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Nutrient Adequacy of Children Participating in WIC

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USDA's Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) provides supplemental foods to participants, in most cases through vouchers for retail purchase of foods designated as approved by the program. WIC food packages were initially designed to include foods rich in nutrients that were lacking in the diets of low-income participants, in particular, protein, iron, calcium, vitamin A, and vitamin C. Later legislation removed reference to specific nutrients but required assurance to the degree possible that the fat, sugar, and salt content of foods prescribed by WIC is appropriate.

Since the initial development of the WIC food packages, U.S. food consumption patterns and dietary standards have changed. In addition, the prevalences of overweight and obesity have increased and the WIC participant population has become more ethnically diverse. Addressing these developments by considering changes to WIC food packages can be informed by an updated look at the nutrient intake levels of the program's target population, particularly WIC children (IOM, 2003). This brief summarizes two recent ERS-sponsored studies that provide new assessments of nutrient intakes of WIC children, income-eligible children not participating in the program, and children ineligible for the program.

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Background and Methodology

Previous research examining the effects of WIC participation on nutrient intakes of children estimated either the mean intakes of WIC and non-WIC children or the percentages in each group not meeting a nutrient's Recommended Dietary Allowance (RDA). However, since the RDA is set at a level higher than most individuals' requirements, individuals consuming less than the RDA may still have adequate consumption levels.[1] Thus, data obtained from these studies could not be used to measure the prevalence of nutrient inadequacy.

In 1997, the National Academy of Sciences' Institute of Medicine (IOM) began developing new, revised dietary standards—the Dietary Reference Intakes (DRIs). The new standards were accompanied by a recommended methodology for estimating the prevalence of nutrient inadequacy within population groups (IOM, 2000).

In particular, the IOM recommends using longrun average, or "usual," intake to estimate the prevalence of nutrient inadequacy. The distribution of usual intakes has lower variance than the distribution of 1-day intakes because measuring usual intake removes the day-to-day variation within an individual's daily intakes and includes only the variation among individuals. As a result, the share of individuals falling below a cutoff point (for cutoffs below the mean) is generally lower for usual intakes than for observed 1-day (or even 2-day) intakes.

For many nutrients, the new IOM methodology estimates the prevalence of nutrient adequacy in a population group as the share of the group with usual intake above the IOM's new Estimated Average Requirement (EAR). To assess intake of some nutrients, such as iron, the IOM recommends another approach, referred to as the "probability method," which matches each individual's level of usual intake with IOM's estimated risk of inadequacy at that intake level, and then takes the average risk of inadequacy for the group. Where the distribution of individual requirements cannot be determined, the IOM recommends comparing the mean intake for a group with a level of Adequate Intake (AI) set using either experimental data or observed intake for an apparently healthy population. The IOM also published Acceptable Macronutrient Distribution Ranges (AMDR) for total fat, omega-3-fatty acids, carbohydrates, and protein, and Estimated Energy Requirements (EER) by age and weight, as well as by gender and physical activity level in the case of older children and adults.[2]

Two ERS-sponsored studies assessed the nutrient intake of WIC children using the IOM's new dietary standards and methods for dietary assessment. Devaney et al. (2005) used data on children ages 1-3[3] from the Continuing Survey of Intake by Individuals 1994-96, 1998 (CSFII) while Cole and Fox (2004) used data on children ages 1-4 from the Third National Health and Nutrition Examination Survey 1988-94 (NHANES III).

Both studies examined the distributions of usual intake of nutrients, rather than the average of 2 days of observed intake[4] and both studies used the DRIs for micronutrients rather than the 1989 RDAs. Devaney et al. used the 2003 EAR for protein; the 2003 AI for fiber; the 2003 EERs; and the 2003 AMDRs for total fat, carbohydrates, and protein as a share of calories consumed. Because the new DRIs did not establish a reference intake for saturated fat or cholesterol—stating, instead, that diets should minimize intake—the Devaney et al. CSFII study did not examine these nutrients. Cole and Fox completed their NHANES study before these standards were published and thus used earlier standards to examine intakes of total fat, saturated fat, cholesterol, and fiber. Those results are not reported here. Cole and Fox used the National Research Council's 1989 standard for sodium (2,400 mg/day).[5]

Findings

WIC-targeted nutrients

Vitamin C: Both studies found very high prevalence of adequate intake of vitamin C in all three categories of children—99 percent or greater for WIC children, income-eligible children not participating in the program, and children ineligible for the program.

[1] The RDAs are set to meet the individual requirements of 97-98 percent of the population.

[2] The IOM also published revised RDAs, for use as a target for individuals, and Tolerable Upper Intake Levels for some nutrients with toxic effects when consumed at high doses.

[3] Four-year-olds were excluded from the study due to budget limitations; since the DRIs are established separately for children ages 1-3 and 4-8, estimates for 4-year-olds would have doubled the computation and analysis required for the study.

[4] The CSFII collected 2 days of intake data for most respondents, from which day-to-day intake variances were estimated as part of the usual intake distribution estimates. Because the NHANES collected 2 days of data from only 5 percent of respondents, Cole and Fox used estimates of day-to-day variance from the CSFII in their estimates of usual intake from the NHANES.

[5] The IOM's Tolerable Upper Intake Level for sodium (2,300 mg/day) was not available for use in either of these studies.

Nutrient adequacy of children by WIC status

Nutrient	Standard	Children ages 1-3[1] WIC participants	Children ages 1-3[1] Income-eligible nonparticipants
WIC-targeted nutrients			
Vitamin C	Percent meeting EAR	>99	>99
Iron	Probability of adequacy	99	99
Vitamin A	Percent meeting EAR	>99	>99
Calcium	Mean intake relative to AI AI (age 1-3) = 500 mg	850 mg (>AI)	805 mg (>AI)
Protein	Percent meeting EAR	>99	95
	Percent within AMDR	>99	>99
Other nutrients			
Zinc	Percent meeting EAR	>99	>99
Magnesium	Percent meeting EAR	>99	>99
Vitamin E	Percent meeting EAR	48	42
Folate	Percent meeting EAR[2]	92	92
Energy	Mean intake relative to EER	1,408 kcal (>EER 1,105)	1,419 kcal (>EER 1,174)
Carbohydrate	Percent meeting EAR	94	97
	Percent below AMDR	5	11[3]
Total fat	Percent within AMDR	69	75
	Percent below	25	20
	Percent above	6	5
Fiber	Mean intake relative to AI = 19 grams[4]	9g (<AI)	9g (<AI)
Sodium	Percent meeting 2,400 mg or less[5]	48	50

Notes: EAR = Estimated Average Requirement. AI = Adequated intake level. EER = Estimated Energy Requirement. AMDR = Appropriate Macronutrient Distribution Range.

[1]CSFII 1994-96, 1998 unless otherwise noted.

[2]Does not reflect folate potency, absorption, and fortification.

[3]Statistically significant difference ($p<0.01$).

[4]AI refers to total fiber, while intake refers to dietary fiber measured by current analytical methods; total fiber intake is likely higher than dietary fiber.

[5]Estimated for children ages 2-4, NHANES III 1988-1994

Sources: Compiled by USDA/ERS from Devaney et al. (2005) and Cole and Fox (2004).

Iron: Both studies found virtually all children in each category had adequate iron intake. The NHANES study, however, also examined biochemical indicators of iron status and found that 5 percent of WIC children, 10 percent of income-eligible nonparticipants, and 4 percent of ineligible nonparticipants had iron deficiency as indicated by the presence of at least two out of three possible biochemical markers.[6] The difference between income-eligible nonparticipants and WIC children was statistically significant.

[6]Biochemical indicators measured in NHANES included low serum transferrin saturation, high erythrocyte protoporphorin, and low serum ferritin.

Vitamin A: The CSFII study examined intakes of vitamin A and found very high prevalence of nutrient adequacy among WIC children and income-eligible nonparticipants.

Calcium: Both studies found that mean intakes of calcium exceeded the Adequate Intake for WIC children and other children, indicating that the prevalence of inadequate intake is likely to be low.

Protein: The CSFII study examined intakes of protein, both in absolute terms and as a share of calories. Less than 1 percent of WIC children ages 1-3 had intakes below the Estimated Average Requirement, compared with 5 percent of income-eligible nonparticipants. This difference was not statistically significant. Less than 1 percent of WIC children or income-eligible nonparticipants had protein intakes outside the IOM's recommended range of 5-20 percent of calories.

Other nutrients

Zinc and magnesium: Both studies found intakes of zinc adequate for more than 99 percent of children in each category. The CSFII study found the same result for magnesium intakes of WIC children ages 1-3 and income-eligible nonparticipants.

Vitamin E: The CSFII study found 48 percent of WIC children ages 1-3 and 42 percent of income-eligible nonparticipants had usual intakes of vitamin E above the Estimated Average Requirement.

Devaney et al. note that clinical measures of vitamin E levels in blood plasma from NHANES III showed very low levels of inadequacy. They urge additional research to reconcile this difference and speculate that the inconsistency may reflect the difficulty in assessing the types and amounts of fats and oils added during cooking and the variability in food composition databases.

Folate: The CSFII study found 8 percent of WIC children ages 1-3 and 8 percent of income-eligible nonparticipants had inadequate usual intakes of folate. This estimate is probably high, since intake data from the CSFII do not reflect new information about differences in potency and absorption of folate from food, compared with folate from fortification additives or new levels of folate in fortified grains.

Energy: The CSFII study compared mean usual energy intake with the IOM's new Estimated Energy Requirements for children ages 1-3, which account for age and weight. Energy intake for both WIC children (1,408 kcal) and income-eligible nonparticipants (1,419 kcal) exceeded the mean Estimated Energy Requirements for the two groups (1,105 kcal and 1,174 kcal, respectively), suggesting overconsumption of energy for both groups, or perhaps overreporting of intake.

Fat: The CSFII study found that 69 percent of WIC children ages 1-3 had fat intakes within the IOM's recommended range of 30-40 percent of calories, while 25 percent had intakes below this range and 6 percent had intakes above this range. Among income-eligible nonparticipants, 75 percent had intakes within the range, with 20 percent below the range and 5 percent above the range.

Carbohydrates: The CSFII study found 5 percent of WIC participants and 11 percent of income-eligible nonparticipants had carbohydrate intakes below the IOM-recommended 45 to 65 percent of calories.

Fiber: The CSFII study compared usual intake of fiber with the IOM's 2003 Adequate Intake. WIC children ages 1-3 and income-eligible nonparticipants both had intakes of 9 grams, compared with the Adequate Intake of 19 grams. Note that the Adequate Intake refers to total fiber, while intake refers to dietary fiber measured by current analytical methods that exclude some fiber components; total fiber intake is likely to be somewhat higher than dietary fiber intake, but still less than the Adequate Intake. While the adequacy of intake cannot be determined when intakes are below the Adequate Intake, Devaney et al. suggest the magnitude of this discrepancy is cause for concern.

Sodium: The CSFII study did not examine sodium, as the IOM had not yet published a DRI for sodium at the time of the study. The IOM's 2004 tolerable upper limit for sodium, 2,300 mg/day, is fairly close to the 2000 Dietary Guideline of 2,400 mg/day or less. The NHANES study applied the 2000 Dietary Guideline and found nearly half of WIC children met the guideline, slightly less than the level of income-eligible nonparticipants but significantly less than the level of ineligible nonparticipants.

Conclusions

According to the two studies, it appears that of the original nutrients targeted by WIC, protein, calcium, vitamin A, and vitamin C are no longer lacking in the diets of preschool children in the United States. The studies were not designed to determine whether WIC children may have had inadequate intake levels of these nutrients had they not participated in the program. Biochemical indicators suggest some children are still iron deficient, though iron intake per se appears adequate. The source of this discrepancy remains an issue. Other outstanding issues include the discrepancy between dietary and clinical measures of vitamin E adequacy and the need to update nutrient content databases to better reflect folate potency and absorption. Mean dietary fiber intake is far below the Adequate Intake for total fiber; this gap will likely shrink somewhat when nutrient databases are updated to include all components of total fiber in foods, but probably not enough to ease concern over possible intake inadequacy.

Overconsumption of energy may be a problem for both WIC and non-WIC children. Further, according to the new Acceptable Macronutrient Distribution Ranges for fat, carbohydrate, and protein, the balancing of these macronutrients may pose a challenge for those planning the diets of many children.

This brief is drawn from . . .

Devaney, Barbara, Myoung Kim, Alicia Carriquiry, and Gabriel Camaño-García. *Assessing the Nutrient Intakes of Vulnerable Subgroups*, Contractor and Cooperator Report No. CCR11, prepared for the U.S. Department of Agriculture, Economic Research Service. Mathematica Policy Research, Inc., 2005.

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