Review of WIC Food Packages: An Evaluation of White Potatoes in the Cash Value Voucher: Letter Report

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Kathleen M. Rasmussen, Marie E. Latulippe, and Ann L. Yaktine, Editors; Committee to Review WIC Food Packages; Food and Nutrition Board; Institute of Medicine

Review of WIC Food Packages

An Evaluation of White Potatoes in the Cash Value Voucher

LETTER REPORT

Committee to Review WIC Food Packages

Food and Nutrition Board

Kathleen M. Rasmussen, Marie E. Latulippe, and Ann L. Yaktine, *Editors*

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Willing is not enough; we must do."
—Goethe

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COMMITTEE TO REVIEW WIC FOOD PACKAGES

KATHLEEN M. RASMUSSEN (*Chair*), Professor of Nutrition, Division of Nutritional Sciences, Cornell University
GAIL G. HARRISON (*Vice Chair*), Professor Emeritus, Department of Community Health Sciences, Center for Health Sciences, University of California, Los Angeles
SUSAN S. BAKER, Professor and Co-Chief, Digestive Diseases and Nutrition Center, Department of Pediatrics, Women and Children's Hospital of Buffalo
MARIANNE P. BITLER, Professor, Department of Economics, University of California, Irvine
PATSY M. BRANNON, Professor, Division of Nutritional Sciences, Cornell University
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HELEN H. JENSEN, Professor of Economics and Head, Food and Nutrition Policy Division of CARD, Iowa State University
RACHEL K. JOHNSON, Robert L. Bickford, Jr., Green and Gold Professor of Nutrition, Professor of Medicine, University of Vermont
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CHARLENE RUSSELL-TUCKER, Chief Operating Officer, Connecticut Department of Education
SHANNON E. WHALEY, Director of Research and Evaluation, Public Health Foundation Enterprises WIC Program

Consultants

MEI CHUNG, Research Assistant Professor, Department of Public Health and Community Medicine, School of Medicine, Tufts University
SUZANNE P. MURPHY, Researcher (Professor) Emeritus, University of Hawaii Cancer Center

IOM Staff

MARIE E. LATULIPPE, Study Director
BERNICE CHU, Research Associate
AMBAR SAEED, Senior Program Assistant
ANN L. YAKTINE, Director, Food and Nutrition Board

Reviewers

This report has been reviewed in draft form by individuals chosen for their diverse perspectives and technical expertise, in accordance with procedures approved by the National Research Council's Report Review Committee. The purpose of this independent review is to provide candid and critical comments that will assist the institution in making its published report as sound as possible and to ensure that the report meets institutional standards for objectivity, evidence, and responsiveness to the study charge. The review comments and draft manuscript remain confidential to protect the integrity of the deliberative process. We wish to thank the following individuals for their review of this report:

CHERYL A. M. ANDERSON, University of California, San Diego
RONNETTE BRIEFEL, Mathematica Policy Research
JOHANNA T. DWYER, Tufts Medical Center
KAREN GLANZ, University of Pennsylvania Perelman School of Medicine
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PATRICIA O. RACE, New York State Department of Health
JOANNE L. SLAVIN, University of Minnesota
PARKE E. WILDE, Tufts University Friedman School of Nutrition Science and Policy

Although the reviewers listed above have provided many constructive comments and suggestions, they were not asked to endorse the conclusions or recommendations nor did they see the final draft of the report before its release. The review of this report was overseen by **John W. Erdman, Jr.,** University of Illinois at Urbana-Champaign, and **Elena O. Nightingale,** Retired Scholar, Institute of Medicine. Appointed by the National Research Council and the Institute of Medicine, they were responsible for making certain that an independent examination of this report was carried out in accordance with institutional procedures and that all review comments were carefully considered. Responsibility for the final content of this report rests entirely with the authoring committee and the institution.

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Summary

The *Dietary Guidelines for Americans* (DGA) are the cornerstone of federal nutrition guidance. The policy document, revised every 5 years, underpins the dietary goals of federal nutrition assistance programs, including the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC). Given that the previous Institute of Medicine (IOM) review of WIC food packages applied the 2005 DGA as a benchmark, and that the 2010 DGA are currently undergoing reevaluation and update, the U.S. Department of Agriculture (USDA) requested that the IOM undertake a review of the WIC food packages to bring the program into alignment with current dietary guidance. This letter report is the first in a series of reports by the IOM Committee to Review WIC Food Packages in response to that request. For this report, the committee was tasked with assessing the impact of the 2009 regulation to allow the purchase of vegetables and fruits, excluding white potatoes, with a cash value voucher (CVV) on food and nutrient intakes of the WIC population and to consider whether white potatoes should be permitted for purchase with the voucher. The recommendations were to consider the effects on diet quality, the health and cultural needs of the WIC population, and allow for effective and efficient administration nationwide in a cost-effective manner. Following this report, phases I and II of the Review of WIC Food Packages study will update the findings presented here, evaluate the current WIC food packages as outlined in the statement of task, and recommend updates, in the context of the 2015 DGA.

Although the available data did not permit a direct comparison between

food and nutrient intakes before and after CVV implementation, data from the National Health and Nutrition Examination Survey (NHANES) (2007–2010) indicated that intakes of starchy vegetables (which includes white potatoes) among WIC participants are 64 and 56 percent of the 2010 DGA goals for children and women, respectively. For children, intakes of several nutrients of concern (vitamin D, calcium, potassium, and fiber) fall short of current Dietary Reference Intakes (DRIs). Women's intakes of all nutrients of concern (vitamin C for iron absorption, folate, vitamin D, calcium, potassium, iron, and fiber) are in need of substantial improvement. Although there is some evidence that attention to glycemic index (GI) is important for individuals with type 2 diabetes or gestational diabetes, the GI value of white potatoes depends on the method of preparation. Other evidence indicates that consumption of vegetables and fruits may have long-term health benefits. The committee assessed the effect of various cost-neutral shifts in the intake of categories of vegetables and fruits to accommodate higher consumption of potentially WIC-eligible white potatoes, applying ad hoc assumptions. The scenarios tested included doubling at-home intake of white potatoes or doubling total intake of white potatoes. For children, this resulted in a 2 to 5 percent increase in potassium intake with intakes of other nutrients of concern changing from 0 to 3.3 percent. For women, potassium intakes increased from 2.7 to 6.7 percent and intakes of other nutrients of concern changed from 0 to 4.6 percent. Energy intake increased by less than 2 percent across all scenarios. Apart from the subscore for total vegetable intake (which increases by default), individual subscores of the Healthy Eating Index (a measure of diet quality) change by no more than 5 percent for either women or children under the tested scenarios. The projected changes are small across scenarios because the CVV covers approximately 5 percent of monthly food costs for women 19–50 years of age-based 2014 Thrifty Food Plan estimates. Information related to participant satisfaction and use of the CVV including the influence of culture, as well as on vendor response to CVV implementation, was limited. The committee makes the following recommendations (see the Recommendations section of the report for supporting rationale):

1. **The committee recommends that the U.S. Department of Agriculture allow white potatoes as a WIC-eligible vegetable, in forms currently permitted for other vegetables, in the cash value voucher pending changes to starchy vegetable intake recommendations in the 2015 *Dietary Guidelines for Americans* (DGA). If there are relevant changes in the 2015 DGA, the committee should reevaluate this recommendation.**

2. **The committee recommends that the U.S. Department of Agriculture and the U.S. Department of Health and Human Services collaborate to achieve expansion of data collection on dietary intakes for pregnant, breastfeeding, and postpartum women in the National Health and Nutrition Examination Survey.**
3. **The committee recommends that the U.S. Department of Agriculture undertake a separate, comprehensive examination of currently available data to assess the effectiveness of the current cash value voucher in meeting participants' food pattern and dietary intake goals as recommended by the *Dietary Guidelines for Americans*, including use of white potatoes in the context of cultural diversity among WIC participants.**
4. **The committee recommends that the U.S. Department of Agriculture allocate resources to support studies related to (1) participant satisfaction with the cash value voucher (CVV); (2) the strategies participants use to decide how much of the CVV to spend; (3) the strategies participants use to decide how to apportion this benefit among the vegetables and fruits, between vegetables and fruits, and between the CVV and other food purchases; (4) how vendors have changed the WIC-eligible vegetables and fruits they stock because of the implementation of the CVV; and (5) how the CVV and its implementation have affected vendors.**

INSTITUTE OF MEDICINE
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Food and Nutrition Board

January 28, 2015

Mr. Jay Hirschman
Director, Special Nutrition Services
Office of Analysis, Nutrition and Evaluation
Food and Nutrition Service
U.S. Department of Agriculture

Dear Mr. Hirschman:

The Institute of Medicine (IOM), in response to a request from Congress that the U.S. Department of Agriculture Food and Nutrition Service (USDA-FNS) review and assess the nutritional status and food and nutritional needs of the population eligible for the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) and update the WIC food packages to be consistent with the 2015 *Dietary Guidelines for Americans* (DGA), considering the health and cultural needs of an increasingly diverse WIC population, while remaining cost-neutral, established the Committee to Review WIC Food Packages (the committee). This letter report is the first of three reports in this review, and builds on the previous committee's work (IOM, 2006). In 2003, USDA-FNS asked the IOM to conduct a two-phase evaluation of the WIC food packages, including in phase I reviewing the nutritional needs of WIC participants and proposing priority nutrients and nutrition recommendations. In phase II the committee was asked to use its initial assessment to recommend specific changes to the WIC food packages. An important recommendation of the 2003 committee was to establish a program to allow purchases of vegetables and fruits, excluding white potatoes. In this letter report, the committee presents a reevaluation of the white potato exclusion, with consideration to the original rationale.

THE COMMITTEE'S TASK AND APPROACH

The current committee was charged with the following task (see Appendix B for the complete Statement of Task): To review the scientific literature published since the 2006 report as well as government reports and other relevant publications to assess the current WIC food packages for consistency with the DGA; review the nutritional requirements of the WIC population and conduct analyses of dietary and energy intakes; conduct analysis of food expenditures of the WIC population; review and assess the effect of cultural food preferences on nutritional needs and food intake patterns; and develop plans for cost analyses on WIC food package components, food group and subgroup costs, and information on program participation. Following this report, phases I and II of the Review of WIC Food Packages study will update the findings presented here, evaluate the current WIC food packages as outlined in the statement of task, and recommend updates, in the context of the 2015 DGA.

A component of the committee's task, which is the subject of this report, was to evaluate the exclusion of white potatoes from purchase with the cash value voucher (CVV). This included assessment of nutrient and energy intake from white potatoes among WIC participants and WIC-eligible nonparticipants who are pregnant and breastfeeding and nonbreastfeeding postpartum women, and children ages 1 to less than 5 years.[1] The analysis was to include a comparison of white potato consumption among these groups before and after the enactment of regulations in 2009, which allowed the purchase of vegetables and fruits (excluding white potatoes) with the CVV, against key recommendations of the 2010 DGA. Analyses were also to include nutrient intake referenced to the Dietary Reference Intakes (DRIs) and estimates of adequacy of nutrient intakes. Food intakes for each food group/subgroup represented in the 2010 DGA were also to be assessed. The Healthy Eating Index (HEI) 2010 and a second dietary quality index to be selected by the committee were to be used as comparators to assess healthy eating scores before and after exclusion of white potatoes from the WIC food package. A sensitivity analysis for WIC and WIC-eligible groups was to be conducted to assess nutrient and food group intake values relative to the DGA as well as to project changes in indicators of diet quality when fresh white potatoes are included in the WIC CVV. The committee was asked to make specific evidence-based recommendations, based on its evidence review and grounded in the most recently available science and reports. These recommendations should be consistent with the current DGA, consider the health and cultural needs of the WIC popula-

[1] In phases I and II of this study, infants less than 1 year of age will be included in the population subgroups of interest.

tion, and be administered effectively and efficiently nationwide and in a cost-effective manner.

Approach to the Task

In response to its charge, the committee developed criteria, derived from the 2006 WIC report, but specifically applicable to the evaluation of white potatoes in the WIC food package. The criteria are as follows:

1. The package reduces the prevalence of inadequate and excessive nutrient intakes in participants.
2. The package contributes to an overall dietary pattern that is consistent with the DGA (for individuals ages 2 years and older).
3. The package contributes to an overall diet that is consistent with established dietary recommendations for children 1 to less than 2 years of age.
4. Foods in the package meet the health and cultural needs of the WIC population and can be administered effectively and efficiently nationwide in a cost-effective manner.
5. Indexes of diet quality are not substantially altered when white potatoes are included in the CVV.

The committee engaged in a series of data and information collection and evaluation activities as described below. Applicable methodologies and underlying rationales are provided here and in the appendixes.

Public Data Gathering, Sponsor, and Public Comment Sessions

A data-gathering workshop, public comment session,[2] and sponsor session were held October 14–15, 2014, in Washington, DC. Workshop presentations included information on national trends in the production and consumption of white potatoes; WIC voucher purchase patterns; nutrient content of white potatoes; nutrient bioavailability and relationships to health outcomes; and white potato products and processing. In the open meeting with the study sponsor, USDA-FNS staff provided up-to-date information on the design and implementation of the WIC program and its component parts and briefed the committee on the USDA's expectations for this work (see Appendix C for the workshop and sponsor session agendas).

[2] Public comments are accessible through the National Academies Public Access File. Email: paro@nas.edu.

Literature Review

The committee developed an approach to review and evaluate the range of evidence available through general and focused literature searches. Because of limitations in time and resources, the committee was not able to conduct a systematic evidence-based review of the literature. Alternatively, the committee opted to conduct a comprehensive review of peer-reviewed published evidence, as well as of non-peer-reviewed evidence to identify relevant scientific and government reports. The committee also reviewed commissioned data collection and analyses of the response to the 2009 WIC food package implementation describing changes in food consumption of WIC participants, white potato consumption patterns, program administration issues related to exclusion of white potatoes from the CVV, health impacts related to white potato intake, and vendor and stocking issues linked to use of the CVV (see Appendix D for the search strategy). Additional evidence was gathered from the IOM reports on other nutrition assistance programs, childhood obesity, weight gain during pregnancy, and the DRIs, as well as a search of government reports for relevant information.

Data Analyses

Nutrient profile evaluation The nutrient profile of white potatoes was assessed in relation to the nutrient profiles of other WIC-eligible vegetables and fruits. Vegetable and fruit group and subgroup nutrient profiles were compiled from the most recent USDA Center for Nutrition Policy and Promotion (CNPP) food pattern models (Personal communication, P. Britten, USDA/CNPP, December 9, 2014), along with selected representative foods to illustrate the range of nutrient levels provided by that group. Data for foods were sourced from the USDA National Nutrient Database for Standard Reference, Release 27 (USDA/ARS, 2014).

Nutrient and energy intakes and food group and subgroup intakes The primary source of data on food and nutrient intake was the *What We Eat in America* (WWEIA) component of the National Health and Nutrition Examination Survey (NHANES) (USDA/ARS, 2007–2010). The data used included dietary intake data (foods and nutrients from food sources but not from dietary supplements) and demographic information including age, gender, and physiological status, e.g., pregnant or lactating or postpartum women (0–6 months after delivery). The committee compared nutrient intakes to the DRIs to assess adequacy of nutrient intake.

Data on forms (fresh, frozen, canned, dehydrated without addition of fats, oils, sugar, or sodium) of white potatoes (which includes white, russet, red, yellow, fingerling, blue, or purple) typically consumed both at home and

away from home, and their respective proportions were also obtained from NHANES using the Food Patterns Equivalent Database (FPED), a file that identifies the food group and subgroup intakes associated with the DGA. Historical and recent trends in the production and availability of white potatoes and forms were evaluated using data from the USDA National Agricultural Statistical Service (NASS) and Economic Research Service (ERS). Analysis of NHANES was conducted for five low-income (defined as ≤ 185 percent of the poverty-income ratio) population subgroups[3]:

1. Women, ages 19 to 50 years
   a. WIC participants,
   b. WIC-eligible (pregnant, breastfeeding, or postpartum) nonparticipants, and
   c. WIC-ineligible (neither pregnant, nor breastfeeding, nor postpartum) nonparticipants,
2. Children ages 1 to less than 5 years
   a. WIC participants,[4] and
   b. WIC-eligible nonparticipants.

These subgroups allow for comparison of nutrient and food intake of all individuals on WIC, compared to individuals who qualify, but do not participate in the program. In addition, WIC-ineligible, but low-income women could become eligible at a later time with a change in physiological status.

To assess nutrient and energy intakes among WIC participants, WIC-eligible, and low-income but noneligible population groups, the committee examined the 2007–2008, 2009–2010, and 2011–2012 NHANES datasets. Although the 2011–2012 dataset had been released as this report was in preparation, two critical components were not yet publicly available[5]:

[3] PC Software for Intake Distribution Estimation (PC-SIDE) and the Iowa State University method were implemented to estimate usual intake distributions of nutrient and major food group intakes.

[4] Capturing WIC participation is dependent upon accurate reporting in NHANES. The committee's comparison of the weighted total number of recipients reporting WIC as well as extensive experience with reporting of program like WIC suggest that WIC use is underreported, and some WIC recipients are in group b or c for women and group b for children. There is also a challenge in identifying the low-income group as eligible: The concept of income reported in NHANES does not correspond to state-level income requirements for eligibility. Some individuals may be income ineligible but may still legitimately participate in the program if adjunctively or automatically eligible due to participate in Medicaid, Temporary Assistance for Needy Families (TANF), or the Supplemental Nutrition Assistance Program (SNAP).

[5] An inquiry from the IOM to the USDA Agricultural Research Service indicated that the 2011–2012 NHANES FPED database would be released by the end of 2014. This was not compatible with timely delivery of this report.

(1) the identifier indicating which respondents report being WIC program participants and (2) the corresponding FPED, needed to determine DGA food group and subgroup intakes and to compute the HEI. Without these components the 2011–2012 NHANES dataset could not be used for this task. Therefore, only the 2007–2008 and 2009–2010 NHANES datasets were used for the analyses reported here.

Inspection of the NHANES data revealed that there were limited numbers of women of childbearing age, defined as 14 to 50 years old. Women ages 14 to 18 years were not included in the analysis because the data were not consistently available in NHANES to identify those among them who were WIC participants.[6] Additionally, the subgroups of pregnant, breastfeeding, and postpartum WIC participants were too few in number for separate analyses. Therefore, the data were grouped as follows: (1) the 2007–2008 data were combined with the 2009–2010 data given that food intake was similar among women in both datasets; (2) women of childbearing age were considered to be those aged 19 to 50 for consistency across the combined datasets; and (3) data for pregnant, breastfeeding, or postpartum women were combined for all analyses. The analyses of nutrient and food intakes, therefore, evaluated all categories of women against the DRIs and food group recommendations for women who were neither pregnant nor breastfeeding.[7] Similarly, children in the group 1 to less than 2 years of age were combined with those aged 2 to less than 5 years. Further details on the data analysis methodology are noted in the appendix data table footnotes.

For the five population subgroups delineated above, nutrient intake distributions were compared to the DRIs (IOM, 1997, 1998, 2000, 2001, 2002/2005, 2005, 2011a) (see Appendix E) and food group intakes were compared to the intakes of food groups as recommended in the 2010 DGA (USDA/HHS, 2010a). In this report, the committee focused on nutrients of concern as outlined in the 2010 DGA[8] (USDA/HHS, 2010a). The intake of white potatoes was obtained through analysis of the intake of white potatoes eaten in all food items (through the FPED) of the WWEIA and matched into two forms: potentially WIC-eligible and not WIC-eligible. To be categorized as potentially WIC-eligible, white potatoes had to be consumed at home and eaten in food items likely to be prepared from ingredi-

[6] No women ages 14–18 years were identified in the public use versions of the 2007–2008 dataset as participating in WIC. Additionally, the WIC identifier has not been released for women ages 14–18 years in the public use version of the 2009–2010 NHANES dataset.

[7] The approach of the IOM (2000) was applied in which, when combining groups with different Estimated Average Requirements (EARs), intakes in one of the groups are re-scaled so that they can be compared to the EAR of the other group.

[8] Nutrients of concern as listed in the 2010 DGA are vitamin D, potassium, calcium, and dietary fiber. Additional nutrients of concern for women are folate, iron, and vitamin C (for iron absorption).

ents purchased in a form allowable for other vegetables based on current regulations: fresh, frozen or canned, without added sugars, fats, or oils and dehydrated without added sugars fats, oils or sodium, as described in the *Federal Register* published in March 2014 (U.S. National Archives and Records Administration, 2014). Because most of the white potatoes available in frozen, canned, or dehydrated forms do not meet the requirements, if the food item was clearly identified as coming from one of these forms, the food item was considered to be in the "not WIC-eligible" form. White potatoes consumed at home but not purchased in allowable forms (e.g., potato chips) or consumed away from home in any form were categorized as not WIC-eligible white potatoes. The current intake of potentially WIC-eligible white potatoes was used as a baseline when estimating plausible scenarios for changes in intake in the sensitivity analyses.

Assessment of diet quality The diet quality of WIC participants and WIC-eligible nonparticipants was evaluated using the 2010 HEI (Guenther et al., 2013). Options for a second index were considered by the committee, based on its evaluation of the literature on existing diet quality indexes other than the HEI, and with consideration to three criteria: (1) the index can be applied to adults and children, (2) 24-hour recall data are applied, and (3) the index is based on a metric other than comparison to the DGA. After reviewing potential indexes, the committee determined that responding to the task would require an index that focuses mainly on nutrient content to provide a contrast to the food-group focus of the 2010 HEI. However, the committee found that existing nutrient-based indexes could not be applied directly for two reasons. First, they could not be applied because they use Daily Values based on a 2,000 calorie diet as reference standards for nutrient intake rather than age-appropriate DRI values. Second, they do not necessarily include all of the nutrients and dietary components the committee was interested in assessing, based on current knowledge about nutrients of concern in the diets of young children and women of childbearing age (the 2010 DGA) and the committee's assessment of the nutrient intakes of WIC populations. The committee developed an adapted nutrient-based diet quality index to be scored by comparison to the DRI values. Given the time needed to test this index, it is not presented here and will be used in the next phases of this study.

Sensitivity Analysis

A sensitivity analysis was conducted to project the effect of including potentially WIC-eligible white potatoes in the CVV on (1) changes in intake levels of white potatoes compared to other vegetables and fruits, (2) intakes of nutrients of concern consistent with the 2010 DGA, and (3) diet quality.

Scenarios, developed by the committee, were based on the NHANES intake data as described above, applying various ad hoc assumptions about how participants might change purchase and consumption patterns between white potatoes and other CVV eligible foods.

The "baseline" scenario is that there would be no change in white potato purchases or consumption. For the sensitivity analysis, two scenarios of increased potato consumption were modeled under a constraint to be cost neutral (a change in cost within approximately ± $0.10) and included (1) a modest increase in at-home potato consumption equal to twice the current consumption of white potatoes of a form eligible under current CVV specifications for vegetables and fruits; and (2) a large increase in at-home potato consumption equal to twice the current total consumption of white potatoes (at home plus away from home) in all forms. The goal of the sensitivity analysis scenarios was to examine reasonable changes in intake. Although adding one cup is easier to describe, it does not allow tailoring the change to be proportional to current intake of women and children. To maintain cost neutrality, two conditions were applied to compensate for each level of increase in potato consumption: (1) to offset the cost of purchasing white potatoes, purchases of other vegetables and fruits were decreased in proportion to their current intake; or (2) purchases of other vegetables only were decreased in proportion to current intake. No changes were made to consumption of food groups other than vegetables and fruits (such as grains, protein foods, or dairy). These models were tested for children and women separately. The addition of calories or fat due to butter or other toppings added to white potatoes was not evaluated. Although the committee recognized that such toppings may be added to vegetables, no data were available to determine that these additions were more likely for white potatoes than for the vegetables that they would potentially replace in the various scenarios. The WIC program is intended to facilitate acquisition of foods into the home, with nutrition education provided to encourage healthy preparation. However, within the vegetable subgroups, nutrient profiles, and thus nutrient densities, are similar so the committee did not consider the addition of toppings to white potatoes in its modeling.

Costs for each vegetable subgroup and for fruit were estimated in two ways: assuming all fresh items, and assuming a mix of fresh and canned vegetable items based on those reported to be commonly consumed by WIC participants and other low-income populations. Further details of these analyses are described in Appendix F. Outcomes evaluated under each scenario included changes in food group intakes compared to recommendations contained in the 2010 DGA, changes in nutrient intakes compared to the DRIs, and changes in dietary quality, scored by the HEI. All nutrient analyses focused on "nutrients of concern" as defined in the 2010 DGA,

namely potassium, dietary fiber, calcium, and vitamin D for the general population, and folate, iron, and vitamin C for women capable of becoming pregnant, pregnant, or breastfeeding (USDA/HHS, 2010a).

RESULTS, FINDINGS, AND CONCLUSIONS

Findings and conclusions of the committee are summarized below, organized by tasks provided by the sponsor for committee consideration.

Task 1: Compare white potato consumption among the population subgroups of interest before and after the enactment of regulations in 2009, finalized in 2014, to exclude white potatoes from the WIC food packages.

Purchasing Patterns for White Potatoes

In reviewing the literature, the committee identified studies indicating that changes in vegetable and fruit purchase patterns after the CVV implementation may vary geographically. In Andreyeva and Luedicke's (2014) study of 2,137 WIC-participating households in New England, examination of scanner data of grocery store purchases demonstrated increased purchasing of vegetables and fruits by 17.5 percent and 27.8 percent, respectively, following the change to the new WIC food package. Conversely, Gleason and Pooler (2011) found that the proportion of families in Wisconsin purchasing vegetables decreased from 63.2 percent to 59.9 percent, while the proportion purchasing fruit remained the same. However, none of the available studies included information on white potato purchases in conjunction with the CVV.

The committee reviewed studies describing purchasing patterns that occur when supplemental funds are provided for vegetables and fruits. Chiasson et al. (2013) found that vegetable consumption increased 3.5 percent among children 1 to 4 years of age, when comparing a 5-month period before the package change to a 5-month period in 2011. In one study conducted before implementation of the CVV, women enrolled in a California WIC program that were provided $40 monthly as a vegetable and fruit voucher most frequently purchased carrots, tomatoes, lettuce, broccoli, and potatoes, respectively, of vegetables (Herman et al., 2006). Potatoes made up approximately 10 percent of total supermarket purchases of fresh vegetables. Overall, vegetable and fruit intake increased as a result of the intervention (Herman et al., 2006). This study suggests that if white potatoes were not excluded from the voucher, they would likely be among the top 10 most frequently purchased vegetables. Inasmuch as the voucher in this study was four times that provided to women in the WIC CVV, it is

difficult to estimate how these findings would translate to the current $10 and $8 CVV for women and children participants, respectively.

The committee was unable to identify studies indicating specifically how WIC households would change their use of the CVV if white potatoes could be purchased. However, given a set amount for the CVV, if WIC participants bought more fresh white potatoes with the CVV, they would likely spend less on other fresh produce. USDA ERS reports estimate that fresh white potatoes, which the NHANES analysis suggests are the most commonly consumed form of potato at home by WIC participants, are among the least expensive when compared to other vegetables and fruits permitted for purchase with the CVV (USDA/ERS, 2011a). Liebtag and Kumcu (USDA/ERS, 2011b) reported that vegetable and fruit prices vary regionally, which limits the ability to predict the effect of changes in use of the CVV nationally.

Finding The literature review indicated that insufficient evidence is available to support that including white potatoes in the CVV will alter purchasing patterns. There is some evidence that provision of fruit and vegetable benefits in the revised WIC food packages increased overall purchases of vegetables and fruits among households participating in WIC in New England. The committee did not find sufficient evidence on purchasing behavior of WIC participants to determine whether white potatoes would displace currently available vegetables and fruits or white potatoes currently purchased with other funds if permitted for purchase with the CVV. Compared to all other vegetables and fruits permitted for purchase with the CVV, fresh white potatoes are among the least expensive per serving, thus their purchase with the CVV may have only a minimal effect on the purchase of other vegetables and fruits purchased with the voucher.

National Trends in Potato Production, Use, and Consumption

The committee examined long-term potato availability data (as a proxy for consumption) to understand fluctuations in demand that may have occurred relative to the 2009 exclusion regulation. In 2012, total U.S. potato production was 38 billion pounds, down from a high of more than 40 billion pounds produced in 1996 (USDA/ERS, 2014a). During the same period, exports increased steadily while per capita availability (fresh weight equivalent) fell from a high of nearly 145 pounds in 1996 to a low of 110 pounds in 2011 (USDA/ERS, 2014a). Although per capita production of white potatoes is now nearly the same as it was in 1980, product use has changed. In 1980, 63.6 pounds of white potatoes per capita were used for processed foods (e.g., frozen form, primarily french fries, potato chips,

dehydrated form, and canned), while 51.1 pounds per capita were used as table stock or "fresh." Preliminary data indicate that in 2013, processed uses increased to 80.6 pounds per capita, while table stock uses declined to 36.1 pounds (USDA/ERS, 2014b). The shift in production from the fresh market into processed potato products is likely attributable to changes in consumer preferences, changes in retail markets including food service, and processing technologies (Richards et al., 1997; USDA/ERS, 1997).

The USDA's Loss-Adjusted Food Availability Data Series provides an estimate of food available for consumption, after adjustment for losses in the system due to spoilage, removal of inedible components in processing, and other waste (USDA/ERS, 2014a). It is a useful measure of trends in consumption over time, both in aggregate as well as per capita basis, and converted into units equivalent to measures used in the DGA. Since 1970, consumption of all vegetables has been increasing (measured in terms of loss-adjusted availability per week), reaching 12.4 cup-equivalents per capita per week during the 1990s (calculated on a weekly basis from the Loss-Adjusted data series). By 2012, however, consumption had fallen by about 1 cup-equivalent per capita per week to 11.4 cup-equivalents.

Overall, consumption of starchy vegetables has fallen, especially since the mid-1990s. In 2012, total potato consumption represented more than one-third of the total loss-adjusted vegetable availability. Consumption of total white potatoes fell from more than 5 cup-equivalents per capita per week in 1996 to 4.3 cup-equivalents per capita per week in 2012. During the same period, consumption of fresh white potatoes dropped from more than 2 cup-equivalents per capita per week in 1996 to just more than 1.5 cup-equivalents per capita per week in 2012. The amount of potatoes consumed in other forms (chips, frozen products, canned and dehydrated potatoes) has remained nearly steady in the same period (USDA/ERS, 2014a).

Finding Although there has been a long-term decrease in loss-adjusted availability of fresh white potatoes (used for all forms of potentially WIC-eligible white potatoes) per capita, beginning well before the 2009 WIC food package changes, the committee was not able to identify changes in the availability of white potatoes in potentially WIC-eligible forms (i.e., fresh, canned, or frozen without added fat or added sugars), compared to non-WIC-eligible forms (e.g., chips, fries) nor to identify any change in potato consumption in response to the 2009 introduction of the CVV that excluded white potatoes from purchase. There is no evidence to show that the introduction of the CVV to WIC has had an effect on overall demand for white potatoes.

National Survey Data on White Potato Consumption

A direct comparison of vegetable or fruit consumption before and after the 2009 exclusion of white potatoes from the CVV was not possible using the available NHANES datasets. Although the 2009–2010 NHANES database captures approximately 15 months of CVV use, the committee could not determine either the date of interview for the respondent or the state of residence. This information is required to determine if the individual respondent would have received the CVV as part of the WIC benefits. In addition, changes in potato consumption between the survey years 2007–2008 and 2009–2010 were relatively small, and some of the group sample sizes were too small to make any statistical comparisons across the two sample periods.

The committee's analysis of the food groups and subgroups from the combined 2007–2010 NHANES data included white potatoes consumed in all types of products, including those consumed in a form likely prepared at home from fresh potatoes only (i.e., not dehydrated, canned, or frozen).

Some differences were apparent between WIC and WIC-eligible populations and location of eating (see Appendix G). A relatively large share of the white potatoes consumed by WIC participants (32 percent for children and 46 percent for women) was eaten away from home. About two-thirds of the white potatoes consumed by all low-income children ages 1 year to less than 5 years were consumed at home. Among children participating in WIC, of all white potatoes consumed, 40 percent were consumed at home and in a form that was likely prepared from potentially WIC-eligible white potatoes (for this analysis, prepared at home from fresh potatoes), and 19 percent were eaten at home in the form of potato chips. Twenty-three percent of the white potatoes that these children consumed were in the form of french fries eaten away from home. In contrast to the patterns for white potatoes, consumption of almost all other starchy vegetables among the low-income WIC children (85 percent) occurred at home (see Table G-1).

Among low-income women, the patterns were similar, although compared to the children, women WIC participants consumed relatively fewer potatoes at home in comparison to WIC-eligible nonparticipants (54 percent compared to 65 percent). Among all low-income women, over half of white potatoes were consumed at home (54 percent for the women who participated in WIC). Similar to the children, more than 40 percent of all potatoes consumed by the women participating in the WIC program were consumed at home in a form that was likely prepared from fresh potatoes. Women participating in WIC consumed 26 percent of their intake of white potatoes away from home in the form of french fries or other frozen potato products (see Table G-2).

Finding Approximately 40 percent of all potatoes consumed by the WIC population are consumed at home in a form that is likely to be prepared from potentially WIC-eligible white potatoes.

Conclusion *The data to conclude whether or not exclusion of white potatoes from the CVV has affected the availability of white potatoes to WIC participants were unavailable at the time of the committee's analysis. The committee was unable to determine if the exclusion of white potatoes from purchase with the CVV had any effect on the consumption of potentially WIC-eligible forms of white potatoes by WIC participants or low-income nonparticipants. This was because the complete data from 2011–2012 NHANES survey needed for the most direct assessment of the impact of the 2009 exclusion were not available.*

Task 2. Determine the nutrient intake (mean and distribution) for each nutrient for which a Dietary Reference Intake has been established.

Nutrient Intakes of WIC Populations

The committee examined the adequacy of intakes for seven nutrients that were deemed "of concern" by the 2010 DGA. Five of these nutrients have an Estimated Average Requirement (EAR),[9] and thus it is possible to estimate the prevalence of dietary inadequacy. All nutrients are presented for both children and women, although vitamin C, iron, and folate are considered of concern for women only. As shown in Appendix H, dietary inadequacy was very high for vitamin D (77–87 percent) for both WIC children and children who were WIC-eligible but not participating (see Tables H-1 and H-2). Sunlight is also a source of this nutrient, but the increased risks of certain forms of cancer associated with sun exposure are well-documented (IOM, 2011a). The prevalence of calcium inadequacy among children was much lower (8–13 percent), and overall the prevalence of inadequacy was higher for WIC-eligible nonparticipating children than children participating in WIC for all nutrients of concern. The other two nutrients of concern, potassium and dietary fiber, have an Adequate Intake (AI) rather than an EAR. For children, mean intakes of both of these nutrients were well below the AI, indicating that the prevalence of inadequacy may be very

[9] The EAR is the intake level expected to satisfy the needs of 50 percent of the people in that age group based on a review of the scientific literature. The AI is used when a recommended average daily intake level based on observed or experimentally determined approximations or estimates of nutrient intake by a group (or groups) of apparently healthy people are assumed to be adequate.

high. Although potassium intakes were higher for WIC children compared to non-WIC children, dietary fiber intakes were slightly lower. The prevalences of inadequate intakes for both WIC children and children who were WIC-eligible but not participating were very low for vitamin C (less than 1 percent) and folate (2.1–2.8 percent), and had a slightly wider range for iron (1.3–3.4 percent).

Also shown in Appendix H are nutrient intakes for WIC and WIC-eligible but nonparticipating women, as well as for a third group of women, those who reside in low-income households, but are not WIC-eligible because they are not pregnant, breastfeeding, or postpartum (see Tables H-3 through H-5). The prevalence of inadequacy was undesirably high for all nutrients with an EAR, and mean intakes of both potassium and dietary fiber were well below the respective AIs. No consistent differences in the magnitude of the inadequacies were noted across the three populations. Although the prevalence of iron inadequacy ranged from 9 percent to 20 percent across the three populations, these numbers are an underestimate of the true prevalence values for the groups that included pregnant women because it was necessary to use the much lower nonpregnant iron EAR distribution to calculate the prevalence.

The results for women should be interpreted with some caution due to the small sample sizes for WIC and WIC-eligible women (n = 96 and 51, respectively). Furthermore, because these samples include a mix of pregnant, breastfeeding, and nonpregnant/nonbreastfeeding women, it is not possible to state whether the prevalence of inadequacy is higher or lower across these three subgroups of women. Likewise, the group of low-income but WIC-ineligible women is different from the two WIC-eligible groups because none of them is pregnant, breastfeeding, or up to 6 months postpartum.

Finding The intakes of calcium, vitamin D, potassium, and fiber of low-income children fall short of current DRIs, and women's intakes of all seven nutrients of concern (vitamin C for iron absorption, folate, vitamin D, calcium, potassium, iron, and dietary fiber) are in need of substantial improvement. Differences between WIC and WIC-eligible groups were small for both women and children, but inadequacies were consistently lower for WIC children compared to WIC-eligible but nonparticipating children for all nutrients except dietary fiber.

Nutritional Value of White Potatoes

White potatoes in potentially WIC-eligible forms do not contain any of the "food components to reduce" identified in the 2010 DGA. They do contain two "nutrients to increase," namely potassium and dietary fiber

(USDA/HHS, 2010a). Potatoes also contain vitamin C, which is "recommended for specific population groups," namely women capable of becoming pregnant (USDA/HHS, 2010a). In its data-gathering workshop, the committee heard evidence that because white potatoes are so widely consumed in the American diet, they can be considered a major source of dietary fiber (Slavin, 2008). Additionally, the committee was presented with evidence that white potatoes ranked higher than dark green, red-orange, and other starchy vegetables when considering nutrients available on a cost basis (Drewnowski and Rehm, 2013).

Nutrient Profile Evaluation

Public comments that were received by the committee included statements that white potatoes are of minimal nutritive value. To determine the nutritional value of white potatoes, the committee used USDA nutrient profiles to compare cup-equivalent amounts of white potatoes with other starchy vegetables as well as other WIC-eligible vegetable and fruit food groups (see Appendix I, Table I-1). The committee further compared the nutrient profile of white potatoes against the nutrients of concern as outlined in the 2010 DGA (USDA/HHS, 2010a).

Finding With the exception of vitamins C and folate, the nutrient content of vegetables and fruits within subgroups did not vary greatly. Overall, the nutrient profile of white potatoes was similar to that of other starchy vegetables. Because they are widely consumed, white potatoes provide useful quantities of potassium and fiber in the diets of Americans.

Conclusion *The nutrient profile of white potatoes does not support their exclusion from the CVV, given that their nutrient content is similar to that of other starchy vegetables that are permitted for purchase with the voucher. Because white potatoes are particularly high in potassium, increased consumption may help reduce deficits of potassium in the diets of both children and women.*

Task 3. Determine the mean intake (mean and distribution) for each food group and subgroup presented in the *Dietary Guidelines for Americans* (DGA). Compare these to the levels recommended in the DGA.

Starchy Vegetables in the Dietary Guidelines for Americans

The 2005 Committee to Review the WIC Food Packages (IOM, 2006) based its recommendation to exclude white potatoes from purchase on a

comparison of available consumption data with recommended daily food group amounts in the USDA Food Guide for consumption of starchy vegetables in the 2005 DGA (USDA/HHS, 2005a). Food intake data at that time indicated that consumption of starchy vegetables met or exceeded these suggested amounts (Briefel et al., 2004; FSRG/USDA/ARS, 1999; USDA/ARS, 1997, 2002), and showed that white potatoes were the most widely used type of vegetable (Briefel et al., 2004; Cavadini et al., 2000; FSRG/USDA/ARS, 1999; IOM, 2006; USDA/ARS, 1997, 2002).

The current committee conducted analyses on mean intakes of white potatoes and other starchy vegetables relative to the 2010 DGA (USDA/HHS, 2010a). Starchy vegetables include corn, peas, potatoes, lima beans, and cassava; all fresh, frozen, and canned forms can contribute to meeting this recommendation. The recommendation for consumption of starchy vegetables was increased in the 2010 DGA: from 2.5 to 3.5 cup-equivalents per week (0.36 to 0.50 cup-equivalents per day) for children consuming the range of 1,200–1,400 kcal/day, and from 3.0 to 5.0 cup-equivalents per week (0.42 to 0.71 cup-equivalents per day) for adult women consuming 2,000 kcal/day (USDA/HHS, 2010a). The Dietary Guidelines Advisory Committee (DGAC) applied the USDA's redesigned recommended food patterns in 2010, which used a food pattern modeling approach to realign the vegetable subgroups. As a result, a new vegetable subgroup was added (red-orange vegetables) and amounts of the other vegetable subgroups were either increased (starchy vegetables) or decreased (dark green vegetables, beans and peas, and "other" vegetables) (USDA/HHS, 2005b). Daily recommendations for total vegetables are currently as follows: 0.2 cups dark green vegetables, 0.2 cups of beans and peas, 0.8 cups of red and orange vegetables, 0.6 cups of "other" vegetables, and 0.7 cups of starchy vegetables, for a total consumption of 2.5 cups of vegetables daily (at a daily intake of 2,000 kcal). Evaluating 2001–2004 NHANES data, the 2010 DGA reported that "typical American diets" met 59 percent of the recommended intake of vegetables (USDA/HHS, 2010a).

Food Group Intakes Among the WIC Population

Analyses of 2007–2010 NHANES data (see Appendix G) show that WIC children were consuming, on average, 2.0 cup-equivalents/week of starchy vegetables (0.29 cup-equivalents/day × 7 days), or only 64 percent of their recommendation based on the 2010 DGA (see Table G-1). WIC women were consuming 2.8 cup-equivalents/week (0.40 cup-equivalents/day × 7 days), or only 56 percent of their 2010 DGA recommendation (see Table G-2).

Intakes of other vegetable subgroups are even lower relative to the 2010

DGA recommendations (see Table 1).[10] Dark green vegetable intakes were only 17 percent and 29 percent of recommended intakes for children and women, respectively, while red-orange vegetable intakes were 48 percent (for children) and 36 percent (for women) of recommendations. Likewise, total vegetable intakes were low, at 44 percent of recommendations for children, and 45 percent for women. Women's total fruit intakes (including juices) were only 50 percent of the DGA recommendation, but children's total fruit intake was 122 percent of the recommendations. The distribution of food group intakes is shown in Appendix J, Tables J-1 through J-5.

Finding WIC participants' intakes of all of the vegetable subgroups were below recommendations, as were intakes of fruit for women participants. Intakes of starchy vegetables were closer to recommendations than intakes of the other vegetable subgroups, but were still considerably below the 2010 DGA recommendations.

Conclusion *Intakes of all vegetable subgroups should be improved, including those of starchy vegetables. Because the 2010 DGA recommendations for starchy vegetable intake have increased compared to the 2005 DGA, intakes no longer meet or exceed these recommendations as was the case in the 2006 IOM report. Thus, the basis for excluding white potatoes that was used by the 2005 committee no longer applies.*

Task 4. Determine the score (mean and distribution; by category and total) on at least two established indexes of overall diet quality (including the Healthy Eating Index-2010 and at least one other index).

The committee used data from NHANES 2007–2010 to estimate mean scores for the components of the HEI-2010 as well as the mean total score (see Appendix K, Table K-1). WIC children had a higher score than other low-income children not participating in WIC (52.6 and 50.3, respectively). In contrast, women participating in WIC had a mean HEI score very similar to low-income women not participating in WIC (46.6 and 46.9, respectively). The score ranged from approximately 31 to 36 for all low-income women at the 10th decile to 56 to 62 at the 90th decile (see Appendix K, Table K-2).

[10] Recommended food group intakes for children were developed based on a 1,300 kcal diet weighted for 1- to < 5-year-olds per the method outlined in IOM (2011b) and as presented in Table 1 (page 33). Although under-reporting of foods is likely with 24-hour recalls for adults (Subar et al., 2003), it is unknown to what extent fruit and vegetable intake would be affected.

Finding All of the population subgroups had mean HEI-2010 scores indicating that, on average, these populations achieved approximately half of the maximum score considering 12 key recommendations in the 2010 DGAs. For women, of the four subscores for intake of vegetables and fruits, intakes of total vegetables achieved the highest value, while intakes of greens and beans (which includes dark green vegetables, mature beans, and peas) were lowest for both WIC and non-WIC women participants. For children, subscore for total fruit reached the highest value of fruit and vegetable scores. A nutrient-based score will be applied in phase I of this study.

Conclusion *The overall quality of the diets of both WIC participants and WIC-eligible nonparticipants, as measured by the HEI, is in need of improvement, especially for greens and beans.*

Task 5. Address the health and cultural needs of a widely diverse WIC participant population.

The addition of the CVV to the WIC food package was designed to make vegetables and fruits available to WIC participants, increase the consumption of diverse kinds of vegetables and fruits, and be culturally acceptable (IOM, 2006). By aligning the WIC food packages with the 2005 DGA, the revised food package in general, and the CVV in particular, were intended to contribute to the nutritional health of WIC participants consistent with the evidence available at the time.

White Potatoes and Health Outcomes

In its review of published literature, the 2010 DGAC report, and evidence presented in its workshop, the committee did not find any direct evidence linking consumption of white potatoes with adverse health outcomes or risk of chronic disease among WIC-eligible or low-income populations. Therefore, the committee primarily relied on evidence from general adult populations.

The committee reviewed evidence on associations between consumption of vegetables and fruits and potential health outcomes in general. The 2010 DGAC conducted a systematic review of the relationship between vegetable and fruit intake and various health outcomes in generally healthy adults (body weight, cancer, cardiovascular disease [CVD], and type 2 diabetes [T2D]) (USDA/HHS, 2010b). The evidence was rated moderate for an inverse relationship of increased fruit and vegetable intake for some cardiovascular outcomes, insufficient to assess a relationship to blood pressure or cholesterol, modest for decreased weight gain, and insufficient for

weight loss. Evidence was limited and inconsistent to suggest an association with T2D. The DGAC also noted a significant and consistently protective relationship between intake of nonstarchy vegetables and fruits and risk of all cancers, but evidence was insufficient for a relationship between starchy vegetables and site-specific cancers. In addition, the 2010 DGAC concluded that there were significant and positive associations with health outcomes linked to a minimum of five daily servings of vegetables and fruits, with additional benefits linked to more than five servings per day.

Evidence presented at the committee's workshop indicated that consumption of potatoes could have a favorable impact on several measures of cardiovascular and metabolic health (McGill et al., 2013). Evidence was also presented indicating that potassium intake was low among particular racial and ethnic groups; for example, non-Hispanic black women consumed significantly less potassium than other women, although a relationship with cardiovascular health was not shown (Personal communciation, M. Storey, Alliance for Potato Research and Education, presented to the committee at its workshop held on October 14, 2014).

The committee considered the question of white potatoes and glycemic index (GI) because of its particular concern about the risk of diabetes mellitus (DM), including T2D or gestational diabetes mellitus (GDM) among women participating in WIC. As noted in the data-gathering workshop, white potatoes are high in starch, and their GI value[11] varies based on variety and preparation from low (boiled Carisma potatoes at 53) to moderate (baked Russet potatoes at 72) to high (microwaved Russet potatoes 98). Microwaved Russet potatoes have a higher GI at 98, but Pontica potatoes have a moderate GI (79) when microwaved but a high GI (93) when baked (Personal communication, J. Slavin, University of Minnesota, presented to the committee at its workshop held on October 14, 2014). Thus, it is difficult to predict any impact of including white potatoes based on GI. The 2010 DGAC found strong evidence that there was not an association of GI with body weight or weight loss, or any cancers. There was insufficient evidence to determine a relationship between GI and CVD, but a moderate body of inconsistent evidence supporting some association of GI with T2D. The national prevalence of GDM in 2009–2010 was 9.2 percent (DeSisto et al., 2014). However, the prevalence of T2D or GDM is difficult to estimate for the WIC population at present because information on diabetes is taken at intake and may change over the course of pregnancy and participation in WIC. Based on 2014 survey results from Los Angeles County, California,

[11] The glycemic index (GI) is an in vivo measure of the blood glucose response to a standard amount of carbohydrate from a food relative to a reference food (glucose or white bread). The GI value ranks foods on a scale from 0–100 according to the extent to which they raise postprandial blood glucose values; foods ranked less than 55 are considered low GI.

the prevalence of GDM is 12 percent, varying with ethnicity (from 6.6 to 17.6 percent), suggesting that prevalence in WIC participants may be higher than in the general population (Personal communication, S. Whaley, Public Health Foundation WIC Enterprises, January 12, 2015). Thus, the committee considered whether, for WIC participants with T2D or GDM, the consumption of white potatoes (in forms potentially permitted for purchase) has implications for diabetes management. Currently, two small systematic reviews support the usefulness of low GI foods in diets to manage both T2D and GDM (Ajala et al., 2013; Viana et al., 2014), but not diets restricted in energy or carbohydrate (Viana et al., 2014).

Finding The evidence reviewed indicates that consumption of vegetables and fruits (including white potatoes) may have some long-term health benefits. The committee found no direct evidence that consumption of white potatoes affects the health outcomes of WIC participants. Although the evidence was limited by the number and quality of studies, the committee found that consuming low GI foods may be useful for dietary management of GDM and T2D.

White Potatoes and Cultural Needs

WIC services are delivered in each of the 50 states, American Samoa, the District of Columbia, Guam, the Northern Mariana Islands, Puerto Rico, and the U.S. Virgin Islands in addition to 34 Indian Tribal Organizations (USDA/FNS, 2012). Consequently, the population served by the WIC program is geographically and culturally diverse. Yet, few studies have examined cultural differences in white potato consumption or purchases among WIC participants by race/ethnic or cultural/geographic differences in use of the CVV. The committee therefore examined evidence for a relationship between the current WIC food package and increases in the purchase and consumption of both vegetables and fruits.

Several studies included subjects from culturally diverse groups. Odoms-Young et al. (2014), in a study of Hispanic and African-American WIC participants in Chicago, Illinois, found that the revised package was associated with significant increases in fruit intake only among Hispanic women and increases in the number of types of vegetables consumed only among African-American mothers and their children. Whaley et al. (2012) found small but significant increases in fruit and vegetable intake among a sample of WIC recipients (women and children), approximately 80 percent of whom were Hispanic. A study in Wisconsin found that although more than three-quarters of WIC participants used their CVVs, almost 5 percent more participants did not use any food instruments (checks or CVVs) between 1 month before to 18 months after implementation of the CVV

(Gleason and Pooler, 2011). Nonuse of the CVV was disproportionate among some WIC subpopulations. This change was seen across participant categories and racial and ethnic groups, but non-Hispanic Black and non-Hispanic American Indian/Alaska Native participants appeared more likely to use none of the checks provided (Gleason and Pooler, 2011). Reasons for nonuse were not known.

Finding Studies reviewed by the committee suggest that the evidence was insufficient to clearly quantify the effect and magnitude of food package changes among racial or ethnic groups.

Conclusion *Although the GI value of foods may have implications for prenatal care in individuals with T2D or GDM, the GI value of white potatoes varies too widely to predict the effects on health if included in the CVV. Based on the limited evidence available, it is not clear that allowing the purchase of white potatoes with the CVV would affect certain WIC subpopulations compared to others. Should white potatoes be permitted, WIC participants could still purchase a wide variety of vegetables and fruits with the CVV that take into account their cultural food preferences.*

Task 6. Conduct sensitivity analyses to estimate the effect of including white potatoes in the CVV in terms of (1) food group and nutrient intakes relative to the 2010 DGA (and DRIs), and (2) changes in dietary quality when fresh[12] white potatoes are included in the WIC Food Package.

The committee conducted a sensitivity analysis to estimate the effect of including white potatoes in the CVV on intakes of food groups, nutrients, and the HEI. A summary of the output from this analysis is presented in Tables 2a (children, page 34) and 2b (women, page 35). As noted in the data analysis section of this letter report, four scenarios were tested for children and four for women. Appendix L provides one example scenario for children (see Table L-1a) and one example scenario for women (see Table L-2a) as well as the related nutrient calculations (see Tables L-1b and L-2b). Finally, Table L-3 in Appendix L shows the cost data used for the scenarios. Presented in Tables 2a and 2b are the results from scenarios testing modification of the intake of fresh vegetables only (not canned, frozen, or dehydrated) in response to increased potato intake. The costs of canned

[12] The term "fresh" was included in this task by the sponsor of the study. Although the committee considers that potentially WIC-eligible white potatoes include all forms currently approved for other vegetables, the NHANES data used for the sensitivity analysis includes only fresh forms, as described above.

and frozen vegetables tend to be lower (see Appendix L, Table L-3), so that larger changes in the amounts of vegetables purchased were needed to maintain cost-neutrality. However, these differences had only a small effect on changes in intakes in the various scenarios.

The projected changes are small across scenarios because the CVV covers approximately 5 percent of monthly food costs for women 19 to 50 years of age based 2014 Thrifty Food Plan estimates (USDA/CNPP, 2014). Small increases in energy intake (less than 2 percent across all scenarios) were seen. In addition, although the sensitivity analyses examined a relatively large increase in daily potato consumption (doubling of total potato intake), the monthly cost of this increase was small, approximately $1.37 for children (see Table 2a) and $1.85 for women (see Table 2b). Thus, even with this extreme scenario, the percent of the CVV that would be spent on white potatoes was not large (17 percent of the $8 children's CVV and 19 percent of the $10 women's CVV). Tables 2a and 2b show the increases and decreases in consumption of vegetables and fruits based on a modest or a large change in potato consumption. As shown in the first two columns of Table 2a, if inclusion of white potatoes in the CVV led to a 0.09 cup-equivalent/day increase in a child's potato consumption, this would result in a 19.7 percent increase in consumption of starchy vegetables, a 0.4–1.2 percent decrease in consumption of other vegetables subgroups and up to a 2 percent decrease in fruit consumption.

All changes in intake were determined to be cost-neutral within approximately $0.10 per month. Because fresh white potatoes (the most commonly consumed form at home) are relatively inexpensive, using the CVV to purchase 1 to 3 pounds per month has a minor effect on intakes of the other DGA food groups and subgroups. However, these sensitivity analyses rely on several ad hoc assumptions about how the purchases with the CVV would be redistributed if white potatoes were to be allowed. Owing to a lack of behavioral data on the response of WIC participants to changes in allowable vegetables and fruits with the CVV, the quality of these assumptions is unknown.

The committee also examined the potential effect of these changes in potato consumption on HEI scores. Four of the HEI subscores would be affected by changes modeled by the committee. These are total vegetables, greens plus beans, total fruit, and whole fruit. Changes in these subscores were estimated using the scenario for children that projected the effect of a moderate change in potato purchases using the CVV (0.09 cup-equivalents/day) and assumed that intakes of purchases of both fruit and vegetables would decline to compensate for the cost of the white potatoes. With this scenario, energy intake would increase slightly (0.6 percent) and total vegetable intake would increase by about 10 percent while greens and beans would decrease by less than 1 percent and total fruit and whole fruit would

decrease by 2 percent and 4 percent, respectively. Because all of these HEI components have the same maximum score (5 points), the overall effect on the HEI is positive, but small. These relative percentages would also apply to the other sensitivity analysis scenarios.

Finding Based on several scenarios and a set of reasonable assumptions about purchase changes, projected food group and subgroup intakes, when compared to the 2010 DGA, were only slightly changed, moving women and children from below recommended intakes for starchy vegetables to closer, or slightly above the recommendation. Likewise, projected nutrient intake changes were small across the scenarios, in part because the variability in nutrient content is relatively small across all vegetable categories that are permitted for purchase.

Conclusion *Various cost-neutral shifts in the intake of categories of fruits and/or vegetables to accommodate higher consumption of fresh white potatoes would not appreciably impact nutrient or food group intake, or the HEI scores, for women or children. Further, if potato consumption increases, then intakes of starchy vegetables would move closer to the 2010 DGA recommendations, although small declines in meeting recommendations for other vegetable subgroups may be seen.*

Task 7. Ensure that the program can be administered effectively and efficiently across the nation in a cost-neutral manner.

Administration of the Current CVV

The committee collected information on program administration to assess the potential effect of including white potatoes in the CVV. Although various forms of vegetables and fruits are permitted at the national level (U.S. National Archives and Records Administration, 2014), state-level program administration varies. Fifteen states and 2 of 34 Indigenous Tribal Organizations (about 20 percent of all WIC agencies) allow the CVV to be used to purchase only fresh vegetables (USDA/FNS, 2011). In addition, although USDA regulations require authorized vendors to stock at least two different fruits and two different vegetables, minimum stocking requirements vary from state to state. California, for example, requires vendors to stock at least five different fruits and five different vegetables (U.S. National Archives and Records Administration, 2014). The committee identified one study indicating that, at the time of the evaluation, approximately 42 percent of vendors allowed minor substitutions for vegetables and fruits under the CVV, suggesting that white potatoes are at present, frequently inappropriately purchased (USDA/FNS, 2013).

Vendor response to past program changes was also considered. One study, presented to the committee in its workshop, found that fruit availability in stores increased following the 2009 regulation to exclude white potatoes from the CVV (Gleason, 2011), possibly due to stocking requirements. Gittelsohn et al. (2012) reported that overall, vendor response to the 2009 food packages changes were positive. Havens et al. (2012) reported that the availability of fruit but not vegetables increased after the 2009 WIC food package changes in 45 Hartford, Connecticut, certified WIC vendor corner stores. Three small, regional studies indicated that the variety of vegetables available increased in Philadelphia (Hillier et al., 2012), New Orleans (Rose et al., 2014), and across seven Illinois counties (Zenk et al., 2012). Additionally, the fact that at least three food companies created a one-pound size loaf of 100 percent whole wheat bread to match the revised WIC food package guidelines indicates that market adaptations to the WIC program have occurred in the past. Regarding administrative burden, monthly data on overall WIC program caseloads indicates no remarkable change in number of cases in the 12 months after implementation of the CVV (USDA/FNS, 2014).

Finding Overall, the committee found that vendors have been able to administer the CVV and the exclusion of white potatoes from purchase with the CVV.

WIC Participant Satisfaction with the CVV

The study by Gleason and Pooler (2011) showed high satisfaction with the CVV by WIC participants. They also found that, at 18 months after implementation, only 45 percent of children and pregnant women used the full CVV, and only 63 percent used the CVV to purchase any vegetable. Additionally, use of the full voucher varied by ethnicity, ranging from 30 percent for non-Hispanic Native Americans or Alaskan Natives to a high of 65 percent for non-Hispanic Asian and Pacific Islanders (Gleason and Pooler, 2011). Ritchie et al. (2014) reported that more than 90 percent of 2,996 participants interviewed were generally satisfied with the 2009 WIC food package revisions. No data were identified that assessed WIC participant response to exclusion of white potatoes from the CVV.

Finding Although WIC participants report satisfaction with the CVV, a significant proportion do not take full advantage of the voucher. The reasons for their failure to use the CVV fully are not currently understood.

Conclusion *Exclusion of white potatoes from purchase with the CVV has not been documented as a concern among WIC participants. Based on the 2009 vendor response to food package revisions, future vendor adaptations to further revisions can be anticipated. If vendors opted to count white potatoes toward the minimum stocking requirement, this could potentially impact the variety of vegetables available to WIC participants, particularly in smaller stores and in states that have implemented the federal requirement of only two different vegetables. Because the proposed policy change results in no change in the amount of money WIC households are allotted, it would be reasonable to consider that there might be no change in their overall purchases of fruit and vegetables if there is no change in the availability of other WIC-eligible vegetables and fruits.*

RECOMMENDATIONS

In response to its task, and based on its findings and conclusions, the committee offers four recommendations, considered in the context of maintaining the CVV as culturally suitable, cost-neutral, efficient for nationwide distribution, and nonburdensome to administration.

1. **The committee recommends that the U.S. Department of Agriculture allow white potatoes as a WIC-eligible vegetable, in forms currently permitted for other vegetables in the cash value voucher, pending changes to starchy vegetable intake recommendations in the 2015 *Dietary Guidelines for Americans* (DGA). If there are relevant changes in the 2015 DGA, the committee should reevaluate this recommendation.**

Rationale

The WIC food package must align with the current DGA, which means that the CVV must be aligned with recommended intakes of categories of vegetables and fruits. The recommendation of the report *WIC Food Packages: Time for a Change* (IOM, 2006) was based on the 2005 DGA. The recommendation for intake of total vegetables and starchy vegetable increased in the 2010 DGA; however, the intakes of total vegetables, starchy vegetables, and white potatoes did not change appreciably. The committee determined that inclusion of white potatoes in the CVV would not adversely affect and may slightly improve the intakes of potassium; would not adversely affect long-term health if consumed in alignment with the DGA; would offer WIC participants more choice of ways to meet their preferences for vegetable consumption or at minimum would not reduce

them; and might reduce the administrative burden for vendors by reducing restrictions for the CVV use. Nonetheless, concerns regarding effective implementation of the recommendation remain. These concerns require action to ensure that allowing purchase of white potatoes with the CVV does not (1) adversely affect achieving the Dietary Guidelines recommendation to consume a variety of vegetables and to limit intakes of saturated fat and sodium, or (2) limit the availability in other categories of vegetables offered by vendors.

2. The committee recommends that the U.S. Department of Agriculture and the U.S. Department of Health and Human Services collaborate to achieve expansion of data collection on dietary intakes for pregnant, breastfeeding, and postpartum women in the National Health and Nutrition Examination Survey.

Rationale

The committee's ability to respond to the USDA's request for specific analyses was compromised by a lack of data on dietary intake for adequate numbers of pregnant, breastfeeding, or postpartum women at any income and, especially, for low-income women in general and WIC participants in particular. These data are critical to future evaluations of changes in the WIC food packages.

3. The committee recommends that the U.S. Department of Agriculture undertake a separate, comprehensive examination of currently available data to assess the effectiveness of the current cash value voucher in meeting participants' food pattern and dietary intake goals as recommended by the *Dietary Guidelines for Americans*, including use of white potatoes in the context of cultural diversity among WIC participants.

Rationale

The committee's ability to respond to the USDA's request that its recommendations be able to be "administered effectively and efficiently nationwide" was hampered by the lack of comprehensive national data on numerous aspects of the implementation of the WIC Program and, in particular, the use of the CVV.

4. The committee recommends that the U.S. Department of Agriculture allocate resources to support studies related to (1) participant satisfaction with the cash value voucher (CVV); (2) the strategies participants use to decide how much of the CVV to spend; (3) the

strategies participants use to decide how to apportion this benefit among the vegetables and fruits, between vegetables and fruits, and between the CVV and other food purchases; (4) how vendors have changed the WIC-eligible vegetables and fruits they stock because of the implementation of the CVV; and (5) how the CVV and its implementation have affected vendors.

Rationale

The committee's ability to construct a thorough, relevant, and evidence-based sensitivity analysis for this report was hampered by a lack of information about how participants have thought about and used the CVV. Moreover, the committee's ability to understand the satisfaction of either WIC participants or vendors with the CVV or understand how either WIC participants or vendors thought about how to use the CVV was also hampered by a lack of information.

TABLES

TABLE 1 Summary of Daily Food Group Recommendations and Intakes

	WIC Children (n = 643)			WIC Women (n = 96)		
Food Group	Recommendation	Mean Intake	Percent of Recommended Intake	Recommendation	Mean Intake	Percent of Recommended Intake
Starchy Vegetables (c-eq/d)	0.5	0.3	64	0.7	0.4	56
Dark Green Vegetables (c-eq/d)	0.1	0.02	17	0.2	0.06	29
Red-Orange Vegetables (c-eq/d)	0.4	0.2	48	0.8	0.3	36
Other Vegetables	0.3	0.1	43	0.6	0.4	74
Total Vegetables (c-eq/d)	1.4	0.6	44	2.5	1.1	45
Fruits (c-eq/d)	1.2	1.5	122	2.0	1.0	50
Grains (oz-eq/d)	4.1	4.0	97	6.0	6.6	110
Dairy (c-eq/d)	2.4	2.5	105	3.0	1.6	53
Protein Foods (oz-eq/d)	3.1	2.8	90	5.5	5.1	93
Oils (g-eq/d)	16.5	11.1	67	27.0	17.5	65

NOTES: c-eq/d = cup-equivalents/d; g-eq/d = gram-equivalents/d; oz-eq/d = ounce-equivalents/d. See Appendix J for intake distributions.
DATA SOURCES: Mean intake data are from NHANES 2007–2010 for low-income individuals identified as participating in WIC: low-income children 1–4.9 years of age and women 19–50 years of age (USDA/ARS, 2007–2010). Food group intake recommendations are from the 2010 *Dietary Guidelines for Americans* (USDA/HHS, 2010a). Food group recommendations for children are weighted in a 1:3 ratio using 1,000 and 1,300 (averaged from 1,200 and 1,400) calorie food patterns, following the methodology applied by the IOM (2011b). Recommendations for women are for 2,000 kcal diet.

TABLE 2a Sensitivity Analysis Summary for Children Participating in WIC

	Moderate Increase in White Potatoes	Moderate Increase in White Potatoes, No Change in Fruit	Large Increase in White Potatoes	Large Increase in White Potatoes, No Change in Fruit
Changes from Baseline Assumptions				
Change in white potatoes, c-eq/d	0.09	0.09	0.24	0.24
Cost of white potatoes, $/month	$0.51	$0.51	$1.37	$1.37
Increase in % of starchy veg recommended	19.7%	19.4%	52.1%	51.7%
Decrease in % of other 3 veg subgroups recommended	0.4–1.2%	0.8–2.3%	1.5–4.3%	2.1–5.9%
Decrease in % of fruit recommended	2.0%	NA	7.3%	NA
Results from Changes to Baseline				
Increase in total vegetable intake, c-eq/d	0.08	0.07	0.20	0.19
Decrease in fruit intake (without juice), c-eq/d	0.02	NA	0.07	NA
% Increase in energy intake	0.6%	0.7%	1.5%	1.1%
% Increase in dietary fiber intake	1.5%	1.9%	3.3%	1.4%
% Increase in potassium intake	2.0%	2.2%	5.1%	4.1%
% Change in other nutrients of concern*	0–0.7%	0–0.9%	0–1.3%	0–0.9%

NOTES: c-eq/d = cup-equivalents/d; NA = not applicable. An example of calculations for one scenario can be found in Appendix Tables L-1a and L-1b. Cost calculations are in Appendix Table L-3 and based on all fresh substitutions.

* Nutrients of concern as listed in the 2010 DGA (USDA/HHS, 2010a): calcium, iron, potassium, vitamin C, folate, vitamin D, and dietary fiber.

DATA SOURCES: NHANES 2007–2008 and NHANES 2009–2010 data for low-income children 2–5 years of age (USDA/ARS, 2007–2010). Food group recommendations per 2010 *Dietary Guidelines for Americans* (USDA/HHS, 2010a); nutrient intakes were compared to the RDA/AI for children 1–3 years of age and 4–8 years of age as listed in Table E-1. Food group recommendations are weighted in a 1:3 ratio using 1,000 and 1,300 (averaged from 1,200 and 1,400) calorie food patterns, following the methodology applied by the IOM (2011b). Nutrient profiles of the food subgroups are presented in Table L-1b.

TABLE 2b Sensitivity Analysis Summary for Women Participating in WIC

	Moderate Increase in White Potatoes	Moderate Increase in White Potatoes, No Change in Fruit	Large Increase in White Potatoes	Large Increase in White Potatoes, No Change in Fruit
	Changes from Baseline Assumptions			
Change in white potatoes, c-eq/d	0.14	0.14	0.33	0.33
Cost of potatoes, $/month	$0.80	$0.80	$1.85	$1.85
Increase in % of starchy veg recommended	19.2%	19.1%	44.5%	44.3%
Decrease in % of other 3 veg subgroups recommended	1.0–1.9%	1.2–2.3%	2.4–4.6%	3.0–5.8%
Decrease in % of Fruit Recommended	1.1%	NA	2.6%	NA
	Results from Changes to Baseline			
Increase in total vegetable intake, c-eq/d	0.12	0.11	0.27	0.25
Decrease in fruit intake (without juice), c-eq/d	0.02	NA	0.05	NA
% Increase in energy intake	0.7%	0.8%	1.7%	1.9%
% Increase in dietary fiber intake	1.9%	2.0%	4.0%	4.6%
% Increase in potassium intake	2.7%	2.9%	6.5%	6.7%
% Change in other nutrients of concern*	0–1.1%	0–1.3%	0–2.6%	0–3.0%

NOTES: c-eq/d = cup-equivalents/d; NA = not applicable. An example of calculations for one scenario can be found in Appendix Tables L-2a and L-2b. Cost calculations are in Appendix Table L-3 and based on all fresh substitutions.

* Nutrients of concern as listed in the 2010 DGA (USDA/HHS, 2010a): calcium, iron, potassium, vitamin C, folate, vitamin D, and dietary fiber.

DATA SOURCES: NHANES 2007–2008 and NHANES 2009–2010 data for WIC women 19–50 years of age (USDA/ARS, 2007–2010). Food group recommendations per 2010 *Dietary Guidelines for Americans* (USDA/HHS, 2010); nutrient intakes were compared to the RDA/AI for women 19–50 years of age as listed in Table E-1. Nutrient profiles of the food subgroups are presented in Table L-1b.

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Appendix A

Acronyms and Abbreviations

AI	Adequate Intake
ARS	Agricultural Research Service, U.S. Department of Agriculture
CACFP	Child and Adult Care Food Program
c-eq/d	cup-equivalents per day
c-eq/wk	cup-equivalents per week
CNPP	Center for Nutrition Policy and Promotion, U.S. Department of Agriculture
CVD	cardiovascular disease
CVV	cash value voucher
DFE	dietary folate equivalent
DGA	*Dietary Guidelines for Americans*
DGAC	Dietary Guidelines Advisory Committee
DGV	dark green vegetable
DM	diabetes mellitus
DRI	Dietary Reference Intake
EAR	Estimated Average Requirement
ERS	Economic Research Service, U.S. Department of Agriculture
F&V	fruit and vegetable
FNS	Food and Nutrition Service, U.S. Department of Agriculture

FPED	Food Patterns Equivalent Database
GDM	gestational diabetes mellitus
g-eq/d	gram-equivalents per day
GI	glycemic index
HEI	Healthy Eating Index
HHS	U.S. Department of Health and Human Services
IOM	Institute of Medicine
IU	international unit
kcal	kilocalorie/calorie
kg	kilogram
mg	milligram
µg	microgram
NASS	National Agricultural Statistical Service, U.S. Department of Agriculture
NHANES	National Health and Nutrition Examination Survey
nutr	nutrients
oz-eq/d	ounce-equivalents per day
RDA	Recommended Dietary Allowance
Red-Or	red and orange vegetable
SNAP	Supplemental Nutrition Assistance Program
T2D	type 2 diabetes
TANF	Temporary Assistance for Needy Families
tsp-eq/d	teaspoon-equivalents per day
USDA	U.S. Department of Agriculture
USDA-FNS	U.S. Department of Agriculture Food and Nutrition Service
WIC	Special Supplemental Nutrition Program for Women, Infants, and Children
WP	white potato
WWEIA	*What We Eat in America* (NHANES)

Appendix B

Statement of Task

An ad hoc expert committee will undertake a two-phase comprehensive examination of the U.S. Department of Agriculture's Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) food packages (i.e., the foods provided to supplement the diet of participants, tailored to their age and health status). The committee will review and assess the nutritional status and food and nutritional needs of the WIC-eligible population and the impact of the 2009 regulation, finalized in 2014, to exclude white potatoes from WIC Food Packages against the key recommendations of the 2010 *Dietary Guidelines for Americans*, on nutrient intake and indicators of diet quality; and changes in nutrient and food intake values and indices of diet quality if fresh white potatoes are included in the WIC benefit. The committee will make specific evidence-based recommendations based on its evidence review and grounded in the most recently available science. Recommendations for changes to the WIC food packages will build on the revisions recommended in the 2006 Institute of Medicine WIC report and implemented in 2009. Recommended revisions to WIC food packages will be consistent with the 2015 *Dietary Guidelines for Americans*, the Dietary Reference Intakes, and advice from the American Academy of Pediatrics. The recommendations will take into account the health and cultural needs of the WIC participant population, support efficient program operations and allow effective administration across the geographic scope (national plus some U.S. territories) of the program. The goal is to recommend changes in the food packages, as appropriate, while ensuring that the recommendations are practical and economical, reflect current nutritional sci-

ence, and allow the program to effectively meet the nutritional and cultural needs of the WIC population. The study will be carried out in two phases and produce a letter report as well as reports from each phase. The letter report will include dietary and energy intake analyses, food intake analyses relative to the *Dietary Guidelines for Americans*, diet quality indices, and a sensitivity analysis to determine the impact of exclusion of white potatoes in WIC food packages on consumption of other foods and the ability of WIC participants to meet key recommendations of the *Dietary Guidelines for Americans*. The report will contain findings and recommendations for white potatoes that are consistent with the current *Dietary Guidelines for Americans*, consider the health and cultural needs of the WIC population, and can be administered effectively and efficiently nationwide and in a cost-effective manner. The Phase I report will contain a description of the evidence-based review strategy, dietary and energy intake analyses, data on breastfeeding trends and variability, and food expenditure analysis and will recommend general food groups that could be used to address specific nutritional deficits. The Phase II report will be based on the findings in Phase I, including a review of white potatoes and WIC, evidence gathered from the literature review, evaluation of costs, and assessment of the sensitivity and regulatory impact analyses and will recommend revisions for WIC Food Packages that are culturally suitable, cost-neutral, efficient for nationwide distribution, and non-burdensome to administration.

Appendix C

Workshop Agendas

Examining Evidence on a Role for White Potatoes in WIC Food Packages
Committee to Review WIC Food Packages
October 14, 2014

8:30 am **Registration**

INTRODUCTION AND OPENING REMARKS

9:00 **Welcome**
Kathleen Rasmussen, Chair, Committee to Review WIC Food Packages

9:10 **Opening Remarks**
Jay Hirschman, USDA—Food and Nutrition Service

SESSION 1: TRENDS IN MARKET AVAILABILITY AND CONSUMPTION OF WHITE POTATOES

Moderated by Mary Kay Fox, Mathematica Policy Research

9:20 **Trends in the Production and Pricing of White Potatoes**
Jennifer Bond, USDA—Economic Research Service

9:40	**Potato Consumption Trends: Data from the Economic Research Service** *Joanne Guthrie, USDA—Economic Research Service* *Elizabeth Frazao, USDA—Economic Research Service*
10:00	**WIC Voucher Purchase Patterns for Fresh Fruits and Vegetables** *Stacy Gleason, Altarum Institute*
10:20	**Panel Discussion with Speakers**

SESSION 2: PRODUCTS, PROCESSING, AND COMPOSITION OF WHITE POTATOES

Moderated by Rachel Johnson, University of Vermont

10:50	**White Potato Products and Processing—Healthy Options** *Maureen Storey, Alliance for Potato Research and Education*
11:10	**Nutrient Content and Bioavailability of White Potatoes** *Connie Weaver, Purdue University*
11:30	**Carbohydrates, Fiber, and Resistant Starch in White Potatoes—Links to Health Outcomes** *Joann Slavin, University of Minnesota*
11:50	**Panel Discussion with Speakers**
12:15 pm	**Lunch**
1:00	**Public Comments**
4:00	**Adjourn**

Open Session with the U.S. Department of Agriculture
Food and Nutrition Service
Committee to Review WIC Food Packages
October 15, 2014

INTRODUCTION AND OPENING REMARKS

8:00 am	**Opening Remarks** *Debra Whitford, Director, Supplemental Food Programs Division* *Jay Hirschman, Director, Special Nutrition Research and Analysis Division*
8:15	**WIC Program Updates** *Anne Bartholomew, Division Director Supplemental Food Programs* *Patti Mitchell, Senior Program Analyst, WIC* *Jay Hirschman, Director, Special Nutrition Research and Analysis Division* *Debra Whitford, Director, Supplemental Food Programs Division*
9:30	**Q & A with Committee**
10:00	**Break**

REVIEW OF STATEMENT OF TASK

10:30	**Sponsor Review of the Statement of Task** *Jay Hirschman, Director, Special Nutrition Research and Analysis Division* *Karen Castellanos-Brown, Social Science Research Analyst, Special Nutrition Research and Analysis Division*
11:00	**Open Session with Committee**
12:00 pm	**Adjourn**

Appendix D

Literature Search Strategy

LITERATURE SEARCH STRATEGY METHODOLOGY

In order to review the most relevant scientific literature available, study staff searched a range of online bibliographic databases (i.e., Medline and PubMed) for literature published after 2005 in the subject areas identified as relevant to the statement of task. Electronic literature searches of studies indexed in Medline (up to November Week 3, 2014) and PubMed were conducted. All studies published in English language from 2005 onward with human subjects were searched and screened by two independent reviewers to identify articles relevant to the key questions. Disagreement on eligibility was resolved in consultation with a third reviewer or with the committee. The search strategy employed the National Library of Medicine's Medical Subject Headings (MeSH) keyword nomenclature developed for Medline. A broad search was conducted in both Medline and PubMed databases for identifying all studies conducted on the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) program or WIC populations without restrictions to any outcome or study design. Duplicate citations between the two databases were removed before screening. A separate search database for identifying studies conducted among low-income populations living in the United States was conducted in Medline database using a combination of MeSH or search terms for *Medicaid*, *poverty*, and *low income*. This search was then combined with search terms for *potatoes*, *fruits*, and *vegetables*. Furthermore, a search strategy was developed to exclude studies that are focused on health education interventions, research method developments, obesity preventions or treatments, and breastfeeding

interventions or outcomes given that these topics were not reviewed for the letter report. Relevant studies were organized by the key questions, as follows (see Figure D-1):

- Question 1: What are the effects of 2009 WIC food package revisions on nutrient and food group intake and overall diet quality in WIC participants?
- Question 2: What are the effects of 2009 WIC food package revisions on food availability, prices, or quality among WIC-authorized vendors, or on food purchase patterns among WIC households?
- Question 3: What are the effects of 2009 WIC food package revisions on sales or other concerns of WIC-authorized vendors?
- Question 4: What are the WIC participant's concerns or feedback about the 2009 food package revisions?
- Question 5: Are there differences in fruit and vegetable intake or diet quality comparing WIC participants with nonparticipants?
- Question 6: What are the determinants of food or nutrient intake or diet quality among WIC participants or among low-income women/children or families living in the United States?
- Question 7: What are the determinants of fruit and vegetable purchases or home food environment among WIC participants or among low-income households in the United States?
- Question 8: What are the availability, costs, and quality of vegetables and fruits, or fruit and vegetable purchase patterns among low-income households or among vendors in low-income neighborhoods in the United States?

Note: The literature search included *potatoes and health* and *glycemic index and health* as additional terms. An additional search was conducted for information on glycemic index and gestational diabetes, focusing on systematic reviews.

Table D-1 provides an example of how searches were conducted; only a subset of terms from the overall search is shown for practicality.

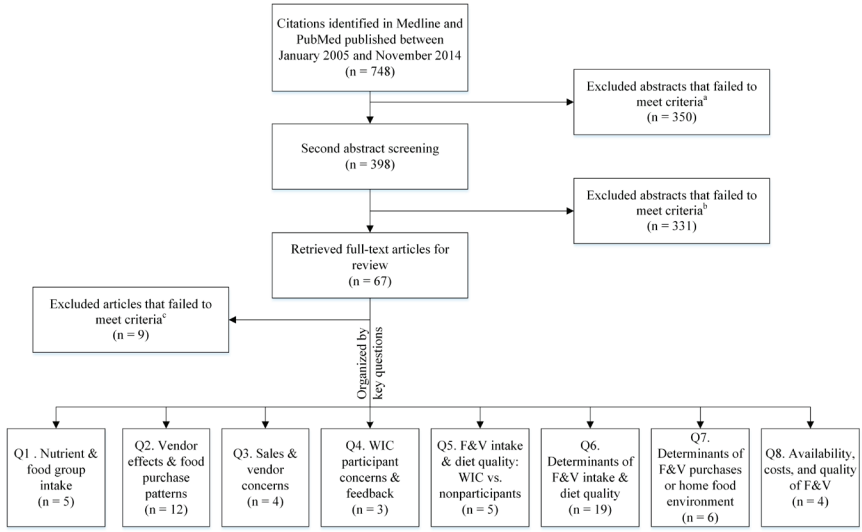

FIGURE D-1 Flow diagram of literature search strategy process.
NOTE: F&V = fruit and vegetable.

[a] First screening inclusion criteria: WIC, farmers' markets, food environment, food purchasing/eating behaviors, anything with a nutrient value (e.g., calcium, zinc, iron), maternal influence on child body mass index, maternal weight (if with food intake parameters), childhood obesity, relevant breastfeeding abstracts. Exclusion criteria: non-WIC population (e.g., fathers; not in the United States), food safety, wellness (unless with food intake parameters), food intake instrument validation, irrelevant breastfeeding abstracts (e.g., sexual abuse, breast pump protocols, provider perceptions of breastfeeding).

[b] Second screening exclusion criteria: relevant review articles tagged "background"; irrelevant review articles; prevalence of anemia; breastfeeding promotion or outcomes; overweight/obesity or other health outcomes; development of measurement instruments or development of feasibility of intervention programs without assessing food/nutrient/fruit and vegetable (F&V) intake; non-WIC, non-low-income populations; food safety without assessing food/nutrient/fruit and vegetable (F&V) intake.

[c] No data or analysis addressing any one of the eight key questions.

TABLE D-1 Ovid Medline Search Strategy to Identify Relevant Literature

Search No.	Search Terms	Number of Hits
1	"Women, Infants, and Children".af. [af=all fields]	593
2	"WIC".af.	698
3	"Special Supplemental Nutrition Program".af.	337
4	1 or 2 or 3	875
5	limit 4 to (english language and yr="2005-Current")	499
6	exp Medicaid or exp poverty [exp=search for requested subject heading and terms related to subject heading]	34,461
7	("low income" or "low-income").mp. [mp=title, abstract, original title, name of substance word, subject heading word, protocol supplementary concept, rare disease supplementary concept, unique identifier]	14,457
8	6 or 7	42,898
9	limit 8 to (english language and yr="2005-Current")	26,307
10	potato.mp.	8,810
11	vegetable.mp. or exp vegetables/	68,149
12	fruit.mp. or exp fruit/	61,865
13	or/10–12	119,157
14	9 and 13	461
15	14 not 5	433
16	limit 15 to (comment or editorial or "review" or systematic reviews)	34
17	16 not 15	399
18	exp education/ or exp "early intervention (education)"/	363,266
19	exp health education/	81,405
20	exp methods/	249,413
21	or/18–20	604,284
22	17 not 21	309
23	*obesity/ or *pediatric obesity/	64,370
24	*breast feeding/	10,049
25	23 or 24	74,194
26	22 not 25	277
27	"United States".cp. [cp=country of publication]	5,015,379
28	26 and 27	148

Appendix E

Dietary Reference Intakes

TABLE E-1 Dietary Reference Intakes for Nutrients of Concern

	Children, 1–3 Years	Children, 4–8 Years	Females, 19–50 Years	Females, 19–50 Years, Pregnant	Females, 19–50 Years, Lactating
Vitamin C (mg/d)	15	25	75	85	120
Vitamin D (IU/d)	600	600	600	600	600
Folate (µg DFE/d)	150	200	400	600	500
Potassium (mg/d)[a]	3,000	3,800	4,700	4,700	5,100
Calcium (mg/d)	700	1,000	1,000	1,000	1,000
Iron (mg/d)[b]	7	10	18	27	9
Total fiber (g/d)[a]	19	25	25	28	29

NOTES: DFE = dietary folate equivalents. Values represent the Recommended Dietary Allowances (RDAs) with the exception of potassium and total fiber.

[a] Sufficient scientific evidence was not available to calculate an RDA for potassium and total fiber. For these nutrients, an Adequate Intake level is established.

[b] Although a Dietary Reference Intake for iron has been established for nonpregnant, nonbreastfeeding, pregnant, or breastfeeding women, the skewed distribution of requirements has only been estimated for nonpregnant, nonbreastfeeding women (IOM, 2001). For this reason, the Dietary Reference Intake for iron from this group has been applied to women of all physiological states in this analysis, recognizing the limitations of this approach.

DATA SOURCES: Nutrients of concern are as presented in the 2010 *Dietary Guidelines for Americans* (USDA/HHS, 2010). Dietary Reference Intake values are from the Institute of Medicine reports (IOM, 1997, 1998, 2000, 2001, 2002/2005, 2011).

REFERENCES

IOM (Institute of Medicine). 1997. *Dietary reference intakes for calcium, phosphorus, magnesium, vitamin D, and fluoride*. Washington, DC: National Academy Press.

IOM. 1998. *Dietary reference intakes for thiamin, riboflavin, niacin, vitamin B6, folate, vitamin B12, pantothenic acid, biotin, and choline*. Washington, DC: National Academy Press.

IOM. 2000. *Dietary reference intakes for vitamin C, vitamin E, selenium, and carotenoids*. Washington, DC: National Academy Press.

IOM. 2001. *Dietary reference intakes for vitamin A, vitamin K, arsenic, boron, chromium, copper, iodine, iron, manganese, molybdenum, nickel, silicon, vanadium, and zinc*. Washington, DC: National Academy Press.

IOM. 2002/2005. *Dietary reference intakes for energy, carbohydrate, fiber, fat, fatty acids, cholesterol, protein, and amino acids*. Washington, DC: The National Academies Press.

IOM. 2005. *Dietary reference intakes for water, potassium, sodium, chloride, and sulfate*. Washington, DC: The National Academies Press.

IOM. 2011. *Dietary reference intakes for calcium and vitamin D*. Washington, DC: The National Academies Press.

USDA/HHS (U.S. Department of Agriculture/U.S. Department of Health and Human Services). 2010. *Dietary guidelines for Americans 2010*. Washington, DC: U.S. Government Printing Office.

Appendix F

Description of Sensitivity Analysis Scenarios

SCENARIOS

Four scenarios each of increased consumption of white potatoes (WPs) purchased with the cash value voucher (CVV) were tested for children and women, as follows:

For children:

1. A moderate increase in WP consumption by children of 0.09 cup-equivalents per day (c-eq/d); other vegetable and fruit categories are reduced proportionally to cover the cost.
2. A moderate increase in WP consumption by children of 0.09 c-eq/d; other vegetable (not fruit) categories are reduced proportionally to cover the cost.
3. A large increase in WP consumption by children of 0.24 c-eq/d; other vegetable and fruit categories are reduced proportionally to cover the cost.
4. A large increase in WP consumption by children of 0.24 c-eq/d; other vegetable (not fruit) categories are reduced proportionally to cover the cost.

For women:

1. A moderate increase in WP consumption of 0.14 c-eq/d; other vegetable and fruit categories are reduced proportionally to cover the cost.

2. A moderate increase in WP consumption of 0.14 c-eq/d; other vegetable (not fruit) categories are reduced proportionally to cover the cost.
3. A large increase in WP consumption of 0.33 c-eq/d; other vegetable and fruit categories are reduced proportionally to cover the cost.
4. A large increase in WP consumption of 0.33 c-eq/d; other vegetable (not fruit) categories are reduced proportionally to cover the cost.

Rationale for Scenario Development

The two potato intake values, respectively, for children and women represent (1) total at-home potentially WIC-eligible WP intake (0.09 or 0.14 c-eq/d), and (2) total WP intake (0.24 or 0.33 c-eq/d). These scenarios represent doubling of at-home potentially WIC-eligible or total WP intake for each population group, the second being a less plausible outcome. Recommended starchy vegetable intake by the 2010 *Dietary Guidelines for Americans* (DGA) is 0.5 c-eq/d for children ages 2 to 5 years (1,200 kcal) and 0.7 c-eq/d for women (2,000 kcal). In this study, food group recommendations for children are weighted in a 1:3 ratio using 1,000 and 1,300 (averaged from 1,200 and 1,400) calorie food patterns, following methodology applied by the Institute of Medicine (2011).

NOTES: These analyses assume no changes in food groups other than vegetables and fruits (e.g., not grains, dairy, or protein groups). The sensitivity analysis is constrained to the CVV, which allows only for purchase of fruits and vegetables. Therefore, tradeoffs in purchases made if white potatoes are purchased were limited to other items that can be purchased with the voucher. Changes in fruit and vegetable intake were tested as sourced from 100 percent fresh purchases, or a combination of fresh, frozen, and canned to represent a variety of price ranges. To estimate prices for each vegetable or fruit subgroups, price data from the Economic Research Service were applied (2011). For subgroups created specifically for this sensitivity analysis (i.e., WP, other starchy vegetable and fruit [no juice]), the percent contribution of the specific vegetable or fruit to the general vegetable or fruit subgroup was rescaled to sum to 100 percent. The costs was then weighted accordingly to determine the new subgroup cost per c-eq (see Appendix L, Table L-3).

REFEFRENCES

IOM (Institute of Medicine). 2011. *Child and adult care food program: Aligning dietary guidance for all*. Washington, DC: The National Academies Press.

USDA/ERS (U.S. Department of Agriculture/Economic Research Service). 2011. *Fruit and vegetable prices*. Washington, DC: USDA/ERS. http://ers.usda.gov/data-products/fruit-and-vegetable-prices.aspx (accessed December 15, 2014).

Appendix G

Food Group and Subgroup Intakes

TABLE G-1 Daily Food Group and Subgroup Intakes: Vegetables and Fruits, Children

FPED Group/Subgroup		Foods	WIC Participants[c]				WIC Nonparticipants[d]			
			At Home		Away from Home		At Home		Away from Home	
			Amount (c-eq/d)	Percent[e] (%)	Amount (c-eq/d)	Percent (%)	Amount (c-eq/d)	Percent (%)	Amount (c-eq/d)	Percent (%)
Vegetables										
Starchy	White Potatoes	Chips	0.05	19	0.00	1	0.05	24	0.00	2
		"French Fries, Frozen"	0.02	7	0.05	23	0.01	6	0.05	24
		Non-WIC-Eligible[a]	0.00	1	0.00	0	0.00	0	0.00	0
		Potentially WIC-Eligible[b]	0.09	40	0.02	9	0.07	37	0.01	7
		Total	0.16	68	0.08	32	0.14	67	0.07	33
	Other Starchy		0.05	85	0.01	15	0.05	76	0.02	24
	Total Starchy		0.21	71	0.08	29	0.18	69	0.08	31
Tomatoes			0.12	80	0.03	20	0.11	74	0.04	26
Dark Green			0.02	80	0.00	20	0.02	87	0.00	13
Red-Orange (excluding tomatoes)			0.04	84	0.01	16	0.03	62	0.02	38
Legumes			0.05	86	0.01	14	0.05	84	0.01	16
Other Vegetables			0.10	73	0.04	27	0.11	75	0.04	25
Fruit										
Citrus-Melon-Berries			0.14	88	0.02	12	0.14	88	0.02	12
Other Fruit			0.52	91	0.05	9	0.51	87	0.08	13
Juices			0.66	92	0.06	8	0.51	87	0.08	13

NOTE: c-eq/d = cup-equivalents/d.

[a] "Non-WIC-Eligible" includes white potatoes in jarred baby foods and canned products, including white potatoes in corned beef hash, stews, and soups.

[b] Although some forms of potatoes that are not fresh might meet the current regulations as allowable forms, it was not possible to distinguish whether the form of non-fresh potato would have been allowable (e.g., whether the "frozen" form had fat added) using information in the NHANES food item codes. If the food item was not specified as to form (from fresh, frozen, or dry mix), it was considered to be from a potentially WIC-eligible source (i.e., "fresh" source).

[c] Children 1–4.9 years of age participating in the WIC program at the time of the survey (n = 643).

[d] Children 1–4.9 years of age not participating in the WIC program at the time of the survey (n = 462).

[e] Percent of the total food group intake; e.g., percent of total starchy vegetable intake.

See additional notes for Tables G-1 and G-2 following Table G-2.

TABLE G-2 Daily Food Group and Subgroup Intakes: Vegetables and Fruits, Women

FPED Group/Subgroup		Foods	WIC Participants[c] At Home Amount (c-eq/d)	At Home Percent[f] (%)	Away from Home Amount (c-eq/d)	Away from Home Percent (%)
Vegetables						
Starchy	White Potatoes	Chips	0.03	9	0.00	0
		"French Fries, Frozen"	0.02	5	0.09	26
		Non-WIC-Eligible[a]	0.00	0	0.00	0
		Potentially WIC-Eligible[b]	0.14	41	0.06	20
		Total	0.18	54	0.15	46
	Other Starchy		0.06	90	0.01	10
	Total Starchy		0.24	60	0.16	40
Tomatoes			0.14	61	0.09	39
Dark Green			0.04	70	0.02	30
Red-Orange (excluding tomatoes)			0.04	76	0.01	24
Legumes			0.12	81	0.03	19
Other Vegetables			0.22	53	0.20	47
Fruit						
Citrus-Melon-Berries			0.13	88	0.02	12
Other Fruit			0.30	95	0.01	5
Juices			0.47	92	0.04	8

NOTE: c-eq/d = cup-equivalents/d.

[a] "Non-WIC-Eligible" includes white potatoes in jarred baby foods and canned products, including white potatoes in corned beef hash, stews, and soups.

[b] Although some forms of potatoes that are not fresh might meet the current regulations as allowable forms, it was not possible to distinguish whether the form of non-fresh potato would have been allowable (e.g., whether the "frozen" form had fat added) using information in the NHANES food item codes. If the food item was not specified as to form (from fresh, frozen, or dry mix), it was considered to be from a potentially WIC-eligible source (i.e., "fresh" source).

WIC Nonparticipants, Eligible[d]				Non-WIC-Eligible[e]			
At Home		Away from Home		At Home		Away from Home	
Amount (c-eq/d)	Percent (%)	Amount (c-eq/d)	Percent (%)	Amount (c-eq/d)	Percent (%)	Amount (c-eq/d)	Percent (%)
0.05	11	0.00	0	0.06	18	0.01	3
0.02	4	0.08	19	0.02	5	0.08	25
0.00	0	0.00	0	0.00	0	0.00	0
0.22	50	0.07	16	0.12	37	0.04	12
0.28	65	0.15	35	0.19	60	0.13	40
0.06	84	0.01	16	0.06	80	0.02	20
0.34	68	0.16	32	0.26	64	0.14	36
0.23	78	0.07	22	0.16	63	0.09	37
0.07	67	0.03	33	0.06	68	0.03	32
0.06	85	0.01	15	0.05	76	0.02	24
0.04	84	0.01	16	0.08	76	0.02	24
0.37	67	0.18	33	0.31	63	0.19	37
0.13	95	0.01	5	0.11	82	0.03	18
0.51	89	0.06	11	0.32	88	0.04	12
0.40	80	0.10	20	0.23	79	0.06	21

[c] Women 19–50 years of age participating in the WIC program at the time of the survey (n = 96).

[d] Women 19–50 years of age identified in the survey as being pregnant, breastfeeding, or postpartum but not participating in WIC (n = 51).

[e] Women 19–50 years of age identified in the survey as not being pregnant, breastfeeding, or postpartum and not participating in WIC (n = 1,379).

[f] Percent of the total food group intake; e.g., percent of total starchy vegetable intake.

See additional notes for Tables G-1 and G-2 following this table.

NOTES FOR TABLES G-1 AND G-2: Population groups are ≤ 185 percent poverty income ratio. Appropriate weights were applied to intake estimates to equate recommended food group intake recommendations that differed between groups. In all of the data analyses, the data were weighted to population values by using the method of balanced repeated replication and constructed the replicated weight sets as described by Fuller (2009). To assess food group intake data, the usual intake distributions were estimated using methods that account for the statistical properties of the data (intra-individual variation and reported data that are normally distributed [Carriquiry, 1999; IOM, 2000]). Underreporting of intake in the NHANES survey has been well documented (Archer et al., 2013). Food and intakes are obtained by 1 to 2 24-hour recalls, which can be useful for assessment of dietary intakes by groups (IOM, 2000).

DATA SOURCES FOR TABLES G-1 AND G-2: NHANES 2007–2008 and NHANES 2009–2010 (USDA/ARS, 2007–2010).

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Archer, E., G. A. Hand, and S. N. Blair. 2013. Validity of U.S. Nutritional Surveillance: National Health and Nutrition Examination Survey caloric energy intake data, 1971-2010. *PLoS ONE* 8(10):e76632.

Carriquiry, A. L. 1998. Assessing the prevalence of nutrient inadequacy. *Public Health Nutrition* 2(1):23-33.

Fuller, W. 2009. *Sampling Statistics*. Hoboken, NJ: John Wiley & Sons.

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USDA/ARS (U.S. Department of Agriculture/Agricultural Research Service). 2007–2010. *What we eat in America, NHANES 2007-2010*. Beltsville, MD: USDA/ARS. http://www.ars.usda.gov/Services/docs.htm?docid=18349 (accessed December 15, 2014).

Appendix H

Nutrient Intakes

TABLE H-1 Usual Intake Distributions of Selected Nutrients: Children Participating in WIC

	Intake Distribution (percentiles and mean)						
Nutrient	10th	25th	Median	Mean	75th	90th	% Inadequate
Calcium (mg/d)	617	781	995	1,018	1,246	1,505	7.6
Iron (mg/d)	6.3	7.9	10.1	10.8	12.7	15.4	1.3
Potassium (mg/d)	1,456	1,708	2,018	2,047	2,372	2,746	—
Vitamin C (mg/d)	37	57	90	104	135	189	0.6
Folate (µg DFE/d)	161	203	259	284	328	403	2.1
Vitamin D (IU/d)	148	210	292	302	391	500	76.5
Total fiber (g/d)	6	7	9	10	12	15	—

NOTES: Analysis sample was data for children 1–4.9 years of age participating in the WIC program at the time of the survey (n = 643). See additional notes for Tables H-1 through H-5 following Table H-5.

TABLE H-2 Usual Intake Distributions of Selected Nutrients: Children Not Participating in WIC

	Intake Distribution (percentiles and mean)						
Nutrient	10th	25th	Median	Mean	75th	90th	% Inadequate
Calcium (mg/d)	580	731	919	956	1,142	1,387	13.3
Iron (mg/d)	7.0	8.6	10.6	11.3	13.0	15.3	3.4
Potassium (mg/d)	1,297	1,555	1,877	1,955	2,239	2,601	—
Vitamin C (mg/d)	38	54	76	85	105	137	0.9
Folate (µg DFE/d)	178	222	279	301	350	430	2.8
Vitamin D (IU/d)	112	165	238	261	328	423	87.1
Total fiber (g/d)	6	8	10	11	13	16	—

NOTES: Analysis sample was data for children 1–4.9 years of age not participating in the WIC program at the time of the survey (n = 462). See additional notes for Tables H-1 through H-5 following Table H-5.

TABLE H-3 Usual Intake Distributions of Selected Nutrients: Women Participating in WIC

	Intake Distribution (percentiles and mean)						
Nutrient	10th	25th	Median	Mean	75th	90th	% Inadequate
Calcium (mg/d)	646	793	974	953	1,174	1,369	27.1
Iron (mg/d)	8.7	10.8	13.5	15.5	17.3	22.2	14.7
Potassium (mg/d)	1,344	1,713	2,187	2,239	2,732	3,286	—
Vitamin C (mg/d)	26	44	75	81	119	170	45.4
Folate (µg DFE/d)	222	276	342	372	420	503	42.9
Vitamin D (IU/d)	99	140	201	209	279	366	91.1
Total fiber (g/d)	7	9	13	14	18	23	—

NOTES: Analysis sample was data for women 19–50 years of age participating in the WIC program at the time of the survey (n = 96). See additional notes for Tables H-1 through H-5 following Table H-5.

TABLE H-4 Usual Intake Distributions of Selected Nutrients: Women Not Participating in WIC But WIC-Eligible

	Intake Distribution (percentiles and mean)						
Nutrient	10th	25th	Median	Mean	75th	90th	% Inadequate
Calcium (mg/d)	536	689	897	1,078	1,150	1,423	36.2
Iron (mg/d)	9.8	11.5	13.7	15.6	16.3	19.0	9.3
Potassium (mg/d)	1,451	1,921	2,457	2,578	3,006	3,511	—
Vitamin C (mg/d)	18	37	72	104	128	201	52.0
Folate (µg DFE/d)	263	312	377	426	452	531	34.5
Vitamin D (IU/d)	93	128	175	207	232	293	98.3
Total fiber (g/d)	8	11	15	16	19	23	—

NOTES: Analysis sample was data for women 19–50 years of age identified in the survey as being pregnant, breastfeeding, or postpartum but not participating in WIC at the time of the survey (n = 51). See additional notes for Tables H-1 through H-5 following Table H-5.

TABLE H-5 Usual Intake Distributions of Selected Nutrients: Women Not Participating in WIC and Ineligible to Participate

	Intake Distribution (percentiles and mean)						
Nutrient	10th	25th	Median	Mean	75th	90th	% Inadequate
Calcium (mg/d)	499	632	807	842	1,018	1,246	48.2
Iron (mg/d)	7.8	9.6	11.9	12.8	14.5	17.4	19.5
Potassium (mg/d)	1,379	1,702	2,104	2,183	2,563	3,037	—
Vitamin C (mg/d)	26	40	63	76	98	141	46.6
Folate (µg DFE/d)	212	257	315	338	384	456	51.2
Vitamin D (IU/d)	64	94	140	158	201	270	98.6
Total fiber (g/d)	7	10	12	13	16	20	—

NOTES: Analysis sample was data for women 19–50 years of age identified in the survey as not being pregnant, breastfeeding, or postpartum and not participating in WIC at the time of the survey (n = 1,379). See additional notes for Tables H-1 through H-5 following this table.

NOTES FOR TABLES H-1 THROUGH H-5: DFE = dietary folate equivalents. Nutrients presented are "nutrients of concern" as presented in the 2010 *Dietary Guidelines for Americans* (USDA/HHS, 2010); % Inadequate is calculated from Dietary Reference Intakes as defined in Table E-1. An AI, rather than an EAR, was set for potassium and total fiber; thus, it is not possible to calculate a percent of the population with inadequate intakes for these nutrients. All population groups are ≤ 185 percent of the poverty-income ratio. In all of the data analyses, the data were weighted to population values by using the method of balanced repeated replication and constructed the replicated weight sets as described by Fuller (2009). To assess nutrient adequacy, the usual intake distributions were estimated using methods that account for the statistical properties of the data (intra-individual variation and reported data that are normally distributed [Carriquiry, 1999; IOM, 2000]). The approach of the Institute of Medicine (2000) was applied in which, when combining groups with different EARs, intakes in one of the groups are re-scaled so that they can be compared to the EAR of the other group. Underreporting of intake in the NHANES survey has been well documented (Archer et al., 2013). Food intakes from which nutrient intakes are determined are obtained by one to two 24-hr recalls, which can be useful for assessment of dietary intakes by groups (IOM, 2000).

DATA SOURCES FOR TABLES H-1 THROUGH H-5: NHANES 2007–2010 (USDA/ARS, 2007–2010).

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Appendix I

Nutrient Profiles

TABLE I-1 Nutrient Composition of CNPP Vegetable and Fruit Categories with Selected Examples and Sensitivity Analysis Adjustments

Food Group and Subgroup, cup-equivalents	Energy (kcal)	Calcium (mg)	Iron (mg)	Potassium (mg)	Vitamin C (mg)	Folate (µg DFE)	Vitamin D (IU)	Total Fiber (g)
Starchy Vegetables	179	17	1.1	604	11.9	26	0	3.7
Adjusted White Potato Starchy Vegetables[a]	*126*	*14*	*0.8*	*553*	*11.5*	*21*	*0*	*2.7*
White potato, baked with skin	112	18	1.3	642	11.5	34	0	2.6
White potato, boiled without skin	133	12	0.5	508	11.5	14	0	2.8
Adjusted Other Starchy Vegetables[b]	*158*	*5*	*0.7*	*360*	*9.1*	*38*	*0*	*4.0*
Corn, cooked	158	5	0.7	360	9.1	38	0	4.0
Green peas, cooked	147	47	2.7	474	24.8	110	0	9.6
Red-Orange Vegetables	43	24	1.3	443	20.0	19	0	2.4
Tomatoes, raw	32	18	0.5	427	24.7	27	0	2.2
Sweet potatoes, baked without skin	184	76	1.4	950	39.2	12	0	6.6
Carrots, raw	52	42	0.3	410	7.6	24	0	3.6
Dark Green Vegetables	33	75	1.5	377	47.5	137	0	3.3
Broccoli, cooked	55	62	1.1	457	101.2	168	0	5.1
Cabbage, raw	25	40	0.5	170	36.6	43	0	2.5
Romaine, raw	16	33	0.9	232	3.8	128	0	2.0
Spinach, raw	14	59	1.6	335	16.9	116	0	1.3

Other Vegetables	48	38	0.7	266	17.0	37	0.5	2.6
Iceberg lettuce, raw	16	21	0.5	161	3.2	33	0	1.4
Green beans, boiled	44	55	0.8	182	12.1	41	0	4.0
Onions, boiled	92	46	0.5	349	10.9	32	0	2.9
Celery	16	40	0.2	263	3.1	36	0	1.6
Cauliflower, cooked	29	20	0.4	176	54.9	55	0	2.9
Green pepper, raw	30	15	0.5	261	119.8	15	0	2.5
Zucchini, cooked	27	32	0.7	475	23.2	50	0	1.8
Fruits, including fruit juice	97	19	0.4	312	33.5	22	0	2.3
Orange juice, unsweetened	117	25	0.3	458	74.9	60	0	0.7
Adjusted Fruits, excluding juice[c]	*81*	*13*	*0.2*	*255*	*15.3*	*15*	*0*	*2.9*
Apple, raw with skin	57	7	0.2	118	5.1	3	0	2.6
Banana, raw and sliced	134	8	0.4	537	13.0	30	0	3.9
Watermelon, cubed	45	10	0.4	168	12.1	4	0	0.6
Orange	91	80	0.2	307	109.3	63	0	4.1

NOTES: CNPP = Center for Nutrition Policy and Promotion; DFE = dietary folate equivalents. Italicized rows include values applied in the sensitivity analysis.

[a] An adjusted average nutrient composition is presented only for white potatoes based on baked with skin and boiled without skin as needed for the sensitivity analysis. This average was weighted 2:1 for baked and boiled to reflect the ratio of forms consumed.

[b] An adjusted average nutrient composition is presented for other starchy vegetables excluding white potatoes as needed for the sensitivity analysis.

[c] An adjusted average for fruits excluding juice because juice cannot be purchased with the CVV.

DATA SOURCES: CNPP draft nutrient profiles for the 2015 USDA Food Patterns (Personal communication, P. Britten, USDA/CNPP, December 9, 2014); Nutrient profiles from selected food items from USDA National Nutrient Database for Standard Reference Release 27 (USDA/ARS, 2014).

REFERENCE

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Appendix J

Food Group Distributions

TABLE J-1 Usual Intake Distributions of Selected Food Groups: Children Participating in WIC

Food Group	Intake Distribution (percentiles and mean)						Recommended Intake
	10th	25th	Median	Mean	75th	90th	
Vegetables (c-eq/d)	0.3	0.4	0.6	0.6	0.8	1.0	1.4
Fruits (c-eq/d)	0.6	0.9	1.4	1.5	1.9	2.5	1.2
Grains (oz-eq/d)	2.0	2.7	3.7	4.0	4.9	6.1	4.1
Dairy (c-eq/d)	1.2	1.7	2.4	2.5	3.2	4.1	2.4
Protein foods (oz-eq/d)	1.4	2.0	2.7	2.8	3.6	4.6	3.1
Added sugars (tsp-eq/d)	3.9	6.2	9.7	10.2	14.3	19.6	NA
Oils (g-eq/d)	4.7	7.0	10.3	11.1	14.6	19.3	16.5
Solid fats (g-eq/d)	17.2	21.9	27.9	28.5	35.1	42.6	NA

NOTES: Analysis sample was data for children 1–4.9 years of age participating in the WIC program at the time of the survey (n = 643). Recommendations are weighted in a 1:3 ratio using 1,000 and 1,300 (averaged from 1,200 and 1,400) calorie food patterns, following methodology applied by the Institute of Medicine (IOM) (2011). See additional notes for Tables J-1 through J-5 following Table J-5.

TABLE J-2 Usual Intake Distributions of Selected Food Groups: Children Not Participating in WIC

Food Group	Intake Distribution (percentiles and mean)						Recommended Intake
	10th	25th	Median	Mean	75th	90th	
Vegetables (c-eq/d)	0.4	0.5	0.6	0.6	0.8	1.0	1.4
Fruits (c-eq/d)	0.5	0.8	1.2	1.4	1.7	2.2	1.2
Grains (oz-eq/d)	2.8	3.6	4.5	4.6	5.5	6.6	4.1
Dairy (c-eq/d)	0.9	1.4	2.0	2.2	2.8	3.6	2.4
Protein foods (oz-eq/d)	2.0	2.4	2.9	3.1	3.5	4.1	3.1
Added sugars (tsp-eq/d)	5.8	8.4	12.1	12.5	16.6	21.7	NA
Oils (g-eq/d)	7.8	9.8	12.4	12.4	15.4	18.3	16.5
Solid fats (g-eq/d)	16.3	21.9	29.0	29.6	37.2	45.3	NA

NOTES: Analysis sample was data for children 1–4.9 years of age not participating in the WIC program at the time of the survey (n = 462). Recommendations are weighted in a 1:3 ratio using 1,000 and 1,300 (averaged from 1,200 and 1,400) calorie food patterns, following methodology applied by the IOM (2011). See additional notes for Tables J-1 through J-5 following Table J-5.

TABLE J-3 Usual Intake Distributions of Selected Food Groups: Women Participating in WIC

Food Group	Intake Distribution (percentiles and mean)						Recommended Intake
	10th	25th	Median	Mean	75th	90th	
Vegetables (c-eq/d)	0.6	0.8	1.1	1.1	1.4	1.8	2.5
Fruits (c-eq/d)	0.4	0.7	1.1	1.0	1.7	2.4	2.0
Grains (oz-eq/d)	3.8	4.9	6.4	6.6	8.1	9.9	6.0
Dairy (c-eq/d)	1.0	1.3	1.7	1.6	2.2	2.6	3.0
Protein foods (oz-eq/d)	2.9	3.8	4.8	5.1	6.1	7.4	5.5
Added sugars (tsp-eq/d)	6.5	10.6	16.7	19.0	24.6	33.5	NA
Oils (g-eq/d)	9.2	12.4	16.6	17.5	21.5	26.5	27.0
Solid fats (g-eq/d)	20.7	27.6	36.2	35.3	45.9	55.3	NA

NOTES: Analysis sample was data for women 19–50 years of age participating in the WIC program at the time of the survey (n = 96). See additional notes for Tables J-1 through J-5 following Table J-5.

TABLE J-4 Usual Intake Distributions of Selected Food Groups: Women Not Participating in WIC But WIC-Eligible

Food Group	Intake Distribution (percentiles and mean)						Recommended Intake
	10th	25th	Median	Mean	75th	90th	
Vegetables (c-eq/d)	0.7	1.0	1.4	1.5	1.9	2.5	2.5
Fruits (c-eq/d)	0.3	0.6	1.0	1.3	1.6	2.3	2.0
Grains (oz-eq/d)	4.6	5.4	6.3	7.1	7.3	8.3	6.0
Dairy (c-eq/d)	0.8	1.1	1.5	1.7	1.9	2.4	3.0
Protein foods (oz-eq/d)	2.8	4.0	5.6	5.6	7.4	9.2	5.5
Added sugars (tsp-eq/d)	9.6	14.1	20.1	20.3	27.0	34.1	NA
Oils (g-eq/d)	13.1	18.0	24.9	25.0	33.7	43.3	27.0
Solid fats (g-eq/d)	23.2	29.3	37.0	38.0	45.5	53.8	NA

NOTES: Analysis sample was data for women 19–50 years of age identified in the survey as being pregnant, breastfeeding, or postpartum but not participating in WIC (n = 51). See additional notes for Tables J-1 through J-5 following Table J-5.

TABLE J-5 Usual Intake Distributions of Selected Food Groups: Women Not Participating in WIC and Ineligible to Participate

Food Group	Intake Distribution (percentiles and mean)						Recommended Intake
	10th	25th	Median	Mean	75th	90th	
Vegetables (c-eq/d)	0.7	0.9	1.2	1.3	1.5	2.0	2.5
Fruits (c-eq/d)	0.3	0.5	0.7	0.8	1.1	1.6	2.0
Grains (oz-eq/d)	3.3	4.2	5.4	5.6	6.7	8.1	6.0
Dairy (c-eq/d)	0.6	0.9	1.4	1.4	1.9	2.5	3.0
Protein foods (oz-eq/d)	2.8	3.6	4.6	4.9	5.8	7.0	5.5
Added sugars (tsp-eq/d)	7.5	11.8	18.3	19.7	26.8	36.6	NA
Oils (g-eq/d)	10.5	13.9	18.5	19.3	24.4	31.1	27.0
Solid fats (g-eq/d)	17.6	23.2	30.7	31.9	39.6	49.2	NA

NOTES: Analysis sample was data for women 19–50 years of age identified in the survey as not being pregnant, breastfeeding, or postpartum and not participating in WIC (n = 1,379). See additional notes for Tables J-1 through J-5 following this table.

NOTES FOR TABLES J-1 THROUGH J-5: All population groups are ≤ 185 percent of the poverty-income ratio. c-eq/d = cup-equivalents/d; g-eq/d = gram-equivalents/d; NA = not applicable; oz-eq/d = ounce-equivalents/d; tsp-eq/d = teaspoon-equivalents/d.

Intakes for vegetables, fruits, and dairy are measured in cup-equivalents per day. Intakes for grains and protein foods are measured in ounce-equivalents per day. Intakes for oils and solid fats are measured in gram-equivalents per day. Intakes for added sugars are measured in teaspoon-equivalents per day. Recommended intakes are from Appendix 7 of the 2010 *Dietary Guidelines for Americans*. Specific recommended intake values are not provided for solid fats and added sugars. (USDA/HHS, 2010).

DATA SOURCES FOR TABLES J-1 THROUGH J-5: NHANES 2007–2010 (USDA/ARS, 2007–2010).

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Appendix K

Healthy Eating Index 2010 Assessment

TABLE K-1 Healthy Eating Index-2010 Based on NHANES 2007–2010

		Children Participating in WIC (n = 405)		Children Not Participating in WIC (n = 374)
HEI-2010 Component	Maximum Score	Mean	Percent of Maximum Score	Mean
Total Vegetable[a]	5	2.14	43	2.13
Greens and Beans[a]	5	0.35	7	0.39
Total Fruit[b]	5	3.85	77	3.53
Whole Fruit[c]	5	2.75	55	2.84
Whole Grains	10	2.20	22	2.61
Dairy[d]	10	8.54	85	8.33
Total Protein Foods[e]	5	3.98	80	4.02
Seafood and Plant Proteins[e,f]	5	1.81	36	2.03
Fatty Acid[g]	10	2.92	29	2.87
Sodium	10	5.84	58	5.34
Refined Grains	10	5.94	59	5.46
Empty Calories[b]	20	12.31	62	10.75
HEI-2010 Total Diet	100	52.62	53	50.31

NOTE: HEI = Healthy Eating Index.

[a] Includes any beans and peas not counted as Total Protein Foods.

[b] Includes 100% fruit juice.

[c] Includes all forms except juice.

[d] Includes all milk products, such as fluid milk, yogurt, and cheese, and fortified soy beverages.

[e] Beans and peas are included here (and not with vegetables) when the Total Protein Foods standard is otherwise not met.

Women Participating in WIC (n = 96)		Women Not Participating in WIC, Eligible (n = 51)	Women Ineligible for WIC (n = 1,379)
Mean	Percent of Maximum Score	Mean	Mean
2.57	51	3.06	2.93
0.57	11	0.89	0.77
2.38	48	2.36	2.10
2.19	44	2.12	2.20
1.96	20	1.62	2.09
6.03	60	6.12	5.53
4.40	88	4.38	4.33
2.09	42	2.06	2.35
4.17	42	4.72	4.72
4.22	42	4.93	4.55
4.91	49	4.49	5.65
11.08	55	10.12	10.87
46.58	47	46.88	48.07

[f] Includes seafood, nuts, seeds, soy products (other than beverages) as well as beans and peas counted as Total Protein Foods.

[g] Ratio of poly- and monounsaturated fatty acids (PUFAs and MUFAs) to saturated fatty acids (SFAs).

[h] Calories from solid fats, alcohol, and added sugars; threshold for counting alcohol is more than 13 grams/1,000 kcal.

See additional notes for Tables K-1 and K-2 following Table K-2.

TABLE K-2 Healthy Eating Index-2010: Total Distributions for Children and Women

Population Subgroup	10th	25th	Median	75th	90th
Children participating in WIC (n = 405)	43.02	47.95	53.27	58.41	62.88
Children not participating in WIC (n = 374)	40.02	44.84	50.09	55.32	60.08
Women participating in WIC (n = 96)	35.57	40.06	45.41	51.17	56.69
Women not participating in WIC (n = 51)	31.07	38.42	47.17	55.49	61.77
Women ineligible for WIC (n = 1,379)	34.70	39.67	45.56	51.78	57.61

NOTE: See notes for Tables K-1 and K-2 following this table.

NOTES FOR TABLES K-1 AND K-2: All groups are ≤ 185 percent of the poverty-income ratio. Analysis sample was data for children 2–4.9 years of age and women 19–50 years of age.

DATA SOURCES FOR TABLES K-1 AND K-2: 2007–2010 NHANES (USDA/ARS, 2007–2010) analyzed using criteria outlined in Guenther et al., 2013.

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Guenther, P. M., K. O. Casavale, J. Reedy, S. I. Kirkpatrick, H. A. Hiza, K. J. Kuczynski, L. L. Kahle, and S. M. Krebs-Smith. 2013. Update of the Healthy Eating Index: HEI-2010. *Journal of the Academy of Nutrition and Dietetics* 113(4):569-580.

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Appendix L

Background Example Data for Sensitivity Analysis

TABLE L-1a Sensitivity Analysis Example Considering the Addition of 0.09 Cup-Equivalents per Day of White Potatoes: WIC Children

Food Groups and Nutrients	Current At-Home Intake	Current Total Intake	Recommended Intake	Intake as % of Recommendation
Starchy Vegetable Subgroups (c-eq/d)				
Total potatoes	0.16	0.23		
Potentially WIC-eligible potatoes	0.09	0.12		
Other starchy vegetables	0.05	0.06		
Total Starchy Vegetables (c-eq/d)	0.21	0.29	0.45	64.7
Dark Green Vegetables (c-eq/d)	0.02	0.02	0.13	16.9
Red-Orange Vegetables (c-eq/d)				
Total tomatoes	0.12	0.15		
WIC-eligible tomatoes	0.06	0.08		
Other red-orange	0.04	0.04		
Total red-orange	0.16	0.20	0.41	48.1
Other Vegetables (c-eq/d)	0.10	0.14	0.32	42.8
Fruit (c-eq/d)				
Total	1.32	1.45	1.00	144.8
Without juice	0.66	0.73		
Change in cost				
Energy (kcal)		1,566	1,300	
Potassium (mg)		2,036	3,200	
Total Fiber (g)		10.9	20.5	
Calcium (mg)		992	775	
Vitamin D (IU)		276	600	
Iron (mg)		11.9	7.8	
Vitamin C (mg)		82.4	17.5	
Folate (μg DFE)		443	163	

NOTES: c-eq/d = cup-equivalents/d; DFE = dietary folate equivalents. Food group recommendations are for 1,300 kcal diet weighted for 1-to 4.9-year-olds per the method outlined by the Institute of Medicine (IOM) (2011). Change per day is based on at-home consumption; 0.09 c-eq/d for potatoes was used in this example with a 6 percent decrease in other vegetable categories and no change in fruit. Cost calculations are in Table L-3 and based on all fresh substitutions.

Cost per c-eq	Change in Intake	Cost of Change per Month	Revised Intake	Revised Intake as % of Recommendation	Change in % Recommendation
$0.19	0.09	0.51	0.32		
1.17	0.00	–0.10	0.05		
			0.38	84.0	19.35
1.37	–0.001	–0.04	0.02	16.1	–0.83
1.07	–0.010	–0.31	0.19	45.7	–2.34
0.42	–0.006	–0.07	0.13	40.9	–1.88
			1.45	144.8	0.00
0.25	0.000	0.00	0.73		
		–0.02			
	11		1,577		
	44		2,080		
	0.2		11.1		
	1		993		
	0		276		
	0		12.0		
	1		83.1		
	1		444		

DATA SOURCES: NHANES 2007–2008 and NHANES 2009–2010 data for low-income children 1–5 years of age (USDA/ARS, 2007–2010); food group recommendations per 2010 *Dietary Guidelines for Americans* (USDA/HHS, 2010), weighted in a 1:3 ratio using 1,000 and 1,300 (averaged from 1,200 and 1,400) calorie food patterns, following methodology applied by the IOM (2011). Nutrient intakes were compared to the RDA/AI for children 1–3 years of age and 4–8 years of age as listed in Table E-1.

TABLE L-1b Projected Changes in Nutrient Intake Considering the Addition of 0.09 Cup-Equivalents per Day of White Potatoes: WIC Children

Nutrients	Current Intake/d	Recommended Intake/d	Nutr/c-eq White Potatoes[a]	Nutr/c-eq Other Starchy Vegetable[b]
Energy (kcal)	1,566	1,300	126	158
Potassium (mg)	2,036	3,200	553	360
Dietary fiber (g)	10.9	20.5	2.7	4.0
Calcium (mg)	992	775	14	5
Vitamin D (IU)	276	600	0	0
Iron (mg)	11.9	7.8	0.8	0.7
Vitamin C (mg)	82.4	17.5	11.5	9.1
Folate (µg DFE)	443	163	21	38.0
At-home food grp intake (current), c-eq/d			0.16	0.01
Change in food grp intake, c-eq/d			0.09	0.00

NOTES: c-eq = cup-equivalents; DFE = dietary folate equivalents; DGV = dark green vegetable; Nutr = nutrients; Red-Or = red and orange vegetable.

[a] Weighted average of boiled white potatoes without peel and baked white potatoes with peel in a 2:1 ratio.

[b] Nutrients are for boiled sweet yellow corn.

[c] CNPP draft nutrient profiles for the 2015 USDA Food Patterns

[d] Weighted average of apple, banana, watermelon, and orange in a 4:2:0.5:0.5 ratio.

[e] Assuming +0.09 c-eq of white potatoes (starchy veg), and –6 percent of other vegetable food groups (no change in fruit groups).

Nutr/c-eq Red-Or[c]	Nutr/c-eq DGV[c]	Nutr/c-eq Other Vegetable[c]	Nutr/c-eq Fruit[d]	Change in Intake[e]	Revised Intake/d	% Change in Intake
43	33	48	81	11	1,577	0.7
443	377	266	255	44	2,080	2.2
2.4	3.3	2.6	2.9	0.2	11.1	1.9
24	75	38	13	1	993	0.1
0	0	1	0	0	276	0.0
1.3	1.5	0.7	0.2	0.1	12.0	0.4
20.0	47.5	17.0	15.3	0.7	83.1	0.9
19	137	37	15	1	444	0.3
0.14	0.02	0.09	0.68			
–0.01	0.00	–0.01	0.00			

DATA SOURCES: Nutrient intake data are for low-income children identified as participating in WIC from NHANES 2007–2010 (USDA/ARS, 2007–2010). CNPP draft nutrient profiles (Personal communication, P. Britten, USDA/CNPP, December 9, 2014); nutrient profiles from selected food items from USDA National Nutrient Database for Standard Reference Release 27 (USDA/ARS, 2014).

Nutrient intakes were compared to the RDA/AI for children 1–3 years of age and 4–8 years of age as listed in Table E-1.

TABLE L-2a Sensitivity Analysis Example Considering the Addition of 0.14 Cup-Equivalents per Day of White Potatoes: WIC Women

Food Groups and Nutrients	Current At-Home Intake	Current Total Intake	Recommended Intake	Intake as % of Recommendation
Starchy Vegetable Subgroups (c-eq/d)				
Total potatoes	0.18	0.33		
Potentially WIC-eligible potatoes	0.14	0.20		
Other starchy vegetables	0.06	0.12		
Total Starchy Vegetables (c-eq/d)	0.24	0.45	0.71	62.6
Dark Green Vegetables (c-eq/d)	0.04	0.06	0.21	28.0
Red-Orange Vegetables (c-eq/d)				
Total tomatoes	0.14	0.23		
WIC-eligible tomatoes	0.11	0.17		
Other red-orange	0.04	0.01		
Total red-orange	0.18	0.24	0.79	30.9
Other Vegetables (c-eq/d)	0.22	0.20	0.57	34.3
Fruit (c-eq/d)				
Total	0.90	0.98	2.00	49.0
Without juice	0.43	0.47		
Change in cost				
Energy (kcal)		2,019	2,000	
Potassium (mg)		2,334	4,700	
Total fiber (g)		15.8	25	
Calcium (mg)		908	1,000	
Vitamin D (IU)		148	600	
Iron (mg)		14.4	18	
Vitamin C (mg)		83	75	
Folate (μg DFE)		543	400	

NOTES: c-eq/d = cup-equivalents/d; DFE = dietary folate equivalents. Food group recommendations are for 2,000 kcal diet. Change/day is based on at-home consumption. 0.14 c-eq/d for white potatoes was used in this example with a 6 percent decrease in all other vegetable categories and no change in fruit. Cost calculations are in Table L-3 and based on all fresh substitutions.

Cost per c-eq	Change in Intake	Cost of Change per Month	Revised Intake	Revised Intake as % of Recommendation	Change in % Recommendation
0.19	0.14	0.80	0.47		
1.17	0.00	–0.12	0.11		
			0.58	81.7	19.11
1.37	–0.003	–0.10	0.06	26.8	–1.18
1.07	–0.011	–0.34	0.23	29.6	–1.35
0.42	–0.013	–0.16	0.18	32.0	–2.30
0.25					
		0.07			
	16.2		2,035		
	68.3		2,402		
	0.3		16		
	1.2		909		
	0.0		148		
	0.1		14		
	1.1		84		
	2.0		545		

DATA SOURCES: NHANES 2007–2008 and NHANES 2009–2010 data for WIC women 19–50 years of age (USDA/ARS, 2007–2010). Food group recommendations per 2010 *Dietary Guidelines for Americans* (USDA/HHS, 2010); Nutrient intakes were compared to the RDA/AI as listed in Table E-1.

TABLE L-2b Projected Changes in Nutrient Intake Considering the Addition of 0.14 Cup-Equivalents per Day White Potatoes: WIC Women

Nutrients	Current Intake/d	Recommended Intake/d	Nutr/c-eq White Potatoes[a]	Nutr/c-eq Other Starchy Vegetable[b]
Energy (kcal)	2,019	2,000	126	158
Potassium (mg)	2,334	4,700	553	360
Dietary fiber (g)	15.8	25.0	2.7	4.0
Calcium (mg)	908	1,000	14	5
Vitamin D (IU)	148	600	0	0
Iron (mg)	14.4	18.0	0.8	0.7
Vitamin C (mg)	83.0	75.0	11.5	9.1
Folate (µg DFE)	543	400	21	38
At-home food grp intake (current), c-eq/d			0.19	0.05
Change in food grp intake, c-eq/d			0.14	0.00

NOTES: c-eq/d = cup-equivalents/d; DFE = dietary folate equivalents; DGV = dark green vegetable; Nutr = nutrients; Red-Or = red and orange vegetable.

[a] Weighted average of boiled white potatoes without peel and baked white potatoes with peel in a 2:1 ratio.

[b] Nutrients are for boiled sweet yellow corn.

[c] CNPP draft nutrient profiles

[d] Weighted average of apple, banana, watermelon, and orange in a 4:2:0.5:0.5 ratio.

[e] Assuming +0.14 c-eq of white potatoes (starchy veg), and –6 percent of other vegetable food groups (no change in fruit groups).

Nutr/c-eq Red-Or[c]	Nutr/c-eq DGV[c]	Nutr/c-eq Other Vegetable[c]	Nutr/c-eq Fruit[d]	Change in Intake[e]	Revised Intake/d	% Change in Intake
43	33	48	81	16	2,035	0.8
443	377	266	255	68	2,402	2.9
2.4	3.3	2.6	2.9	0.3	16.1	2.0
24	75	38	13	1	909	0.1
0	0	1	0	0	148	0.0
1.3	1.5	0.7	0.2	0.1	14.5	0.6
20.0	47.5	17.0	15.3	1.1	84.1	1.3
19	137	37	15	2	545	0.4
0.19	0.03	0.14	0.41			
–0.01	0.00	–0.01	0.00			

DATA SOURCES: Nutrient intake data are for low-income children identified as participating in WIC from NHANES 2007–2010 (USDA/ARS, 2007–2010). CNPP draft nutrient profiles (Personal communication, P. Britten, USDA/CNPP, December 9, 2014). Nutrient profiles from selected food items from the USDA National Nutrient Database for Standard Reference Release 27 (USDA/ARS, 2014).

Nutrient intakes were compared to the RDA/AI for women 19–50 years of age as listed in Table E-1.

TABLE L-3 Cost Calculation of Fruit and Vegetable Groups

		Fresh Only			Fresh, Canned, and Frozen		
Food group	Food item	Cost/c-eq	Percent weight	Cost/lb	Cost/c-eq	Percent weight	Cost/lb
White potatoes	White potatoes, fresh	0.19	100.0	0.48	0.19	100.0	0.48
	Weighted cost/c-eq	0.19			0.19		
Other starchy veg	Corn, yellow, fresh	1.17	9.8	1.80	1.17	0.0	1.80
	Corn, yellow, canned	0.37	0.0	0.69	0.37	9.8	0.69
	Green peas, frozen	0.51	0.0	1.34	0.51	5.3	1.34
	Green peas, canned	0.43	0.0	0.74	0.43	5.3	0.74
	Weighted cost/c-eq	1.17			0.42		
Red-orange veg	Tomatoes, fresh	1.28	70.9	2.94	1.28	70.9	2.94
	Tomatoes, canned	0.41	0.0	0.77	0.41	70.9	0.77
	Carrots, fresh	0.25	17.9	0.77	0.25	17.9	0.77
	Weighted cost/c-eq	1.07			0.60		
Dark green veg	Broccoli, fresh	0.63	39.3	1.84	0.63	39.3	1.84
	Leafy greens	1.95	25.0	0.40	1.95	25.0	0.40
	Spinach, fresh	2.02	23.0	3.92	2.02	23.0	3.92
	Spinach, frozen	0.96	0.0	1.51	0.96	23.0	1.51
	Weighted cost/c-eq	1.37			1.29		

Other veg	Lettuce, fresh	0.26	22.3	0.99	0.26	22.3	0.99
	Green beans, fresh	1.03	10.5	3.23	1.03	0.0	3.23
	Green beans, canned*	0.42	0.0	0.80	0.42	10.5	0.80
	Onions, fresh	0.28	16.0	0.67	0.28	16.0	0.67
	Cabbage, fresh	0.27	5.7	0.62	0.27	5.7	0.62
	Weighted cost/c-eq	0.42			0.30		
Fruit, no juice	Apples	0.28	18.5	1.07	0.28	18.5	1.07
	Bananas	0.21	12.8	0.45	0.21	12.8	0.45
	Watermelon	0.17	5.2	0.26	0.17	5.2	0.26
	Oranges	0.34	5.2	0.57	0.34	5.2	0.57
	Weighted cost/c-eq	0.25			0.25		

NOTES: c-eq = cup-equivalents. Only food items contributing 5 percent or more to the food group are included in the cost calculation. Percent weights reflect the percent contribution of the specific vegetable or fruit to the general vegetable or fruit subgroup. To calculate the weighted costs per cup-equivalent, these percents were rescaled so that they summed to 100 percent.

*Average of cut and whole canned green beans.

DATA SOURCES: Percent weight from Personal communication, P. Britten, USDA/CNPP, September 24, 2014; Cost data from USDA/ERS (2011).

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Appendix M

Committee Biosketches

Kathleen M. Rasmussen, Sc.D., R.D. (*Chair*) is professor of nutrition, Division of Nutritional Sciences, at Cornell University. Dr. Rasmussen is internationally known for her research on maternal and child nutrition, particularly in the areas of pregnancy and lactation. She has served as program director for Cornell's National Institutes of Health (NIH)–sponsored training grant in maternal and child nutrition since 1986 and has also directed a training grant in international maternal and child nutrition. Dr. Rasmussen has taught a nationally recognized course in maternal and child nutrition for graduate students since 1980 and has taught a unique course on public health nutrition for undergraduate students since 1998. As part of her commitment to mentoring future leaders in nutrition, Dr. Rasmussen serves as the principal faculty member at the Dannon Nutrition Leadership Institute, which she helped to develop in 1998. She has received the Excellence in Nutrition Education Award and also the Mentorship Award from the American Society for Nutrition. The American Public Health Association honored her for her research accomplishments with their Agnes Higgins Award in 2012. Dr. Rasmussen has served as president of the American Society of Nutritional Sciences and also as president of the International Society for Research on Human Milk and Lactation. She has been associate dean and secretary of the university faculty and served a 4-year term on Cornell's Board of Trustees as one of its faculty-elected members. Dr. Rasmussen has been a member of several expert committees at the Institute of Medicine (IOM), including the Committee on Scientific Evaluation of WIC Nutrition Risk Criteria. Recently, she served as the chair

of the Committee on Reexamination of IOM Pregnancy Weight Guidelines and then as chair of a committee to disseminate these new guidelines. She received her A.B. degree from Brown University in molecular biology and both her Sc.M. and Sc.D. degrees from Harvard University in nutrition.

Gail G. Harrison, Ph.D. (*Vice Chair*), is distinguished research professor, Department of Community Health Sciences at the University of California, Los Angeles (UCLA), Fielding School of Public Health. Her research focuses on determinants, measurement, and functional consequences of nutrition, malnutrition, and food security, both in the United States and internationally. Prior to joining the UCLA faculty in 1992, Dr. Harrison was on the faculty of the College of Medicine of the University of Arizona, where she was the founding Director of the Program in International Health and Professor of Family and Community Medicine and Pediatrics. She has worked extensively in the area of dietary and nutritional assessment of diverse populations. Dr. Harrison has been a member of the Food and Nutrition Board (FNB) of the National Academy of Sciences (NAS)/IOM and several FNB committees, including the Committee on International Nutrition, the Committee to Review the Risk Criteria for the WIC Program, and the Committee on Implications of Dioxin in the Food Supply, the Committee to Revise the WIC Food Packages, and the Committee to Recommend Changes to School Meals Standards. She has consulted with the World Health Organization and UNICEF and has worked in Egypt, Indonesia, Iran, Lesotho, and the Sudan besides the United States. She received her M.N.S. in nutritional sciences from Cornell University and her Ph.D. in biological anthropology from the University of Arizona. She is the author of many publications on health and nutritional status of vulnerable groups. She was elected to membership in the IOM in 2003.

Susan S. Baker, M.D., Ph.D., is professor, Department of Pediatrics, professor and co-chief, Digestive Diseases and Nutrition Center, University of Buffalo School of Medicine. She also serves as the laboratory director for the Gastroenterology Laboratory at Women and Children's Hospital of Buffalo. Dr. Baker is the program director for the Pediatric Gastrointestinal Fellowship program. Her research focus is on liver (hepatology), nutrition, pediatric gastroenterology, and pediatrics. Dr. Baker worked in Africa and established two new programs in Gastroenterology and Nutrition at the University of Massachusetts Medical Center and the Medical University of South Carolina before moving to Buffalo. She has published many peer-reviewed articles, chapters, reviews, as well as having edited four medical textbooks and one nonmedical book. Dr. Baker is recognized as a leader in the field, having served as the chairperson of the American Academy of Pediatrics Committee on Nutrition, the chairperson of the American Board

of Pediatrics, subboard of Gastroenterology, and numerous other national and international advisory groups, including the IOM, U.S. Department of Agriculture, and the U.S. Food and Drug Administration representative to the CODEX expert committee on infant formula. Dr. Baker received her M.D. from Temple University School of Medicine and her Ph.D. from Massachusetts Institute of Technology.

Marianne P. Bitler, Ph.D., is professor of economics in the Department of Economics at the University of California, Irvine, and a faculty research associate at the National Bureau of Economic Research, in the programs on Children and Health Economics. Dr. Bitler is also a faculty affiliate in demographic and social analysis at the University of California, Irvine; a visiting scholar at the San Francisco Federal Reserve Bank; and a research fellow at the Institute for the Study of Labor in Bonn, Germany. Previously, she was a postdoctoral fellow and then an economist at the RAND Corporation, a research fellow at the Public Policy Institute of California, and an economist on the Board of Governors of the Federal Reserve in the Division of Research and Statistics (where she worked on the Survey of Small Business Finances). Her research interests include labor economics, health economics, public economics, and applied microeconomics. Her publications include several on participation in and effects of the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) program, which appeared in the *Journal of Human Resources*, the *Review of Agricultural Economics*, and the *Journal of Policy Analysis and Management*. Dr. Bitler has a B.S. degree in mathematics from the Pennsylvania State University, and a Ph.D. in economics from the Massachusetts Institute of Technology.

Patsy M. Brannon, Ph.D., R.D., is professor, Division of Nutritional Sciences, Cornell University, where she has also served as dean of the College of Human Ecology. Prior to moving to Cornell University, Dr. Brannon was chair, Department of Nutrition and Food Science, University of Maryland. She has also served as visiting professor, Office of Dietary Supplements, NIH. Her research focus includes nutritional and metabolic regulation of gene expression, especially as relating to human development, the placenta, and exocrine pancreas. She was a member of the Committee on Dietary Reference Intakes for Calcium and Vitamin D, and she is currently a member of the FNB. Dr. Brannon is a member of a number of professional and scientific associations and has served on the Executive Board of the American Society for Nutrition. She has received numerous awards, including the Pew Faculty Scholar in Nutrition award as well as the Centennial Laureate award from Florida State University. Dr. Brannon received her Ph.D. from Cornell University in nutritional biochemistry.

Alicia L. Carriquiry, Ph.D., M.Sc., is a distinguished professor of liberal arts and sciences and professor of statistics at Iowa State University. Dr. Carriquiry research interests include Bayesian statistics and general methods. Her recent work focuses on nutrition and dietary assessment, as well as on problems in genomics, forensic sciences, and traffic safety. Dr. Carriquiry is an elected member of the International Statistical Institute and a fellow of the American Statistical Association and of the Institute of Mathematical Statistics. She has served on the executive committees of the Institute of Mathematical Statistics, the American Statistical Association, and of the International Society for Bayesian Analysis, and she has served on the Council of the International Statistical Institute. She has served on several committees of the NAS. Dr. Carriquiry received a M.Sc. in animal science from the University of Illinois, and an M.Sc. in statistics and a Ph.D. in statistics and animal science from Iowa State University.

David E. Davis, Ph.D., is an associate professor in the Department of Economics at South Dakota State University. Dr. Davis studies industrial organization, currently focusing on the effects of food assistance programs on market interactions. Dr. Davis previously held a position with the Economic Research Service of the USDA, where he studied food markets. He has researched WIC and infant formula markets, and analyzed the effects of WIC cost-containment practices for creating interstate variation in WIC food package costs. He has expertise in empirical microeconometrics: applications of panel data methods to empirical investigations of industrial organization and market power. Dr. Davis received his Ph.D. from the University of Oregon in economics.

Mary Kay Fox, M.Ed., is senior fellow and area leader for nutrition policy research at Mathematica Policy Research. Ms. Fox has more than 25 years of research experience with child nutrition and food assistance programs. She has conducted research on the adequacy and quality of diets consumed by children, from birth through adolescence, and has examined the contributions of school- and childcare-based meal programs to children's dietary intakes and obesity risk. She was a co–principal investigator on the 2002 and 2008 Feeding Infants and Toddler Studies, which examined feeding practices and food and nutrient intakes among infants, toddlers, and preschoolers from birth to 48 months of age. Ms. Fox conducted a comprehensive review of research literature on the impacts of the WIC program on health- and nutrition-related outcomes. She is currently directing the Food and Nutrition Service WIC-Medicaid II study, which is updating the landmark WIC-Medicaid study conducted in the early 1990s. Ms. Fox served on the IOM Committee to Review Child and Adult Care Food Program Meal Requirements, as well as the Committee on Nutrition Standards for

the National School Lunch and Breakfast Programs, and the Committee on the Consequences of Sodium Reduction in Populations. Ms. Fox has a M.Ed. in nutrition from Tufts University.

Tamera J. Hatfield, M.D., Ph.D., is a board certified obstetrician-gynecologist specializing in maternal-fetal medicine at the University of California (UC), Irvine. She treats high-risk pregnancy patients and has a particular interest in managing maternal conditions that complicate pregnancy. Dr. Hatfield's research interests include using magnetic resonance imaging (MRI) to evaluate brain injury as it relates to perinatal risk factors, weight gain during pregnancy among obese patients, and preeclampsia. She is involved with teaching residents, fellows, and medical students and previously served on the Council on Resident Education in Obstetrics and Gynecology. Dr. Hatfield received her M.D. from UC Irvine, where she also completed a residency in obstetrics and gynecology and a fellowship in maternal-fetal medicine. In addition, she holds a Ph.D. in Behavioral Neuroscience from the University of North Carolina at Chapel Hill. She is a member of the Society for Maternal Fetal Medicine and the American College of Obstetricians and Gynecologists.

Helen H. Jensen, Ph.D., is professor of economics and leads a research group focused on food and nutrition programs in the Center for Agricultural and Rural Development at Iowa State University, an internationally recognized research center that addresses issues of the food, agricultural, and natural resource sectors. Her research interests include the design of food and nutrition programs and policies, assessment of nutritional enhancement of foods, food demand and markets, linkages between agricultural policies and nutrition, and food-safety regulations. She has led projects that analyze food demand, and that involve dietary, nutritional, and health assessment as well as the design and implementation food consumption surveys in the United States as well as in several developing countries. Dr. Jensen was elected Fellow of the Agricultural and Applied Economics Association (AAEA) in 2012 and recently completed a term on the Executive Board of Directors of the Agricultural and Applied Economics Association. She has served on several committees of the National Academy of Sciences, including the recent IOM Committee to Review Child and Adult Care Food Program Meal Requirements, and the National Research Council and IOM Committee on Risk-Characterization for Decision-Making at the Food and Drug Administration. She chaired the IOM and National Research Council's True Cost of Food Workshop planning committee and is a member of the Food Forum. Dr. Jensen holds a Ph.D. in agricultural economics from the University of Wisconsin.

Rachel K. Johnson, Ph.D., M.P.H., R.D., is the Robert L. Bickford, Jr., Professor of Nutrition and Professor of Medicine at the University of Vermont. Dr. Johnson served as Dean of the College of Agriculture and Life Sciences at the University of Vermont from 2001 to 2008 and as Associate Provost for Faculty Affairs from 2009 to 2011. Dr. Johnson's research expertise covers pediatric nutrition and obesity, dietary intake methodology, diet and cardiovascular disease, and national nutrition policy. She was appointed to the Year 2000 Dietary Guidelines Advisory Committee. She served on the Panel on Dietary Reference Intakes (DRIs) for the macronutrients for the IOM. Dr. Johnson served on the President's Council on Fitness, Sports and Nutrition Science Board from 2011 to 2014 and was Chair of the American Heart Association Nutrition Committee from 2012 to 2014. Dr. Johnson holds a Ph.D. in Nutrition from the Pennsylvania State University, an M.P.H. from the University of Hawaii, and is a Registered Dietitian.

Angela Odoms-Young, Ph.D., is assistant professor in the Department of Kinesiology and Nutrition at the University of Illinois at Chicago (UIC) College of Applied Health Sciences and an Institute of Health Research and Policy Fellow. Dr. Odoms-Young's research is focused on understanding social, cultural, and environmental determinants of dietary behaviors and diet-related diseases in low-income and minority populations. Her current projects include studies to evaluate the impact of the new WIC food package on dietary intake, weight status, and chronic disease risk in 2–3-year-old low-income children and vendor participation; identify strategies to improve program participation and retention among WIC-eligible children; evaluate the efficacy of a community-based participatory weight loss intervention in African American women; and examine community engagement approaches to promote food justice. Prior to joining UIC, Dr. Odoms-Young served on the faculty of Northern Illinois University in Public Health and Health Education. She completed a Family Research Consortium Postdoctoral Fellowship examining family processes in diverse populations at the Pennsylvania State University and the University of Illinois at Urbana-Champaign and a Community Health Scholars Fellowship in community-based participatory research at the University of Michigan School of Public Health. She received her M.S. in human nutrition and Ph.D. in Community Nutrition from Cornell University.

A. Catharine Ross, Ph.D., is professor and occupant of the Dorothy Foehr Huck Chair of Nutrition in the Department of Nutritional Sciences at Pennsylvania State University. As a nutritional biochemist, Dr. Ross has studied cellular factors involved in the biosynthesis and transport of vitamin A molecules. Her focus has been on the cellular basis of vitamin A homeostasis. She also investigates the role of retinoids in immune function, prin-

cipally antibody production, and in neonatal lung development. She served as Editor-in-Chief of the *Journal of Nutrition* from 2004 to 2013. Dr. Ross has received numerous awards, including the Mead-Johnson Award and the Osborne and Mendel Award from the American Society for Nutrition. She is active within a range of professional societies, including the American Association of Immunologists, Sigma Xi, and the American Physiological Society, and has served on a number of committees for the American Society for Nutrition and the Federation of the American Societies for Experimental Biology. Dr. Ross is a Fellow of the American Association for the Advancement of Science and a member of the NAS. She chaired the Committee on Dietary Reference Intakes for Calcium and Vitamin D and is a member of the FNB. Dr. Ross received her Ph.D. from Cornell University in biochemistry and molecular and cell biology.

Charlene Russell-Tucker, M.S.M., R.D., is the chief operating officer (COO) for the Connecticut State Department of Education. As COO, Ms. Russell-Tucker leads priority project management functions to help improve the planning, efficiency, service, and delivery effectiveness of the Department's programs and services. In addition to broad agency efforts, she also directly provides leadership and oversight to the Department's Office of Student Supports and Organizational Effectiveness. Her prior position was associate commissioner for the Connecticut State Department of Education. In this role Ms. Russell-Tucker was responsible for the administration of the Division of Family and Student Support Services which comprises three bureaus: the Bureau of Choice Programs; the Bureau of Health/Nutrition, Family Services and Adult Education; and the Bureau of Special Education. She provides leadership and support in developing and implementing effective family and student support programs and services to assist schools and other educational partners in improving student performance. Prior to her appointment as Associate Commissioner, Ms. Russell-Tucker was chief of the Bureau of Health and Nutrition Services and Child/Family/School Partnerships at the Connecticut State Department of Education. The Bureau was strategically positioned within the Department to support the social, emotional, physical, and mental health of students and families in order to achieve success in school and in life. Its initiatives and services include School-Family-Community Partnerships, Child Nutrition Programs, School Health Promotion/Mental Health Services/School Nurses, Nutrition Education, Safe and Drug Free Schools Program, 21st Century Community Learning Centers/After-school programs, Family Resource Centers, Young Parents Program, and Education of Homeless Children and Youth. Ms. Russell-Tucker is past president of the Connecticut Dietetic Association and the Child and Adult Care Food Program National Professional Association. She is also an adjunct faculty member at a local college where

she teaches business management courses in the program for nontraditional students. She received her M.S. in management from Albertus Magnus College in New Haven, Connecticut, and is a Registered Dietitian.

Shannon E. Whaley, Ph.D., is the Director of Research and Evaluation for Public Health Foundation Enterprises WIC Program (PHFE WIC), the largest local agency WIC program in the nation. In her 16 years of experience on the front lines of WIC, Dr. Whaley has become an expert in understanding both how the program functions and how it can be maximally effective in achieving positive health outcomes for the families WIC serves. Dr. Whaley's expertise is in the planning, development, and evaluation of programs designed to optimize the healthy development of children and families served by WIC. Her work spans a broad range of topics including childhood nutrition and obesity, prevention of prenatal alcohol use, promotion of early literacy for low-income children, and examination of the impact of the recent WIC food package change on WIC participants. Dr. Whaley's work includes controlled research studies as well as implementation of community-based interventions using evidenced-based practices. In her role at PHFE WIC, Dr. Whaley has been successful in supporting her work with public and private grants that support research endeavors as well as enhance core WIC services. She supervises graduate students from local universities and has mentored a postdoctoral researcher who recently moved on to a full-time academic position. Dr. Whaley also serves as Chair of the Evaluation Committee of the National WIC Association and in this role works closely with other WIC programs to advance the national WIC research agenda. Dr. Whaley received her undergraduate degree in psychology from Pomona College, and her Ph.D. in developmental psychology from UCLA.