculations conducted for this chapter indicate that the *de facto* (i.e., resident) population alone grew at the rate of 3.1 percent per year; however, it is the *de jure* rate of growth (2.6 percent per year) that is published (Lesotho, 1987; World Bank, 1990:228).

Mauritania

Foreign nationals[11] were a relatively low proportion of Mauritania's total resident population (2.1 percent), and their effects on aggregate sex and age distributions were correspondingly small. As shown in Table 8–19, the foreign population was predominantly male in all but the 0- to 14-year-old group, reflecting the migration of men (some with families) who came principally from Senegal, Mali, and Guinea for work in Mauritania's urban areas. As is typical for countries with male labor immigration, the sex ratio was highest (1.73) among foreigners aged 15–59, substantially higher than among Mauritanians of the same age (0.89). However, because of their small numbers, migrants had little effect on the sex ratio of the total population, raising it only by 0.01 point in any age group.

For people under 60, there were notable differences in age distribution between foreign nationals and Mauritanians. Children aged 0–14 years were 32 percent of the foreign population, but 44 percent of the native born. Relatedly, adults 15–59 years of age were more than 65 percent of the former group, but slightly less than 50 percent of the latter. These differences were reflected most sharply in the dependency ratios,[12] which were 53.2 and 100.6 in the foreign and national populations, respectively. The presence of foreign nationals had little demonstrable effect on the age distribution of Mauritania's total population. The preponderance of working-age migrants raised the proportion of all residents 15–59 years by only 0.3 percentage point. However, migrants did serve to lower the dependency ratio of the total population by 1.3.

Malawi

Malawi had a moderately high proportion of foreign born in the total population (5.2 percent) as of the 1977 census, although this proportion fell from 7.3 percent in the 1966 census, a decline that coincided with a deceleration of the country's average annual per capita GNP growth rate (World Bank, 1989:221). The case of Malawi illustrates that the effects of migration on sex and age distributions will depend greatly on the composition of

[11]Foreign national, rather than foreign-born, population is recorded in Mauritania's 1977 census results, which published data on foreign and Mauritanian nationals by sex only for broad age groups.

[12]The dependency ratio is usually calculated as the number of persons in the "dependent" ages (less than 15 and more than 64), divided by the number of persons in the "economically productive" ages (15 to 64 years), multiplied by 100. Because Mauritania, Malawi, and Congo aggregate data by broad age groups, the dependency ratios shown in Tables 8–19 through 8–21 are calculated in a slightly different manner.

that migration. In contrast to Mauritania (and with the exception of those over 60 years of age), the sex ratios of Malawi's native and foreign-born populations (Table 8–20) differed from one another only slightly in 1977, reflecting substantial female immigration or the systematic underenumeration of men in both the native and the foreign-born populations. These sex ratios were virtually unchanged from their 1966 values, although the proportion of migrants originating from adjacent countries declined and the share from other African countries increased (Malawi, 1984:29). This observation runs counter to the frequently heard proposition that longer-distance migration is predominantly male.

The preponderance of males among the foreign born aged 60 years and over is unexplained but could result from a combination of age underreporting by female migrants and male predominance among earlier migrants, long resident in Malawi by 1977. In any case, although the presence of the foreign born had no effect on the overall sex ratio of the total population, the preponderance of foreign males aged 60 and over was sufficient to raise the sex ratio of the total population in this age group by 0.03.

Malawi's foreign-born population in 1977 was notably concentrated in the older age groups, more so than Mauritania's foreign nationals. Nearly 36 percent of the Malawi-born population was under the age of 10, whereas the corresponding figure for the foreign born was less than 10 percent. This difference was sufficient to lower the proportion of the total population in the 0–9 age group by 1.4 percentage points. Available age data do not permit calculation of dependency ratios by the standard age classifications, but dividing the numbers aged 0–9 and 60+ years by those aged 10–59 yields approximate dependency ratios of 42.4 and 70.5 for the foreign and national populations, respectively. This differential is less than that observed for Mauritania in the same year, again because of the substantially greater proportion of Malawi's foreign population (both male and female) who were over age 60.

Congo

During the late 1970s and early 1980s, the Congo's moderately high rates of economic growth associated with oil exports and growth in manufacturing attracted increasing numbers of migrants. The proportion of foreign born in the country's total resident population rose from 4.1 percent in 1974 to 5.1 percent in 1984—a proportion comparable to that observed in Malawi in 1977.

In contrast to Malawi, where female migrants outnumbered males in virtually all age groups, males exceeded females among foreigners in the Congo in all age groups 30 and over (Table 8–21). Once again, however, the predominance of males had little effect on the sex ratio of the total population, raising it by only 0.01; in no age group did the effect exceed 0.02.

As in other migrant-receiving countries, foreign nationals present in 1984 were less concentrated in the younger age groups: 23 percent of foreigners were below age 10, compared with 32 percent of Congolese. The concentration of foreign nationals between the ages of 20 and 39 (47 percent) was even more pronounced than in Malawi (30 percent), possibly because migrants to the Congo were relatively more recent than those to Malawi. Their numbers were sufficient to raise the Congo's total population in these age groups taken together by slightly more than 1 percentage point.

As in Malawi, available data do not permit calculation of dependency ratios by the standard age classifications, but the 0–9 and 60-and-over dependency ratios were 35.7 and 60.8 for the foreign and Congolese populations, respectively, and the relatively small number of foreigners in the dependent ages was sufficient to lower the dependency ratio in the total population by 1.4.

CONCLUSION

Based on analysis of available census data for 35 (out of 48) sub-Saharan African countries, international migrants are estimated to average 3.6 percent of the total population, comparable to the proportion of foreigners in EC countries (4 percent). The actual proportion of migrants in sub-Saharan Africa is quite possibly higher, however, given the prevalence of clandestine movements. In any case, the "true" figure is undoubtedly different: International migration flows in Africa, as elsewhere, are notably volatile, unpredictable, and hard to measure.

Eastern Africa has been most affected by refugee flows (principally from Mozambique, Ethiopia, Sudan, and Somalia), whereas migration for employment (in some cases accompanied by family members) has been the major type of movement in middle, western, and southern Africa. The highest concentration of migrants is found in western Africa, a region that has also recently experienced an increase in refugee flows. Migration in southern Africa has been largely temporary and oscillatory, and is still dominated by movements to South Africa, despite that country's reduced reliance on foreign mine workers. These aggregate data mask a number of country-level variations. Analyses for this chapter have suggested that the type and the composition of international migration, as well as the duration of stay, can vary considerably by both nationality of origin and country of destination.

Fragmentary evidence suggests that since the late 1970s, migration of highly skilled workers within Africa is increasing, as the result of rising levels of education, deepening disparities among African countries, and limited opportunities outside the continent. The number of sub-Saharan Africans seeking asylum in developed countries of the North is growing, however.

Given the limited number of cases for which data are available, it is difficult to draw generalizable conclusions about the effects of migration on population age and sex distributions. At best, one can put forward some observations to be examined in further research. The case of Lesotho suggests that when emigration exceeds 8 percent of total population and is heavily dominated by one sex, there are demonstrable effects on the sex ratios and differential rates of growth in *de jure* and *de facto* populations.

In those migrant-receiving countries such as Mauritania, Malawi, and the Congo, in which foreigners are a small-to-moderate proportion of total population, the effects of migration are evident largely in intergroup differences, notably in the age distributions and dependency ratios. In keeping with conventional wisdom, foreigners are more concentrated than nationals in the economically active age groups, with relatively smaller proportions in the dependent age groups. Correspondingly, dependency ratios are significantly lower among the foreign populations—by as much as 47 per 100 in Mauritania. Nonetheless, these differences appear to have little overall effect on the age distributions or dependency ratios of the total population. At most, the presence of a small-to-moderate proportion of foreigners changes the distribution of population in a given age group by 1.4 percentage points, and changes the overall dependency ratio by no more than 1.7 per 100.

Summary observations as to the effects of small-to-moderate proportions of foreigners on sex ratios are more difficult to make because of variability in the sex composition of foreign populations. In the case of Malawi, there was virtually no difference in the sex ratios of foreign and national populations in any age group or overall. In the Congo and Mauritania, there were substantial differences between foreigners' and nationals' sex ratios within given age groups; but only in the case of Mauritania was the sex ratio of the total foreign population significantly higher than that of nationals. In both countries, these differentials had little effect on the sex ratio of the total population; in no case was the latter figure changed by more than 0.02. However, these results might well have been different in cases such as The Gambia or Côte d'Ivoire, where foreigners are a relatively high proportion of total population and males predominate.

TABLE 8–1 Summary of Population and Migrant Stock

				Immigrants	
Destination[a]	Country Category[b]	Census Date[c]	Data Class[d]	African[e,f]	Non-African[g]
Western					
Benin	OLI	1979	N	–	–
Burkina Faso	LISA	1975	B	107,517	13,275
Côte d'Ivoire	MIOI	1975	N	1,437,319	37,124
The Gambia	LISA	1973	B	53,300	1,254
Ghana	OLI	1970	N	547,149	14,983
Guinea-Bissau	OLI	1979	B	12,043	888
Guinea	OLI	n.a.		–	–
Liberia	MIOI	1974	B	47,654	11,804
Mali	LISA	1976	B	72,365	4,549
Mauritania	MIOI	1977	N	23,007	5,161
Niger	LISA	n.a.		–	–
Nigeria	MIOE	n.a.		–	–
Senegal	MIOI	1976	N	93,072	25,710
Sierra Leone	OLI	1974	N	67,164	8,826
Togo	OLI	1970	B		–
Middle					
Angola	MIOE	1993	B	7,892	7,338
Cameroon	MIOE	1976	B	185,558	14,630
Central African Republic	OLI	1975	B	41,362	3,221
Chad	LISA	n.a.		–	–
Congo	MIOE	1984	B	45,703	5,464
Gabon	MIOE	n.a.		–	–
Zaire	OLI	1984[k]	B	–	–
Eastern					
Burundi	OLI	1979	B	79,902	2,820
Ethiopia	OLI	n.a.		–	–
Kenya	OLI	1979[k]	B	–	–
Madagascar	OLI	1975	B	1,078	52,237
Malawi	OLI	1977	B	281,806	6,938
Mozambique	OLI	1980	N	–	–
Rwanda	OLI	1978	N	36,789	5,122
Somalia	LISA	n.a.		–	–
Tanzania	OLI	1978[k]	N	–	–
Uganda	OLI	1969	B	486,300	56,114
Zambia	MIOI	1980	B	184,742	46,612
Zimbabwe	MIOI	n.a.		–	–
Southern					
Botswana	MIOI	1981	N	8,471	6,886
Lesotho	MIOI	n.a.		–	–
Namibia	MIOI	n.a.		–	–
Swaziland	MIOI	1976	B	21,946	4,212
South Africa	UMI	1985	B	1,404,975	462,084
Northern					
Sudan	OLI	1973[k]	B	–	–
Other Africa[f]		20,581	42,264		
Total		5,267,695	839,516		

Total[h]	Non-immigrants	Not Stated	Total Population	Immigrants (% total population)
41,284	3,286,937	2,779	3,331,000	1.2
110,681	5,517,411	10,000	5,638,092	2.0
1,474,469	5,203,580	31,951	6,710,000	22.0
54,554	437,636	1,309	493,499	11.1
562,132	7,997,181	–	8,559,313	6.6
12,931	755,069	–	768,000	1.7
–	–	–	6,200,000[i]	
59,458	1,443,910	–	1,503,368	4.0
146,089	6,248,829	–	6,394,918	2.3
28,168	1,310,832	–	1,339,000	2.1
–	–	–	6,700,000[i]	
–	–	–	105,400,000[i]	
118,782	4,879,103	–	4,997,885	2.4
79,414	2,655,745	724	2,735,883	2.9
143,620	1,807,380	1,951,000	–	7.4
15,230	8,184,770	–	8,200,000[f]	0.2
218,069	6,914,889	–	7,132,958	3.1
44,583	1,699,451	36,995	1,781,029	2.5
–	–	–	5,200,000[i]	
96,639	1,260,055	552,306	1,909,000	5.1
–	–	–	1,200,000[i]	
637,605	29,033,802	–	29,671,407	2.1
82,851	3,945,569	129	4,028,549	2.1
–	–	–	43,900,000[i]	
157,371	15,169,560	130	15,327,061	1.0
53,315	7,549,710	765	7,603,790	0.7
288,744	5,257,554	1,162	5,547,460	5.2
39,142	11,634,858	–	11,674,000	0.3
41,911	4,788,569	1,047	4,831,527	0.9
–	–	–	7,800,000[i]	
415,684	17,096,927	–	17,512,611	2.4
542,414	8,998,319	2,812	9,543,545	5.7
231,354	5,430,646	–	5,662,000	4.1
–	–	–	9,000,000[i]	
15,619	925,381	–	941.000[j]	1.7
–	–	–	1,600,000[i]	
–	–	–	1,100,000[i]	
26,460	468,074	466	495,000	5.3
1,862,192	–	–	23,386,000[f]	8.0
227,906	12,015,614	1,870,480	14,114,000	1.6
35,272	1,825,339	4,673	1,860,611	1.9
7,863,943	183,742,700		215,643,506	3.6[l]

NOTE: —: data unavailable.

[a]Region classifications from Adepoju (1988).

[b]Country categories from World Bank (1986): LISA=low income semi-arid; OLI=other low income; MIOE=middle income oil exporting; MIOI=middle income oil importing; UMI =upper middle income; SP=small population (<500,000).

[c]n.a.: not available.

[d]N=foreign national; B=foreign born.

[e]Includes all of North Africa.

[f]Unknown foreign born classified as "Other Africa." Includes eight countries of Comoros, Mauritius, Reunion, São Tomé and Principe, Seychelles, Cape Verde, Equitorial Guinea, and Djibouti.

[g]Includes United Kingdom, Belgium, France, Portugal, and other Europe, Asia (excluding countries of the former USSR); Middle Eastern countries, United States, Canada, and other Western Hemisphere. May include African immigrants classified as "undetermined foreigners" by some countries' censuses.

[h]Figures for total immigrants derive either from the sum of African and non-African immigrants or from the total foreign-born population figures in Table 8–5. Discrepancies between these two sources are reflected in the column "Unspecified origin or residual" in Table 8–8.

[i]Figures from Haub and Kent (1986).

[j]Total population figures from World Bank (1986) for mid-1973.

[k]Data on immigrants by country are not yet available.

[l]This figure does not include countries for which immigrant data are not available.

TABLE 8–2 Stocks of Migrants by Source and Destination: Western Africa

Destination Country and Population Abroad	Source Country				
	Benin	Burkina Faso	Côte d'Ivoire	The Gambia	Ghana
Destination[c]					
Burkina Faso	1,544	–	49,141	–	19,162
Côte d'Ivoire	38,403	774,099	–	–	47,431
The Gambia	–	–	–	–	–
Ghana	33,447	159,299	18,301	–	–
Guinea Bissau	–	–	–	–	–
Liberia	51	–	1,770	–	8,068
Mali	–	23,259	3,917	–	322
Mauritania	–	–	–	–	–
Senegal	–	–	–	3,095	–
Sierra Leone	–	–	–	4,539	1,346
Other Africa[a]	–	–	–	–	–
Total population	3,331,000	5,638,092	6,710,000	493,499	8,559,313
Population abroad[b]					
Number	75,957	956,657	73,129	7,634	76,917
Percent	2.3	17.0	1.1	1.5	0.9

NOTES: For country category, date of survey, and data class, see Table 8–1; regional classification from Adepoju (1988); —: no recorded migration.

[a]Unknown foreign born classified as "Other Africa." Category includes the eight countries of Comoros, Mauritius, Reunion, São Tomé and Principe, Seychelles, Cape Verde, Equitorial Guinea, and Djibouti, and all of North Africa except Sudan.

[b]Figures include interregional migration as well as the intraregional migration shown on this table.

[c]Countries not listed had no recorded immigration.

[d]Data not available.

[e]Figures from Haub and Kent (1986).

Destination Country and Population Abroad	Source Country				
	Guinea-Bissau	Guinea	Liberia	Mali	Mauritania
Destination[c]					
Burkina Faso	–	–	–	23,984	–
Côte d'Ivoire	–	99,476	3,824	353,448	–
The Gambia	7,176	10,442	–	5,478	1,779
Ghana	–	–	4,584	13,412	–
Guinea Bissau	–	5,675	–	–	–
Liberia	–	26,337	–	1,597	–
Mali	–	19,394	–	–	9,464
Mauritania	–	1,555	–	3,461	–
Senegal	23,805	38,821	–	8,872	11,294
Sierra Leone	–	44,504	3,213	–	–
Other Africa[a]	35	–	–	–	–
Total population	768,000	6,200,000[e]	1,503,368	6,394,918	1,339,000
Population abroad[b]					
Number	31,016	246,325	11,621	413,975	22,967
Percent	4.0	4.0	0.8	6.5	1.7

Niger	Nigeria	Senegal	Sierra Leone	Togo	Other Africa[a]	Total[b]
4,515	2,122	2,300	–	3,169	1,580	107,517
33,552	42,415	20,288	–	12,830	11,553	1,437,319
–	–	27,177	582	–	666	53,300
15,787	55,539	–	–	244,735	2,045	547,149
–	–	6,368	–	–	–	12,043
–	1,940	197	6,440	203	1,051	47,654
3,816	–	3,615	–	–	8,578	72,365
–	–	17,624	–	–	367	23,007
–	–	–	–	–	7,185	93,072
–	8,209	–	–	–	5,353	67,164
–	–	–	–	–	–[d]	–[d]
6,700,000[e]	105,000,000[e]	4,997,885	2,735,883	1,951,000		
59,316	245,620	81,265	7,022	262,082		
0.9	2.3	1.6	0.3	13.4		

TABLE 8–3 Stocks of Migrants by Source and Destination: Middle Africa

Destination Country and Population Abroad	Source Country			
	Angola	Cameroon	Central African Republic	Chad
Destination[c]				
Angola	–	–	–	–
Cameroon	–	–	12,431	28,063
Central African Republic	–	8,609	–	17,845
Congo	6,218	1,361	7,101	702
Other Africa[a]	965	–	–	–
Total population	8,200,000	7,132,958	1,781,029	5,200,000[e]
Population abroad[b]				
Number	38,458	9,970	19,532	46,610
Percent	0.5	0.1	1.1	0.9

NOTE: For country category, date of survey, and data class, see Table 8–1; regional classification from Adepoju (1988); —: no recorded migration.

[a]Unknown foreign born classified as "Other Africa." Category includes the eight countries of Comoros, Mauritius, Reunion, São Tomé and Principe, Seychelles, Cape Verde, Equatorial Guinea, and Djibouti, and all of North Africa except Sudan.

[b]Figures include interregional migration as well as the intraregional migration shown on this table.

[c]Countries not listed had no recorded immigration.

[d]Data not available.

[e]Figures from Haub and Kent (1986).

Congo	Gabon	Zaire	Other Africa[a]	Total[b]
354	–	1,296	5,886	7,892
1,502	729	211	2,730	185,558
2,774	195	8,998	1,867	41,362
–	476	20,912	1,081	45,703
4	9	–	–[d]	–[d]
1,909,000	1,200,000[e]	29,671,407		
71,786	1,409	79,774		
3.8	0.1	0.3		

TABLE 8–4 Stock of Migrants by Source and Destination: Eastern Africa and Sudan

Destination Country and Population Abroad	Source Country				
	Burundi	Kenya	Madagascar	Malawi	Mozambique
Destination[c]					
Burundi	–	–	–	–	–
Madagascar	–	–	–	–	–
Malawi	–	–	–	–	–
Rwanda	25,609	–	–	–	–
Uganda	40,024	119,614	–	–	–
Zambia	–	–	–	27,089	2,904
Other Africa[a]	–	77	12,997	–	197
Total population	4,028,549	15,327,061	7,603,790	5,547,460	11,647,000
Population abroad[b]					
Number	65,633	127,071	13,701	57,940	76,449
Percent	1.6	0.8	0.2	1.0	0.7

NOTES: For country category, date of survey, and data class, see Table 8–1; regional classification from Adepoju (1988); —: no recorded migration.

[a]Unknown foreign born classified as “Other Africa.” Category includes the eight countries of Comoros, Mauritius, Reunion, São Tomé and Principe, Seychelles, Cape Verde, Equitorial Guinea, and Djibouti, and all of North Africa except Sudan.

[b]Figures include interregional migration as well as the intraregional migration shown on this table.

[c]Countries not listed has no recorded immigration.

[d]Data not available.

[e]Figures from Haub and Kent (1986).

Rwanda	Somalia	Sudan	Tanzania	Uganda
47,750	5	–	13,018	1,825
–	–	–	–	–
–	–	–	–	–
–	–	–	1,104	2,593
161,953	–	65,240	34,398	–
–	–	–	16,493	–
–	–	–	215	–
4,831,527	7,800,000[e]	14,114,000	17,512,611	9,543,545
209,703	5	65,959	68,416	4,900
4.3	0.0	0.5	0.4	0.1

Destination Country and Population Abroad	Source Country			
	Zambia	Zimbabwe	Other Africa[a]	Total[b]
Destination[c]				
Burundi	–	–	294	79,902
Madagascar	–	–	1,078	1,078
Malawi	–	–	281,806	281,806
Rwanda	–	–	253	36,789
Uganda	–	–	1,073	486,300
Zambia	–	48,111	10,220	184,742
Other Africa[a]	24	–	–[d]	–[d]
Total population	5,662,000	9,000,000[e]		
Population abroad[b]				
Number	21,168	147,370		
Percent	0.4	1.6		

TABLE 8–5 Stocks of Migrants by Source and Destination: Southern Africa

Destination Country and Population Abroad	Source Countries						
	Botswana	Lesotho	Namibia	South Africa	Swaziland	Other Africa[a]	Total[b]
Destination[c]							
Botswana	–	464	521	3,807	125	350	8,471
South Africa	28,924	136,911	51,619	–	34,524	913,085	1,404,975
Swaziland	–	–	–	18,678	–	1,213	21,946
Other Africa[a]	–	–	–	341	–	–[d]	–[d]
Total population	941,000	1,600,000[e]	1,100,000[e]	23,386,000	495,000		
Population abroad[b]							
Number	57,745	137,375	52,709	22,829	34,649		
Percent	6.1	8.6	4.8	0.1	7.0		

NOTE: For country category, date of survey, and data class, see Table 8–1; regional classification from Adepoju (1988); —: no recorded migration.

[a]Unknown foreign born classified as "Other Africa." Category includes the eight countries of Comoros, Mauritius, Reunion, São Tomé and Principe, Seychelles, Cape Verde, Equitorial Guinea, and Djibouti, and all of North Africa except Sudan.

[b]Figures include interregional migration as well as the intraregional migration shown on this table.

[c]Countries not listed had no recorded immigration.

[d]Data not available.

[e]Figures from Haub and Kent (1986).

TABLE 8–6 Stocks of Migrants in Sub-Saharan Africa by Source and Destination: Interregional Migration

	Source Region				
Destination Region	Western	Middle	Eastern and Sudan	Southern	Total
Western	–	0	0	0	0
Middle	148,212[a]	–	906	56	149,174
Eastern and Sudan	357	138,469[b]	–	29,337[c]	168,163
Southern	687	8,315[d]	236,169[e]	–	245,171
Total	149,256	146,784	237,075	29,393	562,508

NOTES: For country category, date of survey, and data class, see Table 8–1. See Tables 8–2 through 8–5 for intraregional migration. Cell totals include all interregional migration; country-to-country migrations of more than 2,000 people are detailed in the footnotes.

[a]Includes 135,296 from Nigeria to Cameroon; 2,850 from Mali to Congo; and 2,817 from Senegal to Congo.

[b]Includes 27,682 from Angola to Zambia; 63,998 from Congo to Uganda; 16,653 from Zaire to Burundi; 7,230 from Zaire to Rwanda; and 22,906 from Zaire to Zambia.

[c]Includes 28,821 from Botswana to Zambia.

[d]Includes 3,190 from Angola to South Africa; and 3,154 from Congo to South Africa.

[e]Includes 7,380 from Kenya to South Africa; 30,617 from Malawi to South Africa; 2,055 from Mozambique to Swaziland; 71,209 from Mozambique to South Africa; 3,188 from Tanzania to South Africa; 21,041 from Zambia to South Africa; 2,375 from Zimbabwe to Botswana; and 96,884 from Zimbabwe to South Africa.

TABLE 8–7 Stocks of Migrants in Africa by Source and Destination: Non-African Immigrants

	Source					
Destination	Former USSR	Europe[a]	Middle East and Asia[b]	Americas[c]	Undetermined and Other Countries[d]	Total Non-African
Western						
Benin	–	–	–	–	–	–
Burkina Faso	–	2,560	259	–	10,456	13,275
Côte d'Ivoire	–	30,247	5,902	975	–	37,124
The Gambia	–	–	–	–	1,254	1,254
Ghana	–	7,584	4,926	–	2,473	14,983
Guinea Bissau	–	–	–	–	888	888
Liberia	–	4,101	4,643	2,808	252	11,804
Mali	836	3,054	301	228	130	4,549
Mauritania	–	3,045	–	308	1,808	5,161
Senegal	–	15,125	6,914	1,183	2,488	25,710
Sierra Leone	30	2,054	5,979	763	–	8,826
Togo	–	–	–	–	–	–
Middle						
Angola	–	6,063	118	846	311	7,338
Cameroon	–	12,552	–	1,067	1,011	14,630
Central African Republic	–	–	–	–	3,221	3,221
Congo	–	5,071	–	–	393	5,464
Zaire	–	–	–	–	–	–
Eastern						
Burundi	–	2,284	392	141	3	2,820
Kenya	–	–	–	–	–	–
Madagascar	–	38,310	10,447	278	3,202	52,237
Malawi	–	–	–	–	6,938	6,938

	Source					
Destination	Former USSR	Europe[a]	Middle East and Asia[b]	Americas[c]	Undetermined and Other Countries[d]	Total Non-African
Eastern						
Mozambique	–	–	–	–	–	–
Rwanda	–	3,121	1,568	–	433	5,122
Tanzania	–	–	–	–	–	–
Uganda	–	45,073	10,009	1,032	–	56,114
Zambia	–	12,744	12,989	4,351	16,528	46,612
Zimbabwe	–	–	–	–	–	–
Southern						
Botswana	–	4,985	946	776	179	6,886
South Africa	5,341	405,798	25,879	10,347	14,719	462,084
Swaziland	–	–	–	–	4,212	4,212
Northern						
Sudan	–	–	–	–	–	–
Other Africa	21	24,236	1,210	142	16,655	42,264
Total	6,228	628,007	92,482	25,245	87,554	839,516

NOTE: —: unknown.

[a]Includes United Kingdom, Belgium, France, Portugal, and other Europe.

[b]Includes Asia, China, India, Pakistan, Southeast Asia, Japan and Middle Eastern countries.

[c]Includes United States, Canada, and other Western Hemisphere countries.

[d]May include African immigrants classified as "undetermined foreigners" by some countries' censuses.

TABLE 8–8 Stocks of Migrants in Africa by Destination: Summary

Destination	Total Immigrants[a]	Non-Immigrants	Not Stated	Total Population	Immigrants as Percent of Total Population	Sub-Saharan African Immigrants as Percent of Population[b]	Unspecified Origin or Residual[a]
Western							
Benin	41,284	3,286,937	2,779	3,331,000	1.2	–	41,284
Burkina Faso	110,681	5,517,411	10,000	5,638,092	2.0	1.9	(10,111)
Côte d'Ivoire	1,474,469	5,203,580	31,951	6,710,000	22.0	21.4	26
The Gambia	54,554	437,636	1,309	493,499	11.1	10.8	–
Ghana	562,132	7,997,181	–	8,559,313	6.6	6.4	–
Guinea Bissau	12,931	755,069	–	768,000	1.7	1.6	–
Liberia	59,458	1,443,910	–	1,503,368	4.0	3.2	–
Mali	146,089	6,248,829	–	6,394,918	2.3	1.1	69,175
Mauritania	28,168	1,310,832	–	1,339,000	2.1	1.7	–
Senegal	118,782	4,879,103	–	4,997,885	2.4	1.9	–
Sierra Leone	79,414	2,655,745	724	2,735,883	2.9	2.5	3,424
Togo	143,620	1,807,380	–	1,951,000	7.4	–	143,620
Middle							
Angola	15,230	8,184,770	8,200,000[c]	–	0.2	0.1	–
Cameroon	218,069	6,914,889	–	7,132,958	3.1	2.6	17,881
Central African Republic	44,583	1,699,451	36,995	1,781,029	2.5	2.3	–
Congo	96,639	1,260,055	552,306	1,909,000	5.1	2.4	45,472
Zaire	637,605	29,033,802	–	29,671,407	2.1	–	637,605
Eastern							
Burundi	82,851	3,945,569	129	4,028,549	2.1	2.0	129
Kenya	157,371	15,169,560	130	15,327,061	1.0	–	157,371
Madagascar	53,315	7,549,710	765	7,603,790	0.7	–	–

Destination	Total Immigrants[a]	Non-Immigrants	Not Stated	Total Population	Immigrants as Percent of Total Population	Sub-Saharan African Immigrants as Percent of Population[b]	Unspecified Origin or Residual[a]
Eastern							
Malawi	288,744	5,257,554	1,162	5,547,460	5.2	5.1	–
Mozambique	39,142	11,634,858	–	11,674,000	0.3	–	39,142
Rwanda	41,911	4,788,569	1,047	4,831,527	0.9	0.8	–
Tanzania	415,684	17,096,927	–	17,512,611	2.4		415,684
Uganda	542,414	8,998,319	2,812	9,543,545	5.7	5.1	–
Zambia	231,354	5,430,646	–	5,662,000	4.1	3.3	–
Southern							
Botswana	15,619	925,381	–	941,000[c]	1.7	0.9	262
South Africa	1,862,192	–	–	23,386,000[c]	8.0	6.0	(4,867)
Swaziland	26,460	468,074	466	495,000	5.3	4.4	302
Northern							
Sudan	227,906	12,015,614	1,870,480	14,114,000	1.6	–	227,906
Other Africa	35,272	1,825,339	4,673	1,860,611	1.9	1.1	(27,573)
Total	7,863,943	183,742,700		215,643,506	3.6		1,756,732

NOTE: Parentheses indicate negative numbers.

[a]Figures for total immigrants derive either from the sum of African and non-African immigrants (Tables 8–2, 8–3, 8–4, 8–5, and 8–7) or from the total foreign-born population figures in Table 8–15. Discrepancies between these two sources are reflected in the column "Unspecified origin or residual."

[b]Because several countries in the table do not distinguish African from non-African immigrants, this percentage cannot be calculated for all countries.

[c]Total population figures are World Bank estimates for mid-1973 from Population Growth and Policies (1986).

TABLE 8–9 Refugees, by Asylum Country, 1987, 1988, 1990

Asylum Country	1987	1988	1990[a]
Western			
Benin	3,700	3,000	800
Burkina Faso	180	200	300
Côte d'Ivoire	600	800	270,500
The Gambia	–	–	800
Ghana	140	100	8,000
Guinea Bissau	–	–	1,600
Guinea	–	–	325,000
Liberia	110	200	–
Mali	–	–	10,600
Mauritania	–	–	22,000
Niger	–	–	800
Nigeria	4,800	5,100	5,300
Senegal	5,600	5,200	55,300
Sierra Leone	200	100	125,000
Togo	1,700	500	–
Middle			
Angola	92,000	95,700	11,900
Cameroon	7,300	4,700	6,900
Central African Republic	5,100	3,000	6,300
Chad	100	–	–
Congo	1,200	2,100	3,400
Gabon	100	100	800
Zaire	338,000	325,700	370,900
Eastern and Sudan			
Burundi	76,000	76,000	90,700
Djibouti	13,500	2,000	67,400
Ethiopia	220,000	700,500	783,000
Kenya	9,000	10,600	14,400
Malawi	420,000	630,000	909,000
Mozambique	500	400	700
Rwanda	19,000	20,600	21,500
Somalia	430,000	365,000	358,500
Sudan	817,000	693,600	726,500
Tanzania	266,000	266,200	266,200
Uganda	120,400	125,500	156,000
Zambia	151,500	149,000	133,950
Zimbabwe	150,500	171,500	186,000
Southern			
Botswana	5,200	2,700	1,000
Lesotho	2,000	4,000	1,000
Namibia	–	–	25,000
South Africa	180,000	180,000	201,000
Swaziland	67,000	70,700	47,200
Total	3,408,430	3,914,800	5,215,250

NOTE: —: no refugees reported.

[a]Includes 6,500 that are not accounted for in Tables 8–10 through 8–13 because their source countries are unknown.

SOURCE: Data from U.S. Committee for Refugees (1988; 1989; 1991).

TABLE 8–10 Refugees, by Source and Asylum Countries, 1990: Western Africa

	Source Country				
Asylum Country	Guinea Bissau	Liberia	Mauritania	Niger	Senegal
Côte d'Ivoire		270,000			
The Gambia				800	
Ghana	8,000				
Guinea-Bissau				1,600	
Guinea	325,000				
Mali	100	10,000	500		
Mauritania				22,000	
Nigeria	1,700				
Senegal	5,000		50,100		
Sierra Leone		125,000			

NOTE: These figures exclude interregional refugees and refugees from unknown source countries. See Table 8-14.
SOURCE: Data from U.S. Committee for Refugees (1991).

TABLE 8–11 Refugees, by Source and Asylum Countries, 1990: Middle Africa

	Source Country			
Asylum Country	Angola	Central African Republic	Chad	Zaire
Angola				9,500
Cameroon			6,500	
Central African Republic	1,200			
Congo		300	2,300	400
Zaire	312,700			

NOTE: These figures exclude interregional refugees and refugees from unknown source countries. See Table 8–14.
SOURCE: Data from U.S. Committee for Refugees (1991).

TABLE 8–12 Refugees, by Source and Asylum Countries, 1990: Eastern Africa and Sudan

	Source Country								
Asylum Country	Burundi	Ethiopia	Kenya	Malawi	Mozambique	Rwanda	Somalia	Sudan	Uganda
Burundi						80,600	100		
Djibouti		6,400					61,000		
Ethiopia							385,000	398,000	
Kenya		3,000				2,000	1,000		5,100
Malawi					909,000				
Rwanda	21,500								
Somalia		355,000	3,500						
Sudan		700,000							2,000
Tanzania	154,700				72,000	22,300			
Uganda						87,000	1,500	64,000	
Zambia				250	22,000				1,200
Zimbabwe					185,000				

NOTE: These figures exclude interregional refugees and refugees from unknown source countries. See Table 8–14.

SOURCE: Data from U.S. Committee for Refugees (1991).

TABLE 8–13 Refugees, by Source and Asylum Countries, 1990: Southern Africa

	Source Country	
Asylum Country	Lesotho	South Africa
Botswana		1,000
Lesotho		1,000
South Africa	1,000	
Swaziland		7,700

NOTE: These figures exclude interregional refugees and refugees from unknown source countries. See Table 8–14.
SOURCE: Data from U.S. Committee for Refugees (1991).

TABLE 8–14 Interregional Refugees in Sub-Saharan Africa, 1990

	Source Region			
Asylum Region	Western	Middle	Eastern and Sudan	Southern
Western	–	5,200[a]	0	0
Middle	0	–	63,100[b]	2,400[c]
Eastern and Sudan	0	158,800[d]	–	8,200[e]
Southern	0	25,000[f]	239,500[g]	–
Total	0	189,000	302,600	10,600

NOTE: Cell totals include all interregional migration; country-to-country migrations of 2,000 or more refugees are detailed in the footnotes.
[a]Includes 3,300 from Chad to Nigeria.
[b]Includes 5,100 from Sudan to Central African Republic; 10,000 from Burundi to Zaire; 12,000 from Rwanda to Zaire; 32,000 from Sudan to Zaire; and 4,000 from Uganda to Zaire.
[c]Includes 2,100 from South Africa to Angola.
[d]Includes 10,000 from Zaire to Burundi; 16,000 from Zaire to Tanzania; 98,000 from Angola to Zambia; 9,000 from Zaire to Zambia; 20,000 from Chad to Sudan; and 4,500 from Zaire to Sudan.
[e]Includes 2,000 from South Africa to Uganda and 3,500 from South Africa to Zambia.
[f]All of these refugees are from Angola to Namibia.
[g]Includes 200,000 from Mozambique to South Africa and 39,500 from Mozambique to Swaziland.
SOURCE: Data from U.S. Committee for Refugees (1991).

TABLE 8–15 Foreign-Born Population in Selected Sub-Saharan African Countries

			Foreign-Born Population				
Country or Area	Reference Date	Total Population	Total	Proportion of Total Population	Male	Female	Sex Ratio Male to Female
Western							
Benin	1979	3,331,000	41,284[a]	1.2	21,268	20,016	1.06
Burkina Faso	1975	5,638,000	110,681	2.0	52,854	57,827	0.91
Côte d'Ivoire	1975	6,710,000	1,474,469[a]	22.0	874,073	600,396	1.46
The Gambia	1973	493,000	54,554	11.1	33,334	21,220	1.57
Ghana	1970	8,559,000	562,132[a]	6.6	323,978	238,154	1.36
Guinea-Bissau	1979	768,000	12,931	1.7	6,471	6,460	1.00
Liberia	1974	1,503,000	59,458	4.0	35,759	23,699	1.51
Mali	1976	6,395,000	146,089	2.3	73,458	72,631	1.01
Mauritania	1977	1,339,000	28,168[a]	2.1	16,488	11,680	1.41
Sierra Leone	1974	2,735,000	79,414[a]	2.9	48,336	31,078	1.56
Togo	1970	1,951,000	143,620	7.4	69,294	74,326	0.93
Middle							
Cameroon	1976	7,132,000	218,069	3.1	120,442	97,627	1.23
Central African Republic	1975	1,781,000	44,583	2.5	21,844	22,739	0.96
Congo	1984	1,909,000	96,639	5.1	47,797	48,842	0.98
Eastern							
Burundi	1979	4,028,000	82,851	2.1	42,147	40,704	1.04
Kenya	1979	15,327,000	157,371	1.0	82,298	75,073	1.10
Malawi	1977	5,547,000	288,744	5.2	140,421	148,323	0.95
Mozambique	1980	11,674,000	39,142[a]	0.3	19,759	19,383	1.02
Rwanda	1978	4,832,000	41,911[a]	0.9	21,411	20,500	1.04

			Foreign-Born Population				
Country or Area	Reference Date	Total Population	Total	Proportion of Total Population	Male	Female	Sex Ratio Male to Female
Eastern							
Tanzania	1978	17,513,000	415,684	2.4	219,188	196,496	1.12
Zambia	1980	5,662,000	231,354	4.1	121,436	109,918	1.10
Southern							
Botswana	1981	941,000	15,619[a]	1.7	8,788	6,831	1.29
South Africa	1985	23,386,000	1,862,192	8.0	1,209,967	652,225	1.86
Swaziland	1976	495,000	26,460	5.4	12,554	13,906	0.90
Northern							
Sudan	1973	14,114,000	227,906	1.6	113,028	114,878	0.98

[a]Classified as foreign nationals, not foreign born.

SOURCE: Data from United Nations (1989a).

TABLE 8–16 Sub-Saharan African Source Countries, 1990, Ranked by Refugee Stocks

Source Country	Region	Number	Percent of Total	Cumululative Percentage
Mozambique	Eastern	1,427,500	27.4	27.4
Ethiopia	Eastern	1,064,400	20.4	47.8
Liberia	Western	729,800	14.0	61.8
Sudan	Northern	499,100	9.6	71.3
Somalia	Eastern	448,600	8.6	79.9
Angola	Middle	435,700	8.4	88.3
Rwanda	Eastern	203,900	3.9	92.2
Burundi	Eastern	186,200	3.6	95.8
Mauritania	Western	60,100	1.2	96.9
Zaire	Middle	50,700	1.0	97.9
Chad	Middle	35,200	0.7	98.6
Senegal	Western	24,400	0.5	99.0
South Africa	Southern	20,000	0.4	99.4
Uganda	Eastern	12,300	0.2	99.7
Guinea-Bissau	Western	5,000	0.1	99.9
Kenya	Eastern	3,500	0.1	100.0
Lesotho	Southern	1,000	0.0	100.0
Niger	Western	500	0.0	100.0
Namibia	Southern	300	0.0	100.0
Central African Republic	Middle	300	0.0	100.0
Malawi	Eastern	250	0.0	100.0
Other[a]		6,500		
Total refugee population		5,215,250		

[a]Source country not specified.

SOURCE: Data from U.S. Committee for Refugees (1991).

TABLE 8–17 Sub-Saharan African Asylum Countries, 1990, Ranked by Refugee Stocks

Asylum Country	Region	Number	Percent of Total	Cumululative Percentage
Malawi	Eastern	909,000	17.43	17.43
Ethiopia	Eastern	783,000	15.01	32.44
Sudan	Northern	726,500	13.93	46.37
Zaire	Middle	370,900	7.11	53.49
Somalia	Eastern	358,500	6.87	60.36
Guinea	Western	325,000	6.23	66.59
Côte d'Ivoire	Western	270,500	5.19	71.78
Tanzania	Eastern	266,200	5.10	76.88
South Africa	Southern	201,000	3.85	80.74
Zimbabwe	Eastern	186,000	3.57	84.30
Uganda	Eastern	156,000	2.99	87.29
Zambia	Eastern	133,950	2.57	89.86
Sierra Leone	Western	125,000	2.40	92.26
Burundi	Eastern	90,700	1.74	94.00
Djibouti	Eastern	67,400	1.29	95.29
Senegal	Western	55,300	1.06	96.35
Swaziland	Southern	47,200	0.91	97.26
Namibia	Southern	25,000	0.48	97.74
Mauritania	Western	22,000	0.42	98.16
Rwanda	Eastern	21,500	0.41	98.57
Kenya	Eastern	14,400	0.28	98.85
Angola	Middle	11,900	0.23	99.07
Mali	Western	10,600	0.20	99.28
Ghana	Western	8,000	0.15	99.43
Cameroon	Middle	6,900	0.13	99.56
Central African Republic	Middle	6,300	0.12	99.68
Nigeria	Western	5,300	0.10	99.79
Congo	Middle	3,400	0.07	99.85
Guinea-Bissau	Western	1,600	0.03	99.88
Lesotho	Southern	1,000	0.02	99.90
Botswana	Southern	1,000	0.02	99.92
Benin	Western	800	0.02	99.93
The Gambia	Western	800	0.02	99.95
Niger	Western	800	0.02	99.97
Gabon	Middle	800	0.02	99.98
Mozambique	Eastern	700	0.01	99.99
Burkina Faso	Western	300	0.01	100.00
Total asylum population		5,215,250		

SOURCE: Data from U.S. Committee for Refugees (1991).

TABLE 8–18 Lesotho Population: 1976 and 1986 Censuses

Characteristics	1976	1986	1976–1986
De jure population			
Total	1,216,815	1,577,536	
Male	587,348	760,472	
Female	629,467	817,064	
De facto population			
Total	1,064,188	1,443,853	
Male	458,260	648,021	
Female	605,928	795,832	
Sex ratio (male to female)			
De jure	0.93	0.93	
De facto	0.76	0.81	
Absentees			
Total	152,627	133,683	
Male	129,088	112,451	
Female	23,539	21,232	
Percentage of total *de jure* population	12.5	8.5	
Intercensal growth rate			
De jure			2.6
De facto	3.1		

SOURCE: Data from Lesotho (1987).

TABLE 8–19 Mauritania Population: 1977 Census

	Foreign Nationals			Mauritanians			Total		
Age	Male	Female	Total	Male	Female	Total	Male	Female	Total
Number									
0–14	4,440	4,592	9,032	300,797	278,909	579,706	305,237	283,501	588,738
15–59	11,642	6,745	18,387	307,481	346,015	653,496	319,123	352,760	671,883
60+	406	343	749	33,553	43,907	77,460	33,959	44,250	78,209
All ages	16,488	11,680	28,168	641,831	668,831	1,310,662	658,319	680,511	1,338,830
Percentage									
0–14	15.8	16.3	32.1	23.0	21.3	44.2	22.8	21.2	44.0
15–59	41.3	23.9	65.3	23.5	26.4	49.9	23.8	26.3	50.2
60+	1.4	1.2	2.7	2.6	3.4	5.9	2.5	3.3	5.8
All ages	58.5	41.5	100.0	49.0	51.0	100.0	49.2	50.8	100.0
Dependency ratio[a]			53.2			100.6			99.3
Sex ratio (male to female)									
0–14	0.97	1.08	1.08						
15–59	1.73	0.89	0.90						
60+	1.18	0.76	0.77						
All ages	1.41	0.96	0.97						

[a]Calculated using 0–14 and 60+ as dependent age groups.

SOURCE: Data from République Islamique de Mauritanie (no date).

TABLE 8–20 Malawi Population: 1977 Census

	Foreign Born			Malawian			Total		
Age	Male	Female	Total	Male	Female	Total	Male	Female	Total
Number									
0–9	13,635	13,928	27,562	925,587	955,477	1,881,063	939,221	969,404	1,908,626
10–19	27,242	26,461	53,702	528,545	531,002	1,059,547	555,786	557,463	1,113,249
20–29	23,184	27,410	50,594	376,265	460,438	836,703	399,449	487,848	887,297
30–39	17,075	19,519	36,595	260,218	286,888	547,107	277,293	306,408	583,701
40–49	15,222	17,725	32,946	185,219	204,881	390,100	200,440	222,606	423,046
50–59	13,803	15,159	28,962	116,807	132,955	249,762	130,610	148,113	278,724
60+	30,261	28,122	58,383	141,131	152,844	293,975	171,392	180,966	352,357
All ages	140,421	148,323	288,744	2,533,771	2,724,485	5,258,256	2,674,192	2,872,808	5,547,000
Percentage									
0–9	9.7	9.4	9.5	36.5	35.1	35.8	35.1	33.7	34.4
10–19	19.4	17.8	18.6	20.9	19.5	20.2	20.8	19.4	20.1
20–29	16.5	18.5	17.5	14.9	16.9	15.9	14.9	17.0	16.0
30–39	12.2	13.2	12.7	10.3	10.5	10.4	10.4	10.7	10.5
40–49	10.8	12.0	11.4	7.3	7.5	7.4	7.5	7.7	7.6
50–59	9.8	10.2	10.0	4.6	4.9	4.7	4.9	5.2	5.0
60+	21.6	19.0	20.2	5.6	5.6	5.6	6.4	6.3	6.4
All ages	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

	Foreign Born			Malawian			Total		
Age	Male	Female	Total	Male	Female	Total	Male	Female	Total
Dependency ratio[a]			42.4			70.5			68.8
Sex ratio (male to female)									
0–9	0.98	0.97	0.97						
10–19	1.03	1.00	1.00						
20–29	0.85	0.82	0.82						
30–39	0.87	0.91	0.90						
40–49	0.86	0.90	0.90						
50–59	0.91	0.88	0.88						
60+	1.08	0.92	0.95						
All ages	0.95	0.93	0.93						

[a]Calculated using 0–9 and 60+ as dependent age group.

SOURCE: Data from Malawi (1984).

TABLE 8–21 Congo 1984 Census Results

	Foreign Born			Congolese			Total *de Jure* Population		
Age	Male	Female	Total	Male	Female	Total	Male	Female	Total
Number									
0–9	10,279	10,646	20,925	294,671	292,358	587,029	304,950	303,004	607,954
10–19	5,615	7,265	12,880	219,249	224,341	443,590	224,864	231,606	456,470
20–29	13,031	13,379	26,410	136,757	145,582	282,339	149,788	158,961	308,749
30–39	8,638	7,302	15,940	79,776	89,774	169,550	88,414	97,076	185,490
40–49	3,965	3,275	7,240	61,977	67,420	129,397	65,942	70,695	136,637
50–59	2,236	1,708	3,944	44,480	55,998	100,478	46,716	57,706	104,422
60–69	1,062	839	1,901	28,701	37,428	66,129	29,763	38,267	68,030
70+	478	399	877	14,057	17,526	31,583	14,535	17,925	32,460
Undetermined	555	476	1,031	3,575	4,430	8,005	4,130	4,906	9,036
Total	45,859	45,289	91,148	883,243	934,857	1,818,100	929,102	980,146	1,909,248
Percentage									
0–9	22.4	23.5	23.0	33.4	31.3	32.3	32.8	30.9	31.8
10–19	12.2	16.0	14.1	24.8	24.0	24.4	24.2	23.6	23.9
20–29	28.4	29.5	29.0	15.5	15.6	15.5	16.1	16.2	16.2
30–39	18.8	16.1	17.5	9.0	9.6	9.3	9.5	9.9	9.7
40–49	8.6	7.2	7.9	7.0	7.2	7.1	7.1	7.2	7.2
50–59	4.9	3.8	4.3	5.0	6.0	5.5	5.0	5.9	5.5
60–69	2.3	1.9	2.1	3.2	4.0	3.6	3.2	3.9	3.6
70+	1.0	0.9	1.0	1.6	1.9	1.7	1.6	1.8	1.7
Undetermined	1.2	1.1	1.1	0.4	0.5	0.4	0.4	0.5	0.5
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

	Foreign Born			Congolese			Total *de Jure* Population		
Age	Male	Female	Total	Male	Female	Total	Male	Female	Total
Dependency ratio[a]			35.7			60.8			59.4
Sex ratio (male to female)									
0–9	0.97	1.01	1.01						
10–19	0.77	0.98	0.97						
20–29	0.97	0.94	0.94						
30–39	1.18	0.89	0.91						
40–49	1.21	0.92	0.93						
50–59	1.31	0.79	0.81						
60–69	1.27	0.77	0.78						
70+	1.20	0.80	0.81						
Undetermined	1.17	0.81	0.84						
Total	1.01	0.94	0.95						

[a]Calculated using 0–9 and 60 and over as dependent age groups.

SOURCE: République Populaire du Congo (1984: Tables 203, 204).

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9

Models of the Demographic Effect of AIDS

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INTRODUCTION

With the increasingly high prevalence of the human immunodeficiency virus (HIV) infection, the devastating nature of HIV disease, and the possibility of heterosexual and perinatal transmission, acquired immunodeficiency syndrome (AIDS) seems to have the potential, especially in less developed countries, for major demographic and social effects. The disease obviously affects mortality, and it could indirectly affect fertility through behavioral changes such as condom use, number of partners, and so on, or by causing the death of men and women of childbearing age. Patterns of rural-urban migration could also change if the epidemic's effect is different in urban and rural areas. To help understand the potential effects of this epidemic, several different computer-based epidemic models have been developed. They have been used for both developed and less developed countries (LDCs), especially African countries. These modeling efforts have the potential to help health policymakers understand the dynamics of the epidemic, to forecast the burden of illness in the future, and to evaluate potential interventions.

An exchange in the popular press in 1992 illustrates the results and

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policy uses (and perhaps misuses) of HIV/AIDS models. In June, a number of newspapers and magazines reported on projections made by Roy Anderson and colleagues at Imperial College in London. The *New York Times* article opened with the statement that "populations in the worst-afflicted African countries will within 20 years switch over from their present high rate of increase to an actual decrease in numbers" (Perlez, 1992). The report noted that these projections were "far gloomier than those of other mathematical modelers at the World Bank, the World Health Organization …, and the Population Council in New York" and also said that the findings were controversial because they rely on sexual behavior for which there are still only imprecise data. In support, however, the article noted recent (but as of then not published) pessimistic projections from the Harvard School of Public Health (Altman, 1992). Anderson was quoted as saying that he hoped his projections would awaken policymakers in the West and in Africa to the gravity of the situation, which he called "the most serious threat to humankind in modern times," and he added that "the situation calls for massive investment to find a vaccine." He also mentioned that the projections were useful for assessing how best to curb the rate of infection and called for methods to change behavior soon but suggested that it was already too late for sexually active people in hard hit areas. In response, an unnamed senior official at the U.S. State Department was quoted suggesting that investment in African family planning programs was no longer necessary because "the population is about to be decimated."

In July, two officials from the Rockefeller Foundation wrote in response that even if the projections were accurate, it was wrong to "abandon hopes for millions of people" who were not already infected (Berkley and Hughes, 1992). They added that Anderson's pessimistic assumptions that there would be no change in sexual behavior in Africa might be wrong and that it was unfair to single Africa out in this way. Furthermore, they suggested that fertility rates could possibly increase to offset the loss of young children to AIDS and, despite the State Department official's comment, suggested that family planning is essential where HIV infection is high in order to empower women to manage their own fertility. In addition to the policy issues that this letter raises, the interchange also suggests that we must consider how to validate or otherwise assess the quality of model results, especially when they are necessarily based on many assumptions.

This chapter describes the currently available models of the HIV/AIDS epidemic and summarizes what these models say about the potential future demographic effects of AIDS in Africa. It is not a comprehensive review of the epidemiology of HIV/AIDS or of all modeling efforts. The chapter begins with a brief introduction to the epidemiology of AIDS in Africa, with a focus on aspects of the epidemic that must be incorporated in the models. It then describes the main features of epidemic models developed to date. Some quantitative and qualitative results of these models for the African situation are described, and the major sources of uncertainty are addressed.

This analysis is based, in large part, on a United Nations/World Health Organization (UN/WHO) publication entitled *The AIDS Epidemic and its Demographic Consequences* (United Nations, 1991). The UN/WHO report is the proceedings of a workshop that these two organizations sponsored in late 1989 on modeling the demographic effect of the AIDS epidemic in countries in which HIV transmission is primarily heterosexual or perinatal. The report summarizes the efforts of eight modeling teams to apply their models with a common set of assumptions and compares the results. Reports of more recent modeling efforts are also referred to.

EPIDEMIOLOGY OF AIDS IN SUB-SAHARAN AFRICA[1]

AIDS represents the late clinical stage of infection with HIV. HIV causes severe damage to the immune system, and the course of HIV disease usually spans several years. Some individuals develop an acute illness resembling mononucleosis several weeks or months after infection, but most infected persons have no other clinical signs or symptoms for years. The first clinical symptoms are often nonspecific; they could include chronic diarrhea, weight loss, fever, and fatigue. As the immune system fails, however, the body becomes increasingly susceptible to potentially fatal conditions such as Kaposi's sarcoma and opportunistic infections. The clinical manifestations of AIDS in developing countries can be very different from those in developed countries because the background microbiological flora are different.

The proportion of HIV-infected persons who ultimately develop AIDS is not known precisely because no cohorts have been followed for much more than a decade, but the proportion is usually assumed to be 100 percent. Cohort studies of HIV-infected adults in the United States suggest that about 15 to 20 percent develop AIDS within five years and about 50 percent develop it within ten years. The data for Africa are limited, and the incubation period may be similar or shorter because Africans are typically exposed more frequently to a larger range of infectious agents.

HIV is transmitted in a number of ways, but primarily through sexual intercourse with infected partners, through injections with contaminated needles or syringes, through the administration of infected blood or blood products, perinatally from mother to child, and possibly through breastfeeding. Estimates of the probability that HIV will be transmitted through any of these

[1]Based on Chin (1991) and Anderson et al. (1991b).

routes and of the efficiency of transmission vary substantially. In Africa, the high prevalence of sexually transmitted diseases (STDs) with genital ulcers and the otherwise high infectious disease burden are thought to increase the efficiency of HIV transmission. Individuals become infectious after they are themselves infected and remain so for the course of the disease. Some evidence suggests, however, that individuals have an initial burst of infectiousness soon after they are themselves infected, the level of infectiousness subsides, and then it gradually increases as the concentration of HIV increases in the blood.

The World Health Organization has described three distinct epidemiological patterns of HIV/AIDS, and the countries of sub-Saharan Africa are known as "pattern II" countries: HIV infection and AIDS are found primarily in sexually active heterosexuals. By the end of the 1980s, the HIV/AIDS epidemic appeared to be most severe in middle and eastern Africa, extending into several adjacent countries. Most of the cases in these areas are infected with HIV-1, the form of the virus most prevalent in much of the world. An apparently less pathogenetic form of the virus, HIV-2, has been found in western Africa, but at lower prevalence levels.

The HIV epidemic seems to be concentrated in the cities of Africa; as many as 5 to 10 percent of infants born in these areas, on average, are HIV positive. Chin (1991) estimates that HIV seroprevalence among sexually active adults in urban areas is 20 to 30 percent, about 10 times that in rural areas. Rural areas along heavily traveled roads, however, tend to have higher rates. All told, the World Health Organization (1992) estimates that 8 million people in sub-Saharan Africa are infected with HIV.

PURPOSES AND TYPES OF HIV/AIDS MODELS: GENERAL CONSIDERATIONS

HIV/AIDS models have been developed for several purposes, and these purposes have determined the models' structure and capabilities. The primary purpose of some models is to forecast the effect of the epidemic in order to plan a response or perhaps to warn policymakers of the consequences of inaction. The forecasts could be either short term (a few years) or long term (a few decades or more). Other models have as their primary purpose the assessment of possible interventions and their implications for policy. Such models explore, for instance, the relative effect of changing sexual behaviors such as number and choice of partners, the use of condoms, and the screening of blood. A third group of models aims at understanding the epidemic's dynamics for the purposes of interpreting epidemiological data, understanding biological aspects of HIV disease and transmission, and making policy recommendations for disease control.

Reflecting the disciplines of the modelers as well as the different rea sons for constructing the models, a wide variety of approaches have been taken. In order to compare these approaches, it is helpful to characterize the models in terms of their "state variables" and "dynamics."

State variables summarize the state of the epidemic at any instant. They usually represent the number of people (and sometimes couples) in certain groups who are uninfected, have HIV infection, or have AIDS. These groups are usually chosen to increase the homogeneity with regard to risk of HIV infection within groups and to maximize differences with regard to risk across groups. In the HIV/AIDS models, the categories are generally defined by combinations of age and sex; risk-related practices such as sexual patterns, intravenous (IV) drug use, and so on; rural-urban residence; presence of STDs; and other variables.

The models' dynamics are the mathematical rules that determine how the state variables change over time. Some of these rules relate to the infection process and the natural history of the disease, and others relate to changes in the risk-related behaviors and to population dynamics unrelated to AIDS. A model's dynamics are usually specified through mathematical equations. The form of these equations defines the structure of the model, and the constants in these equations—the model's parameters—adapt it to a given population.

In developing HIV/AIDS models, several choices must be made. Perhaps the most important is the degree to which the model uses statistical extrapolation or attempts to construct a realistic representation of the biological and behavioral patterns that underlie the epidemic.

Statistical models are based on mathematical extrapolations—perhaps complex—of trends in HIV or AIDS incidence. These models have a relatively small number of state variables, and these variables usually correspond to the categories in which HIV/AIDS cases are reported in surveillance systems. Their dynamics are specified mathematically with reference to historical trends, rather than reflecting epidemiological or behavioral functions. Statistical models tend to be simple, and (subject to data quality constraints) one can easily assess how well the model has worked in the past. There is never assurance, however, that historical trends will continue in the future. Furthermore, these models offer no possibility for evaluating behavioral interventions.

Epidemic models, on the other hand, specify biologically and behaviorally realistic dynamics and, therefore, must employ a relatively large number of state variables to reflect differences in behavior and disease status in the population. The dynamics of these models reflect the epidemic process; for instance, the number of new HIV infections in a given period is commonly a function of both the number of infectious individuals (based on past infections, the natural history of HIV disease, and other biological and behavioral assumptions) and the number of susceptible individuals (based on demographic trends and behavioral assumptions).

Because of their more realistic dynamics, epidemic models can be used to explore the effect of the HIV/AIDS epidemic in finer detail than statistical extrapolation models. They can also be used to evaluate possible behavioral and other interventions. Epidemic models, however, make formidable demands on the available data. The modeler must make a large number of assumptions about the parameters that specify the model's dynamics. Initial values are needed for the number of people in a large and complex set of groups. As a result of the complexity of epidemic models, it is often difficult to validate the form of model or its results, or to estimate the parameters needed to adapt a model to a given country's situation.

Modelers face a number of other choices in constructing HIV/AIDS models. The unit of analysis, for instance, can be the entire population (for extrapolation models), subgroups within it (with differing degrees of disaggregation), couples, or individuals.

Models differ in terms of their degree of disaggregation by demographic factors, risk groups, geography, and so forth, and in the inclusion of biological, behavioral, and policy variables. More disaggregation is thought to make the models more realistic, and permits the evaluation of more complex and targeted interventions. Disaggregation, however, tends to increase data demands for parameter estimation in an almost geometric fashion.

Models also can be specified as deterministic or stochastic. In deterministic models, the state variables are continuous variables representing the number of individuals in each population category. The model dynamics consist of equations that describe how the number of individuals in each category changes over time, given the model parameters. The state variables in stochastic or microsimulation models describe the demographic characteristics, risk-related behavioral characteristics, and infection/disease status of each of a finite number of discrete individuals. The dynamics are expressed in probability statements about the possible changes in any individual's characteristics. Microsimulation models can offer more flexibility in specifying complex behavioral patterns and interventions, but they are frequently more computer intensive and the results can be more difficult to interpret.

EXISTING HIV/AIDS MODELS

As already noted, a wide variety of HIV/AIDS models have been developed. Although they differ on a number of dimensions, they can be categorized in three major groups: statistical extrapolation and "back-calculation" models, models that represent the biological nature of the epidemic, and demographic/behavioral models.

Statistical Extrapolation and Back-Calculation Models

Some of the more prominent AIDS modeling efforts in the United States and other developed countries are based on statistical extrapolation of the number of AIDS cases reported to surveillance systems. The earliest projection of AIDS in the United States published by the Centers for Disease Control (CDC), for instance, was based on polynomial extrapolation of AIDS cases reported to the CDC's surveillance system (Morgan and Curran, 1986). Similar projections, relying on a more complex mathematical form, were published by Hyman and Stanley (1988).

The method known as back-calculation, developed by Brookmeyer and Gail (1988), uses the same AIDS case data but brings in additional information on the latency distribution—the time between infection with HIV and onset of the full clinical manifestations of AIDS. It is based on the relationship among the cumulative number of new infections at time *t*, $I(t)$; the cumulative number of new AIDS cases at time *t*, $A(t)$; and the incubation distribution of duration from infection to AIDS, $g(x)$. The relationship is given by the following equation:

$$A(t) = \int_0^t I(t-x)\, g(x) dx \ . \quad (1)$$

By using surveillance estimates of $A(t)$ and estimates of $g(x)$ based on epidemiological studies, this equation can be solved for the unknown $I(t)$ to yield estimates of the number of people infected with HIV in the past. With additional assumptions the model can yield estimates of future HIV prevalence and AIDS incidence.

The strengths of this approach are that additional biomedical information on the latency distribution is used and that a more biologically realistic model is developed. Using the back-calculation model, for instance, Brookmeyer (1991) and others have shown that the number of new HIV infections in the United States peaked in the mid-1980s, but that the number of AIDS cases will not peak until the mid-1990s. Another analysis using this model has looked at the possible effect that AZT has had on AIDS mortality (Gail et al., 1990). Despite the additional complexity, however, the back-calculation model does not generally provide for estimates of the effect of future behavioral interventions.

In the United States and Europe, extrapolation and back-calculation methods have been used to project the epidemic in the population as a whole and in subgroups that correspond to the standard groupings in the CDC AIDS surveillance system: homosexual men, IV drug users, and so on. They are generally not suited for less developed countries, however, because they rely heavily on complete and accurate AIDS case reporting, which few LDCs have (Chin and Lwanga, 1991).

Epidemic Models

Epidemic models employ a more realistic representation of the natural history of HIV disease and its modes of transmission, but have relatively few behavioral variables.

Brouard (1991), for instance, has developed a renewal model analogous to a stable population model in demography. This model can be expressed in terms of three variables. The state variable *I(t)* is the number of new HIV infections in the population at time *t*. In stable population theory, this is analogous to the population born in year *t*. Brouard defines *S(d)* as the probability of surviving without developing AIDS for *d* years after HIV infection. This is analogous to the life table survival function *l(d)*. Finally, $f(d)\Delta d$ is defined as the number of infections that occur in the time interval $[d, d+\Delta]$ that are attributable to a person who has been infected for *d* years (in the limit as Δ goes to zero). This is similar to an age-specific fertility rate. The dynamics of the model are specified by the equation

$$I(t) = \int_0^t I(t-d)\, f(d)\, S(d)\, dd\,. \qquad (2)$$

When combined with a similar renewal model for the entire population, the model provides a full representation of an HIV/AIDS epidemic. One benefit of this model is that it provides mathematical expressions for critical relationships in the epidemic. For instance, it can be shown that the net reproductive rate of the HIV-infected population is

$$R_0 = \int_0^\infty f(d)\, S(d)\, dd\,. \qquad (3)$$

With various simplifying assumptions, Brouard is also able to describe the initial growth rate of the epidemic and its long-run behavior when it comes to equilibrium with the base population.

Artzrouni (1988) has developed a more elaborate version of this model by distinguishing three mutually exclusive states: healthy, infected and asymptomatic, and symptomatic. In his model, the flows among these three states are dependent on assumptions about the incubation period, survival rates, and probabilities that an infected person will infect others (like *f(d)* in the Brouard model).

The major weakness of both of these models is in the definition of *f(d)*. The time invariance of *f(d)* seems untenable unless the number of susceptibles is not appreciably diminished by the epidemic. Furthermore, although all behavioral aspects of the epidemic and the effect of possible interventions are incorporated in the *f(d)* function, there is no clear representation of how specific behavioral or biological changes affect *f(d)*.

Both models are also difficult to fit to empirical data. First, data on the distribution of the incubation period *S(d)* and on mortality rates of people with AIDS are supplied exogenously, based on the experience of study populations. The results, however, are highly dependent on the values chosen, and the data on American or European populations may not be appropriate to describe AIDS in Africa. Furthermore, no information is available on the pattern of *I(t)* over time, and it must be estimated by determining which values of the model's initial values and parameters best reproduce the observed number of AIDS cases. As a result, applying the model in LDCs with poor AIDS surveillance is problematical.

A related model has been developed by Chin and Lwanga (1991) for the WHO Global Programme on AIDS (GPA). Rather than past values of *I(t)* being estimated endogenously by the model, they are estimated directly by analysts from epidemiological surveys. Once this estimation has been done for rough age groups and various points in time, it is possible to calculate future AIDS cases by applying the incubation distribution to the estimated numbers infected. This approach is thought to be superior for LDCs, which typically have poor AIDS surveillance data but numerous HIV surveillance studies. The model is very dependent, however, on the estimates of *I(t)* as well as on the assumed incubation distribution.

Demographic/Behavioral Models

The distinguishing characteristic of demographic/behavioral models is their explicit representation of the behavioral assumptions underlying the generation of new cases as well as a representation of the epidemic as in the previous category. Within this major category, three subcategories can be distinguished: demographic models, sexual behavior simulation models, and analytic models.

The critical elements of all of these models can be represented in terms of differential equations describing the evolution of three subsets (healthy, $H_i(t)$; infected and asymptomatic, $I_i(t)$; and symptomatic, $A_i(t)$) of risk-related population groups indexed with subscript *i*.

First, the rate of change in the population of healthy, noninfected individuals $H_i(t)$ in group *i* is

$$dH_i(t)/dt=\Sigma_j b_{i,j} H_j(t)-H_i(t)\Sigma_j c_{i,j} P_j(t)-\mu_i H_i(t). \qquad (4)$$

The first term in this equation describes the recruitment of new individuals according to a set of "recruitment rates" $b_{i,j}$ from group *j* into group *i*. When $j=i$, this term is a birthrate. The second term describes the number of new infections in group *i* as proportional to the number of individuals currently in group *i* multiplied by a factor for each group with which they come in contact. The factor for group *j* is the proportion of individuals in group *j* who are infectious $P_j(t)$, times a constant $c_{i,j}$ that expresses the rate of infection per contact and per unit time for those in *i* with those in *j*. The proportion $P_j(t)$ is usually defined as $(I_j(t)+A_j(t))/N_j(t)$, where $N_j(t)$ is the total population, but the $A_j(t)$ term can be deleted if it is assumed that symptomatic individuals are no longer sexually active. The third term is the non-AIDS mortality, expressed at a mortality rate μ_i times the population.

The rate of change in the population of infected individuals $I_i(t)$ in group *i* is

$$dI_i(t)/dt=\Sigma_j b'_{i,j} I_j(t)+H_i(t)\Sigma_j c_{i,j} P_j(t)-\pi_i I_i(t)-\alpha_i I_i(t) \quad . (5)$$

The first term in this equation represents recruitment from group *j* into group *i*. The "recruitment rates" $b'_{i,j}$ are not necessarily the same as those for the noninfected population. The second term represents the number of new infections in group *i*. It is the negation of the second term of equation (4). The third term is the mortality in the HIV-infected but asymptomatic population (at a rate π_i). The fourth term is the number of transformations from asymptomatic to symptomatic cases (at a rate α_i).

The rate of change in the population of symptomatic individuals $A_i(t)$ in group *i* is

$$dA_i(t)/dt=\Sigma_j b''_{i,j} A_j(t). \quad (6)$$

The first term in this equation represents recruitment from group *j* into group *i*. The recruitment rates $b''_{i,j}$ are not necessarily the same as those for the noninfected or the infected but asymptomatic population. The second term is the number of transformations from asymptomatic to symptomatic cases (at a rate α_i). It is the negation of the fourth term of equation (5). The third term is the mortality in the symptomatic population (at a rate τ_i).

The main distinctions among the specific models to be discussed below are the definitions of the groups, the treatment of heterogeneity, and the mathematical/computer operationalization of the differential equations above. In the simple formulation above, neither age nor duration of infection is taken into account, although most models do so by adding more population groups and appropriate transition terms. Terms to represent infected and noninfected babies born to infected mothers can also be added, as well as terms explicitly representing IV drug use as well as sexual contact, transfusion-related infections, and so forth.

Demographic Models

Most of the models of the AIDS epidemic are essentially extensions of the models commonly used in demographic projections. These include the models developed by Bulatao (1991), Palloni and Lamas (1991), Bongaarts

(1989), and John (1991). The Interagency Working Group (IWG) model (Stanley et al., 1991) has the same basic structure, but uses more sophisticated mathematical techniques to deal with heterogeneity in risk factors.

The basic structure of these models is determined by the definition of the groups in the differential equations above. The groups are usually some combination of age, sex, urban-rural residence, and social status, as well as groups defined by marital status and sexual practices (including monogamous, contacts with prostitutes and/or others, use of condoms, and so on), and STD status. The models' state variables are the number of people in each group, and computers are used to update these numbers each year (or other unit of time).

Changes in the sizes of the groups, determined by the $b_{i,j}$, $b'_{i,j}$, and b''_i parameters, reflect demographic processes and behavioral changes. Modelers often rely on available demographic data to choose representative age-specific fertility, mortality, and migration rates for particular countries of sub-Saharan Africa as a whole. Behavioral change parameters are chosen to reflect "typical values" and are usually less empirically based.

Infection rates, determined by the $c_{i,j}$ parameters, are based on assumptions about the number of sexual contacts between people in different groups per unit time and the probability of infection per contact. Most models define contact as a single act of intercourse, and the probability of infection per act is used. Other models define contact in terms of new sexual partners, and the probability of infection per partner is used. Estimates of numbers of contacts and probability of infection per contact are based on empirical studies, data from other countries such as the United States, and educated guesses.

HIV-related mortality rates and rates of transition between stages of HIV infection are determined by epidemiological studies. The existing models differ most markedly in the assumptions they make about the distribution of time from infection to the appearance of symptoms of AIDS. Some use a constant rate of progression (implying an exponential distribution); others use a more complex probability distribution such as a Gamma or a Weibull. There are also substantial differences in the assumed mean of this distribution.

The IWG model (Stanley et al., 1991) differs from the others in the way it handles heterogeneity. Unlike the other models that assume homogeneity within each group, the IWG model allows for heterogeneity within groups with respect to risk factors such as the partner acquisition rate. Within each group it is assumed that there is a joint distribution that describes the number of people with the following characteristics: partner acquisition rate, infection duration, circular migration status, condom use frequency, presence of STDs, and transmissibility of the virus. All of these, other than migration and STD status, are continuous variables. For simplicity, some, but not all, of these characteristics are assumed independent of the others. To deal with this heterogeneity, the differential equations expressing changes in the number in each group over time are replaced by equations expressing changes in the distribution over time.

The strength of the demographic approach is that these models provide results for a wide range of demographic outcomes that are difficult to obtain from other approaches. The models can show, for instance, the effect of the epidemic on the rate of population growth, life expectancy, age distribution and dependency ratios, interregional population distributions, and distribution of the population by disease state. They also permit the evaluation and comparison of interventions targeted to particular groups or behaviors. The weaknesses are the large number of parameter values that have to be assumed and the difficulty of empirically verifying the model.

Sexual Behavior Simulation Models

Two of the existing models focus on detailed descriptions of sexual behavior. One of these models uses a microsimulation approach; the other uses macrosimulation.

Auvert (1991) has developed a microsimulation model that permits the study of complex decision rules about sexual behavior. Unlike most other HIV/AIDS models that have been developed, the unit of analysis of this study is the individual, not a population group. Each individual in the model has attributes corresponding to those that define the population groups in the deterministic approach: age, sex, region of residence, marital status, sexual behavior variables, and so on. Individuals can also be classified as having HIV infections, AIDS, and so on, and pairings of particular individuals are tracked. In Auvert's model, rules analogous to the differential equations above are stipulated that govern the way in which an individual's attributes change over time. These rules are implemented as probability statements in a computer simulation for a finite population, and are repeated a number of times to reduce the effect of stochastic variation.

Dietz (1988, 1989, 1991) has developed a deterministic model in which partner selection is a major factor. Through careful selection of the groups in the differential equations above, this model distinguishes between male and female populations according to the number of sexual partners and IV drug use, and allows various degrees of contact and flows between groups.

The population groups in Dietz's model are (1) monogamous males, (2) nonmonogamous males who have relations with nonprostitutes, (3) nonmonogamous males who have contacts with prostitutes, (4) monogamous females, (5) nonmonogamous females who are not prostitutes, and (6) female prostitutes. The populations are also divided into 10 five-year age groups for each sex, and a probability distribution of male preferences for the age of their partners is specified.

An algorithm in the model creates pairings between 225 types of partnerships (three subgroups for each sex times five HIV infection states) and 150 possible combinations of partner ages. The computer keeps track of people in (and movements among) 33,750 types of partnerships.

The major strength of these models is that more complex specifications of sexual behavior can be used. In Dietz's model, moreover, couple formation and marital dissolution are explicitly modeled so that unrealistic assumptions about random mating within a homogeneous population do not have to be made. Dietz shows, for instance, that models that do not include couples can overestimate the effects of the epidemic. As with the demographic models, however, the weakness is the large number of parameters to be estimated.

Analytic Models

Anderson and his colleagues (1988, 1991a,b) have developed a series of formal models based on their experience in population biology. The simplest of these models has a single closed population (e.g., homosexual men) that assumes homogeneous mixing patterns for sexual contacts between susceptible and infectious groups. More complex versions include heterogeneity in sexual behavior via a probability distribution for preferred number of partners. They also include heterosexual transmission, age patterns, and age-sex preference matrices for sexual pairing, and so on.

Much of the attention in these models is focused on the quantity R_0, the reproduction rate of infected persons. This quantity, analogous to the net reproduction rate in stable population theory, expresses the number of secondary cases generated by one primary case in a susceptible population. If R_0 is greater than 1.0, the epidemic grows; if R_0 is less than 1.0, the epidemic dies out. In the simplest model, for instance, Anderson and his colleagues (1988) show that if D is the duration of the incubation period (assumed constant), b is the probability of infection per partner, and c is the average number of new sexual partners per unit time, $R_0=Dbc$. One implication of this formulation is that the rate of acquisition of new partners and the probability of infection per partner are the critical behavioral and epidemiological parameters that determine the epidemic's effect.

For heterosexual transmission, they show that $R_0=D(\beta_1\beta_2 c_1 c_2)^{1/2}$, where β_1 is the probability of female-to-male transmission, β_2 is the probability of male-to-female transmission, c_1 is the average number of new male sexual partners for females per unit time, and c_2 is the average number of new female sexual partners for males per unit time. More complex models are also characterized by R_0, but it is not always possible to arrive at a closed-form representation of it.

These models illustrate several important aspects of the HIV/AIDS epidemic. They show, for instance, that where there is more heterogeneity in the number of new sexual partners per year, the epidemic is smaller (May and Anderson, 1987). The major difficulty with these models is finding data to estimate the model parameters.

Model Results

Because the existing HIV/AIDS models have been developed with different purposes in mind, it is difficult to compare their results. For example, the possible demographic effect of the epidemic—the focus of this chapter—is not the primary issue addressed by some of the models. The UN/GPA workshop held in 1989, however, was an attempt to have modelers address the demographic effects of the epidemic. Moreover, a strong effort was made to coordinate the nature of the model input and the form of the output so that the results would be as comparable as possible. To take advantage of the UN/GPA efforts, this section begins with a summary of the comparative results of the modeling workshop. The section concludes with a discussion of important results that are more recent or are related to topics that were not the primary focus of the workshop.

UN/GPA Workshop Results

The goal of the UN/GPA workshop (United Nations, 1991) was to evaluate model differences by comparing the outputs from a series of different HIV/AIDS models by using a standard set of demographic and epidemiological variables. A working group prepared standard input values, and six modeling groups used these inputs to produce an agreed-upon set of demographic outputs over a 25-year period beginning in 1985. The models included in the exercise included one epidemic model (Brouard), three demographic models (Bulatao, IWG, Palloni), and two sexual behavior simulation models (Auvert, Dietz).

Input Values

A single value was set for most parameters; high and low values were given for some parameters about which there is substantial uncertainty. Details of the standard inputs can be found in the UN/GPA report (United Nations, 1991: Chs. I, II).

The input values specified an initial population structure, fertility and marriage rates, and mortality levels and trends typical of African countries in which the AIDS epidemic is at an advanced stage. The initial mortality rates followed a Coale and Demeny (1966) North model life table with life expectancies of 53 years for women and 50 years for men, and were assumed to change over time consistent with the most recent medium-variant population projections of the United Nations (United Nations, 1989). In the last five years of the projection period, 2005 to 2010, life expectancies were thus assumed to be 63 years for women and 60 years for men. Initial fertility rates were calculated to be consistent with a stable population crude birthrate and an age pattern of fertility corresponding to a mean childbearing age of 29 years. The total fertility rate was assumed to change over the projection period from 7.3 to 5.3. The intrinsic growth rate implied by the initial assumptions was 3.5 percent per year, and it would decline to 3.0 percent per year in the absence of AIDS. Marriage patterns by age were based on the Coale marriage model (Coale, 1971) as incorporated in the Coale and Trussell (1974) fertility model, with parameters consistent with information collected by the World Fertility Survey for the countries in question: that is, it was assumed that the median age of marriage for women is 17 years; 95 percent of all women marry, and women marry men 5 years older than themselves.

The hypothetical population was assumed to be 25 percent urban. The age-specific HIV prevalence rates for urban and rural population were based on HIV serological surveys conducted in several African countries, as estimated by Chin and Lwanga (1991). Age-specific HIV prevalence peaks for urban residents at about 25 percent at ages 30 to 45, and for rural residents at about 24 percent at ages 30 to 34.

The working group found little systematic, quantitative information upon which to estimate parameters describing sexual activity. Using qualitative information, the working group assumed parameter values such as the following: 30 percent of married men were nonmonogamous; each year these men had, on average, 104 sexual contacts with their wives and either 12 or 36 with prostitutes. The working group also assumed that condoms were used in either 2 or 20 percent of all sexual acts and that condoms were 80 percent effective in preventing the transmission of HIV.

Finally, the working group made a set of assumptions about epidemiological parameters. The probability of transmission from an infected person in a single unprotected sexual act was assumed to be .003 to .1 from male to female and .001 to .1 from female to male. The assumed incubation distribution was based on data from large cohorts of U.S. males; 50 percent of those infected with HIV were assumed to become symptomatic with 10 years of infection.

The specification of these input values was somewhat problematical. First, it was impossible for the working group to develop assumptions that were equally applicable to all models. Some modeling groups had to ignore parts of the standard input values; some had to specify values for parameters not covered in the standard set. Attempts were made to assign parameters that were consistent with the assumed values, but this was not always possible. Second, there were problems of internal consistency. For instance, in some models the epidemic is initiated by introducing a few infected persons into a population. For some of the standard values, these models were not able to produce a starting set of HIV prevalence figures consistent with the other parameters.

Results

Results were available from six models under three scenarios corresponding to the best, intermediate, and worst values of three variables: the probability of infection per sexual contact, the number of sexual contacts between males and prostitutes, and the proportion of sexual contacts with condom use. For the intermediate scenario, these variables were set equal to the average of the upper and the lower extremes. The probability of infection was the dominant factor. Summary results on the state of the population and the epidemic after 25 years—in 2010—are shown in Table 9–1, which is based on the UN/GPA report (United Nations, 1991).

The models essentially agree under the "best" scenario (first panel of Table 9–1), the epidemic is not sustained, and there is almost no demographic trace of it in 2010. This scenario was the one for which some of the models were not able to produce starting HIV prevalence rates consistent with the assumed values. Because many African countries already have substantial HIV prevalence rates, it appears as if the combination of assumptions in this scenario is not reasonable, at least for Africa.

In the worst-case scenario (third panel of Table 9–1), there was only modest agreement among the models: HIV prevalence ranges from 30.3 to 57.5 percent; life expectancy at birth ranges from 16 to 45 years. In four of the six models, the intrinsic growth rate is negative after 25 years. The qualitative results, however, are starkly consistent: The HIV/AIDS epidemic has a major demographic effect, especially on mortality rates. The key assumption driving these results, the rate of infectivity, seems high. In this scenario it is assumed to be 10 percent per act of sexual intercourse from male to female and from female to male. Although there is little precise empirical information available, workshop participants agreed that the best values to use were 3 percent for male-to-female transmission and 1 percent for female-to-male transmission.

Discrepancies were largest for the intermediate scenario (second panel of Table 9–1). Although the patterns are somewhat erratic (see Figures 9–1 through 9–7), it appears as if the demographic models (Bulatao, IWG, and Palloni) were more similar to one another than to the others. The two

TABLE 9–1 UN/CPA Modeling Workshop Results—Summary of Selected Outcomes from Selected Models After 25 Years of Projection for Three Scenarios

	Models					
Best, Intermediate, and Worst Case Scenarios	Auvert	Dietz	Brouard	Bulatao[a]	IWG	Palloni
Best Scenario						
HIV prevalence (%)	0.0	0.0	0.2	0.3	0.0	0.1
AIDS prevalence (%)	0.0	0.0	0.0	0.0	0.0	0.0
Cumulative AIDS cases (thousands)	0	0	7	2	7	0
Cumulative AIDS deaths (thousands)	0	0	–	–	7	0
Life expectancy at birth (years)	60	61	–	61	65	60
Rate of natural increase	3.0	3.2	3.3	3.0	2.9	3.1
Population (thousands)	464	470	467	449	392	446
Intermediate Scenario						
HIV prevalence (%)	31.0	21.2	15.0	39.5	3.5	2.8
AIDS prevalence (%)	3.0	1.8	1.9	4.5	0.8	0.4
Cumulative AIDS cases (thousands)	210	69	50	34	212	28
Cumulative AIDS deaths (thousands)	200	63	–	–	199	26
Life expectancy at birth (years)	26	36	–	47	5842	
Rate of natural increase	0.5	1.5	2.4	2.5	2.6	2.8
Population (thousands)	236	355	426	409	378	427
Worst Scenario						
HIV prevalence (%)	55.0	43.9	55.0	57.5	42.4	30.3
AIDS prevalence (%)	5.8	4.7	7.0	4.4	12.0	5.2
Cumulative AIDS cases (thousands)	230	172	138	500	213	166
Cumulative AIDS deaths (thousands)	220	174	–	–	214	154
Life expectancy at birth (years)	16	24	–	45	28	22
Rate of natural increase	–2.0	–0.7	0.16	2.4	–2.5	–0.0
Population (thousands)	146	120	344	382	245	260

NOTE: —: data unavailable.

[a]Values correspond to the interval 20–25 years after the beginning of the projection.

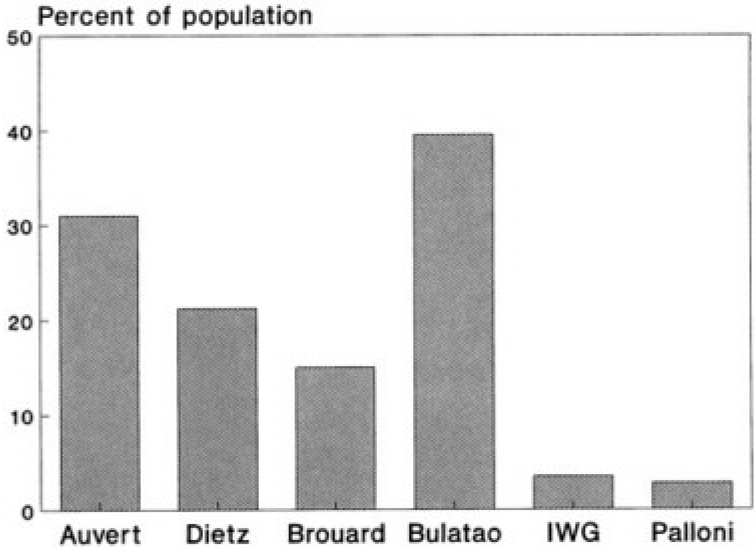

FIGURE 9–1 Prevalence of HIV infection in a hypothetical population after 25 years as projected by six models.

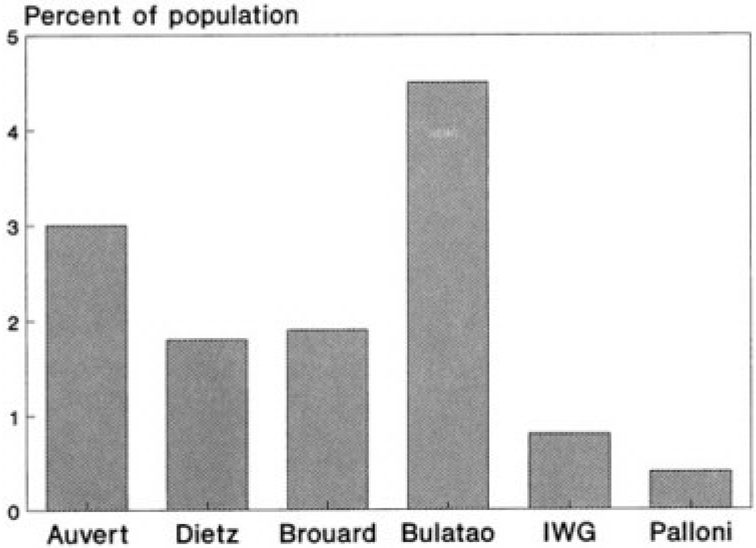

FIGURE 9–2 Prevalence of AIDS in a hypothetical population after 25 years as projected by six models.

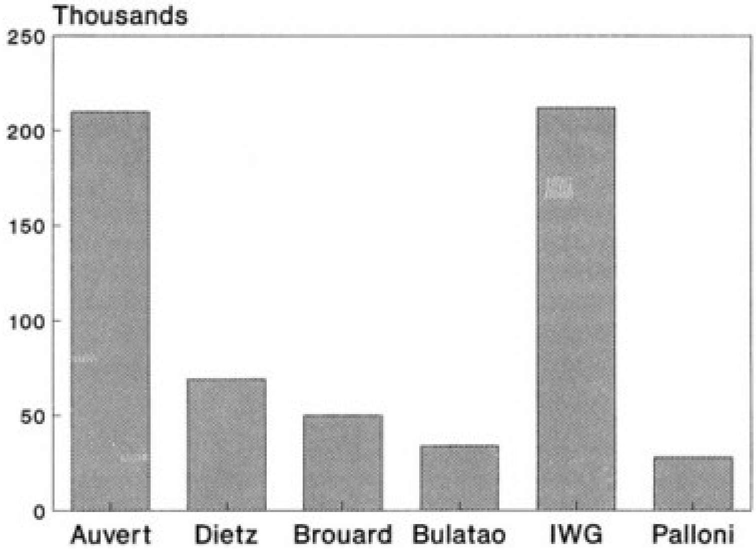

FIGURE 9–3 Cumulative cases of AIDS in a hypothetical population after 25 years as projected by six models.

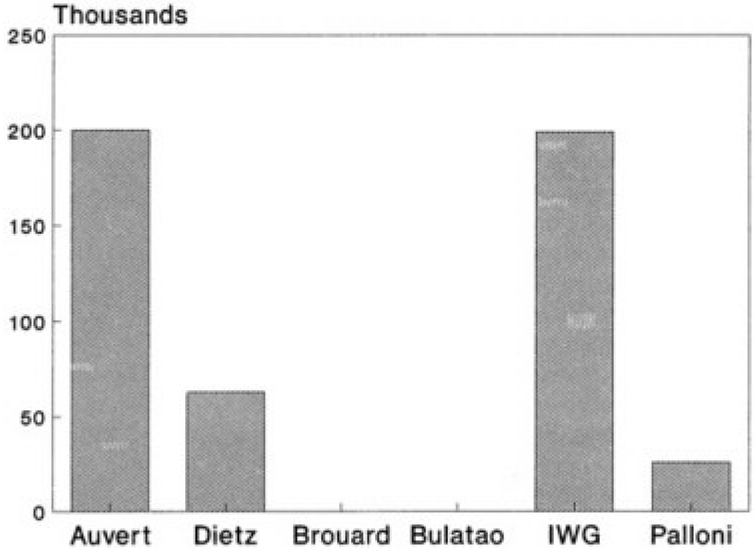

FIGURE 9–4 Cumulative deaths from AIDS in a hypothetical population after 25 years as projected by four models.

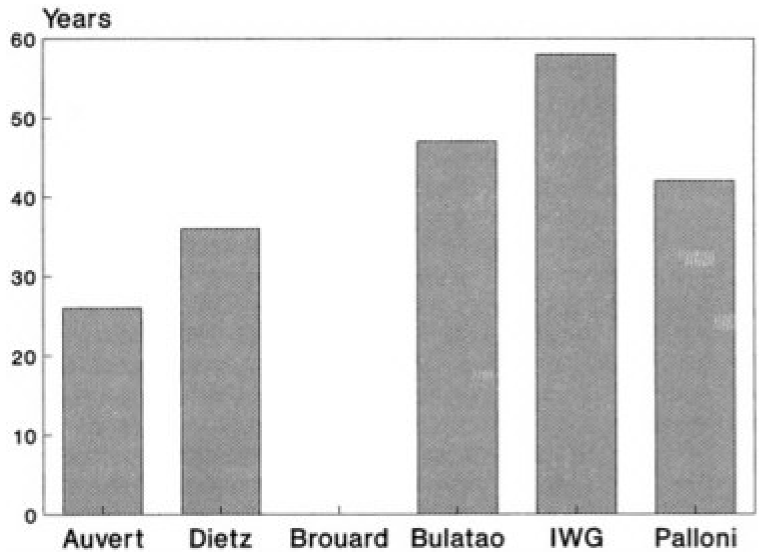

FIGURE 9–5 Life expectancy at birth in a hypothetical population after 25 years as projected by five models.

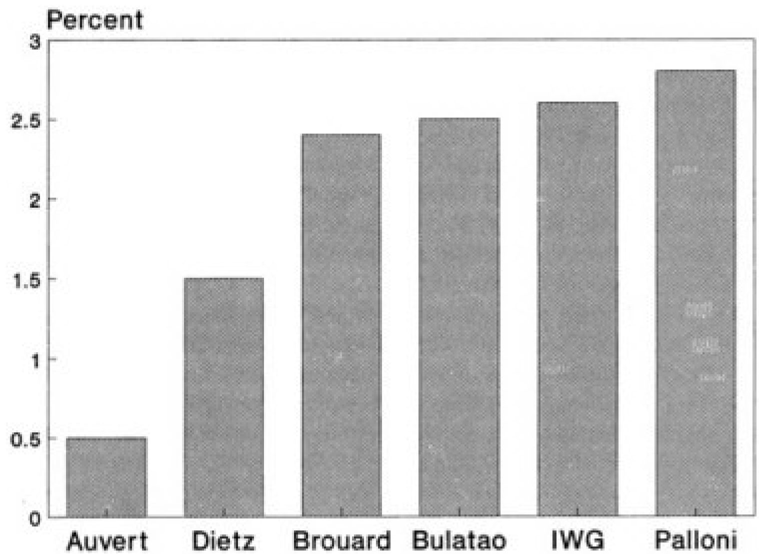

FIGURE 9–6 Rate of natural increase in a hypothetical population after 25 years as projected by six models.

models that followed couples rather than individuals (Auvert and Dietz) also have somewhat similar results. These similarities are more apparent for life expectancy (Figure 9–5), the intrinsic growth rate (Figure 9–6), and the final population (Figure 9–7) than they are for the other outputs. This pattern may indicate the importance of model assumptions about couple formation. Among the demographic models, the Bulatao model predicts substantially higher HIV and AIDS prevalence rates in the final period than all of the other models, and the IWG model predicts substantially higher cumulative AIDS cases and deaths.

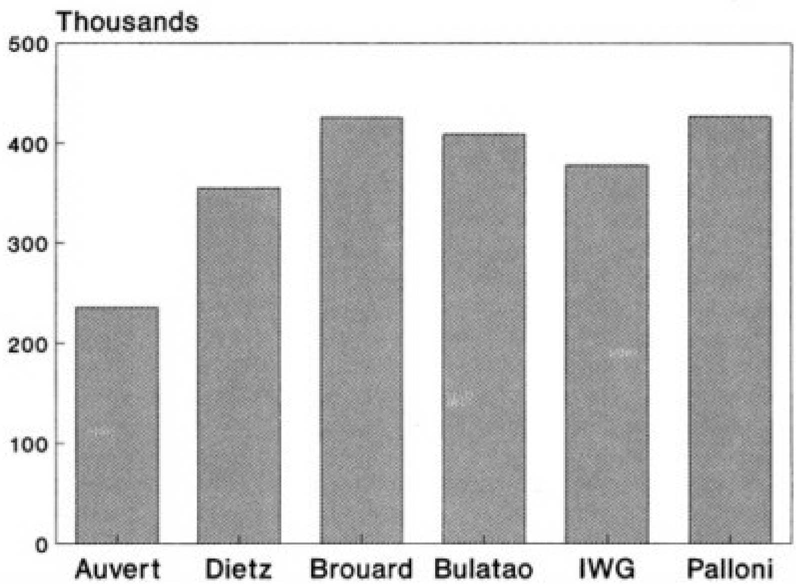

FIGURE 9–7 Size of a hypothetical population after 25 years as projected by six models.

The intermediate scenario seems to be the most realistic of the three UN/ GPA workshop scenarios, but the numerical results are widely divergent. Even so, the results are informative. Models of more than one type predict large numerical effects on epidemiological parameters such as HIV/ AIDS cases and deaths, and on demographic parameters such as life expectancy and the rate of natural increase.

Other Model Results

Beyond the results of the UN/GPA modeling workshop, a number of other aspects of the demographic effects of AIDS have been explored.

The latest report from the Interagency Working Group (Way and Stanecki, 1991), for instance, reaches a number of important conclusions about the demographic effects of AIDS in a 25-year projection that uses data typical of sub-Saharan Africa:

- HIV seroprevalance increases from 4 to 16 percent in urban areas and from 1 to 5 percent in rural areas;
- the number of people infected with HIV in sub-Saharan Africa increases to more than 70 million, and the number infected in rural areas is greater than in urban areas;
- the annual number of deaths in sub-Saharan Africa increases to 13.8 million, of which 4.6 million are due to AIDS; life expectancy in urban areas is 18 years less than expected without AIDS;
- infant mortality levels in urban areas increase by more than 20 percent; urban mortality under the age of 5 increases by nearly 50 percent; and
- mortality rates among those aged 30 to 49 increase to six or seven times the normal level.

These are major demographic changes. Although the precise results depend on a large number of unverifiable model assumptions, it is clear that major demographic effects are possible.

The IWG model predicts one important "noneffect," and this result is supported by other models of various types: The AIDS/HIV epidemic has very little effect on the population age distribution or on dependency ratios. Because AIDS affects childhood as well as adult mortality (and across a relatively wide age range), 25 years into the epidemic the dependency ratio (the ratio of persons under age 15 or 65 and over per 100 persons 15 to 64 years of age) changes only from 76.5 to 77.5. Other models have come to similar conclusions.

Models have also shown the effects of possible policy interventions on the epidemic. Anderson and colleagues (1991b) point to the importance of changes in sexual behavior (especially partner choice) and the use of condoms. Both of these would be more effective if targeted to high-risk groups. Given the growing body of evidence that links other STDs and genital ulcers to increased likelihood of HIV transmission, Anderson and colleagues (1991b) also suggest that treatment and control of STDs could have an important effect on the HIV/AIDS epidemic. Bulatao and Bos (1988) have investigated the effect of various control measures on the spread of HIV infection in African countries, and concluded that encouraging the use of condoms would have a major effect on the HIV/AIDS epidemic. Reducing STDs and genital ulcers, providing clean needles, and screening the blood supply have only minor effects. Using the IWG model, Way and Stanecki (1991) obtain similar results about condom use and blood screening, but find relatively large declines associated with a decrease in the duration of STDs. The difference between the results of Bulatao and Bos with regard to genital ulcers and those of Way and Stanecki with regard to STDs could be due to uncertainty about the prevalence of the problems in question and about their effects on infectivity.

Efforts are being made to understand why some HIV/AIDS models yield the divergent results seen in the UN/GPA workshop. In a recent working session, for instance, developers of the Auvert microsimulation model and the IWG demographic model met and agreed on a set of parameter specifications that had the same meaning for both models. Apparently, this agreement has brought the results of the two models closer (Culotta, 1991).

The IWG model itself continues to be further developed and used, but no complete description of its modeling assumptions or results had been published as of August 1993. Way and Over (1992) have added an economic component to the IWG model and explored the possible macroeconomic effect of the HIV/AIDS epidemic. For a typical African country they find that total gross domestic product (GDP) would continue to grow, but could be reduced by as much as 22 percent relative to the non-AIDS scenario. Per capita GDP would also be reduced (relative to the non-AIDS projection), but by a lesser amount due to the parallel reduction in population size.

Model Uncertainties

Sensitivity analyses using the models have also indicated some of the critical uncertainties. Palloni and Glicklich (1991) identify the following six variables or issues as ones that have a large effect on model results.

Heterogeneity with Regard to Sexual and IV Drug Behavior

The models that include heterogeneity uniformly show that it has an effect on development of the epidemic, yet few behavioral data are available to estimate the details of variations across individuals, time, and location with regard to sexual practices or IV drug use.

Communicability of Groups with Regard to Sexual and IV Drug Behavior

To estimate the parameters of epidemiological and demographic/behavioral models, data are needed to specify the degree of contact between population groups defined by demographic variables and risk behaviors. There is reason to believe that these patterns vary substantially across country and region, but few systematic data are available to describe them.

Probability of Transmission by Sexual Contact

Experience with the models has shown that this parameter is crucial, but there is little direct evidence on its value, and most of what does exist comes from countries not in Africa. The probability is likely to depend on sexual practices and thus to vary across population groups. The probability of transmission also depends on whether sexual contact is defined as a single sexual act or a partnership. Although most models use a fixed probability per sexual act, available evidence suggests that the probability of transmission per partnership is independent of the number of sexual acts between partners (Palloni and Glicklich, 1991).

Cofactors

Cofactors such as the presence of STDs apparently increase infectivity in a given sexual contact, but it is not clear which cofactors or what quantitative effect they have. Data on the prevalence of most potential cofactors are also lacking.

Distribution of the Incubation Period

Each of the models reviewed by Palloni and Glicklich (1991) uses a different functional form to specify the distribution of the incubation period, reflecting the lack of precise epidemiological information, especially for African populations. Whether the mean or the functional form of the incubation period depends on cofactors is not known. There is evidence that antiviral drugs such as AZT can lengthen the incubation period as well as the symptomatic period, but this increase is unlikely to be relevant for African countries in the near future.

Duration-Dependent Infectivity

Some evidence suggests that an infected individual’s infectivity may follow a bimodal pattern, with one peak immediately following the initial infection and the second about the time that the symptoms of AIDS appear. May and colleagues (1988) have shown that such patterns can effect HIV and AIDS trends, and complicate the interpretation of data from the past.

There are, in fact, uncertainties about most elements of the models. Estimates of the probability of transmission from mother to child, for instance, range from 13 to 39 percent (Anderson et al., 1991b), which can have a large effect on the results of demographic/behavioral models.

It is important to note that these uncertainties result from lack of knowledge about behavioral patterns and biological realities. Some information on these variables is available for developed countries, but it is often not clear whether behavioral and biological facts are transferable. Much less information is available for Africa.

As the interchange in the *New York Times* discussed at the beginning of this chapter illustrates, one of the more contentious open questions is whether the HIV/AIDS epidemic in Africa is such that the intrinsic rate of growth will become negative. Under the IWG model, population growth continues in both rural and urban areas, but the total population in the region is reduced by 5 percent by 2015, more than fifty million people, from the non-AIDS projected population (Way and Stanecki, 1991). When they choose their own input values, most of the other AIDS modelers find similar results: large relative decreases but still nonnegative intrinsic growth rates.

The two major exceptions to this result are the UN/GPA worst-case scenario and the Anderson results. The UN/GPA worst-case results are driven by a infection probability of .1 from male to female and from female to male. This probability is substantially higher than the current range of estimates. These rates are comparable to the current best estimates per partnership (Anderson et al., 1991b) but are used in the models to express the probability of transmission in one sexual act. Thus, the negative growth rates found in the UN/GPA workshop results may not be realistic.

In a recent review article, Anderson and his colleagues (1991b:588) comment:

> Simple models based on random mixing in age classes suggest that, with realistic assumptions concerning the major epidemiological and demographic parameters…, AIDS is able to reverse the sign of population growth rates over timescales of a few to many decades. The added refinements of age-dependent changes in sexual behavior, men having sexual contact with women younger than themselves and not infrequent male contact with a small proportion of women with high rates of sexual-partner change, all serve to accentuate the predicted demographic impact, with the only significant uncertainty being whether AIDS induced mortality will decrease population size over a few or many decades.

Note that this statement in a scientific journal is less extreme than the news reports mentioned earlier. In particular, it suggests that part of the differences among the modelers on the question of growth rate might be a matter of time scale. As Anderson and colleagues note in their scientific article, the uncertainty is whether the sign change will take “a few or many decades.” Most of the other modeling efforts make projections for only a few decades, whereas Anderson’s models run for many decades. Given the possibilities for behavioral change and eventual medical interventions, projections that go beyond a few decades are questionable.

May and Stover (1992) have explored these issues using a relatively simple HIV/AIDS model that is essentially an ordinary cohort component demographic projection model with additional exogenous assumptions about adult HIV prevalence rates. Using data and assumptions for Uganda and Rwanda, including assumptions that adult HIV prevalence increases to a plateau of 15 percent in Uganda and 6–12 percent in Rwanda, they find that growth rates fall but do not become negative. Most of the decrease in growth rates, however, is due to large projected decreases in fertility rates.

Because of assumptions about behavioral change not related to AIDS that result in decreasing birthrates, most projections for sub-Saharan Africa show decreasing but not negative growth rates for some decades into the future. Most of the current AIDS models indicate that growth rates will fall, but Anderson and colleagues are generally alone in predicting negative rates. Although these results have not been shown to be incorrect, they have not been replicated by others and should be interpreted with caution.

SUMMARY AND CONCLUSIONS

A wide variety of approaches have been used to model the HIV/AIDS epidemic in less developed countries, and the possible long-range demographic effects predicted by these models vary from minor to substantial. Based on the available demographic, behavioral, and epidemiological information, and on judgments about the appropriateness of different modeling approaches, it is difficult to say that any one of these models is correct or incorrect, or to choose the most accurate among them. The available data do not unambiguously determine the appropriate parameter values of any model, nor do they permit in-depth empirical verification of any model's goodness of fit or predictive ability.

Faced with this uncertainty, it may be best to interpret the variability in the available results as an indicator of the state of current knowledge about the HIV/AIDS epidemic. The variability reflects choice of analytical model as well as the biological and behavioral parameters that are assumed. The large variability evident in the results of models attempting to use similar assumptions suggests that these models (perhaps because of data availability) are not yet capable of accurate numerical projections of the HIV/AIDS epidemic for individual countries.

Despite this variability, the UN/GPA workshop results show that there are plausible scenarios in which AIDS can have large demographic effects. The largest effect would be on mortality rates for children age 0 to 5 years and for young adults, and the changes could reverse mortality gains of the last few decades. Changes of this magnitude would substantially decrease population growth rates, but it is not clear whether negative growth rates would obtain, at least in the next few decades. Despite the effect on mortality rates, however, there is not likely to be a major effect on population age structure or dependency ratios. The most pessimistic projections of Ander son and colleagues (especially those reported in the popular press) have not been replicated by other modelers and are questionable. The range of results from other models, such as those presented at the UN/GPA workshop, however, is sufficient to warn policymakers that the HIV/AIDS epidemic is a major demographic threat in Africa.

Another result of the modeling efforts so far is an understanding of the dynamics of the HIV/AIDS epidemic and the necessary outlines of prevention policies. In particular, the importance of targeting interventions to the groups at highest risk is clear. In further modeling efforts, it might be possible to identify policy choices that are relatively robust to model uncertainties, that is, to identify polices that are appropriate under a broad range of model parameters.

In contrast to these qualitative results, much remains to be learned before HIV/AIDS models can provide reliable numerical estimates of demographic effects. There is little hard information on many of the critical biological parameters that describe the infectious process and the natural history of HIV disease. Even as more information becomes available from developed countries, its relevance for Africa will remain questionable. Similarly, little is known in a systematic way about important aspects of sexual behavior in Africa, especially about the number and choice of sexual partners. Whatever the current patterns, they may change in the future as a result of control strategies or other factors.

Most of the relevant parameters are likely to vary substantially among the different countries of Africa; thus the HIV/AIDS epidemic could take very different forms in different countries. Except for currently available HIV prevalence data, there is little evidence now available to characterize intercountry variability in future HIV/AIDS trends. Major regional, urban-rural, and other differences within countries are also likely.

Current modeling efforts have concentrated on gross demographic variables; little is known about the potential effects of the epidemic on family structure, orphanhood, and so on (Hunter, 1990). Given that HIV is transmitted both horizontally and vertically within families, there could be major effects on family structure. Although there has been some anthropological research on the current effect of AIDS in Africa, as well as the patterns and determinants of sexual behavior (Ahonsi, 1991), the potential future social effect of the HIV/AIDS epidemic in less developed countries has not been explored systematically.

To address the uncertainty in currently available results, it would also be useful to organize more modeling workshops such as the one sponsored by the United Nations and the WHO Global Programme on AIDS. As the results discussed above indicate, this type of activity can identify consistent qualitative or quantitative results that are thus presumably reliable, help clarify the reasons for differences among the existing models and the policy implications of these differences, and suggest areas in which further epidemiological and social/behavioral research in needed. Workshops of this sort provide a mechanism for sensitivity analyses among models. This comparison should not preclude sensitivity analyses within models, nor should it be a substitute for peer review of the individual models. The key idea is that because so much about the modeling assumptions is uncertain, sensitivity analysis should be carried out at the level of the models (or the modelers). As the UN/GPA experience indicated, deciding which assumptions to fix and which to leave up to the modelers is a difficult question that needs serious attention. It is likely, however, that a better set of assumptions could be developed in a series of workshops. Given the state of the art and of knowledge, this approach is likely to yield information not available through the uncoordinated efforts of modelers.

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