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Abstract

Participants in the Food Stamp Program consume more meats, added sugars, and total fats than they would in the absence of the program, while their consumption of fruits, vegetables, grains, and dairy products stays about the same. Participants in the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) consume significantly less added sugars, which may reflect the substitution of WIC-supplied juices and cereals in place of higher sugar soft drinks and cereals. These findings come from a study of low-income Americans using the Continuing Survey of Food Intake by Individuals.

Keywords: Nutrition assistance programs, food intake, dietary quality, Continuing Survey of Food Intake by Individuals (CSFII)

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Summary

Participation in the Food Stamp Program (FSP) tends to increase one's intake of meats, added sugars, and total fats. It does not significantly change one's intake of fruits, vegetables, grains, or dairy products. The effects of food stamp use seem to be similar to the effects of having substantially more income. Food stamps appear to help low-income Americans acquire more of the food energy and other nutrients they need, but public policy is concerned with overall dietary quality and not just with increasing the amount of food intake.

Participation in the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) tends to reduce one's consumption of food products with added sugars, perhaps reflecting the substitution of WIC-supplied cereals and fruit juices for high-sugar cereals and soft drinks. WIC participants also seem to consume more fruits and dairy products than they might otherwise, but this finding was not statistically significant.

The United States invests about $17 billion annually in the FSP and about $4 billion annually in WIC, to improve food security and dietary quality for low-income Americans. This study uses data from the Continuing Survey of Food Intake by Individuals (CSFII) for 1994-96. It measures seven categories of food intake using the serving definitions employed in the Food Guide Pyramid developed by the U.S. Departments of Agriculture and Health and Human Services.

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Introduction

How do the U.S. Food Stamp Program (FSP) and the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) affect dietary quality? This report combines the most recent 3 years of national survey data on food intake with a novel statistical approach to provide some answers to this question. The results have implications for nutrition monitoring and nutrition education efforts.

This question is significant in U.S. food and nutrition policy. The United States invested about $17 billion in the FSP in 1998 and about $4 billion in WIC to improve food security and dietary quality for low-income Americans. WIC had more than 7 million clients on average each month in 1998. The FSP had over 19 million clients on average each month that year, representing about 7.3 percent of all Americans. The effect of these public investments on dietary quality is a major topic in recent studies of public policy in nutrition (Kennedy, 1999; Rossi, 1998; Levedahl and Oliveira, 1999; Oliveira and Gundersen, 2000).

This issue is complicated by several factors:

- First, like many questions in the social sciences, this one involves trying to understand and interpret the choices made by millions of individuals, each of whom faces a distinct economic situation and each of whom has distinct knowledge and opinions. When it comes to dietary choices, in particular, each of these individuals has quite literally his or her own "tastes and preferences." Each family differs from the next, and even within the same family, each member may be different.

- Second, dietary quality is not easy to evaluate. In the case of dietary quality for low-income Americans, public policy is concerned both with food insecurity, which may involve episodes of insufficient food intake, and also with the same problems of nutritional excess that are major concerns for the American population at all income levels. Furthermore, dietary quality is difficult to assess by measuring the consumption of particular foods or nutrients on their own. Instead, dietary quality depends on the composition of a bundle of foods.

- Third, the evaluation of food and nutrition programs stands at a junction between research disciplines. The nature of spending choices subject to resource constraints is, by tradition, in the research portfolio of economics. Nutritional effects of food behaviors have most often been the domain of nutrition science. Assessing food and nutrition programs therefore seems to call for an interdisciplinary approach. Such methods for this area of research are still rapidly developing.

This study investigates the dietary impact of the FSP and WIC while addressing precisely these complications. These issues do not exhaust the list of important factors that could have been considered in this analysis. In particular, this study does not simultaneously address other important nutrition assistance programs, such as school meals programs. This report explains the main results and the reasoning behind the research design for the study, and it refers the reader to a separate article for the more technical details of the analysis (Wilde, McNamara, and Ranney 1999).

In overview, the research uses data from the 1994-96 Continuing Survey of Food Intake by Individuals

(CSFII) to study intake of the five major "pyramid" food groups (meats, fruits, vegetables, grains, dairy) plus added sugars and total fats (fig. 1). The study considers how intake of each major food category is correlated with intake of the other categories. The report offers some background on the FSP and WIC; reviews recent research on nutrition programs and dietary quality; describes the data and methods used in this investigation; summarizes the main results; and suggests some implications both for food and nutrition policy and for future research.

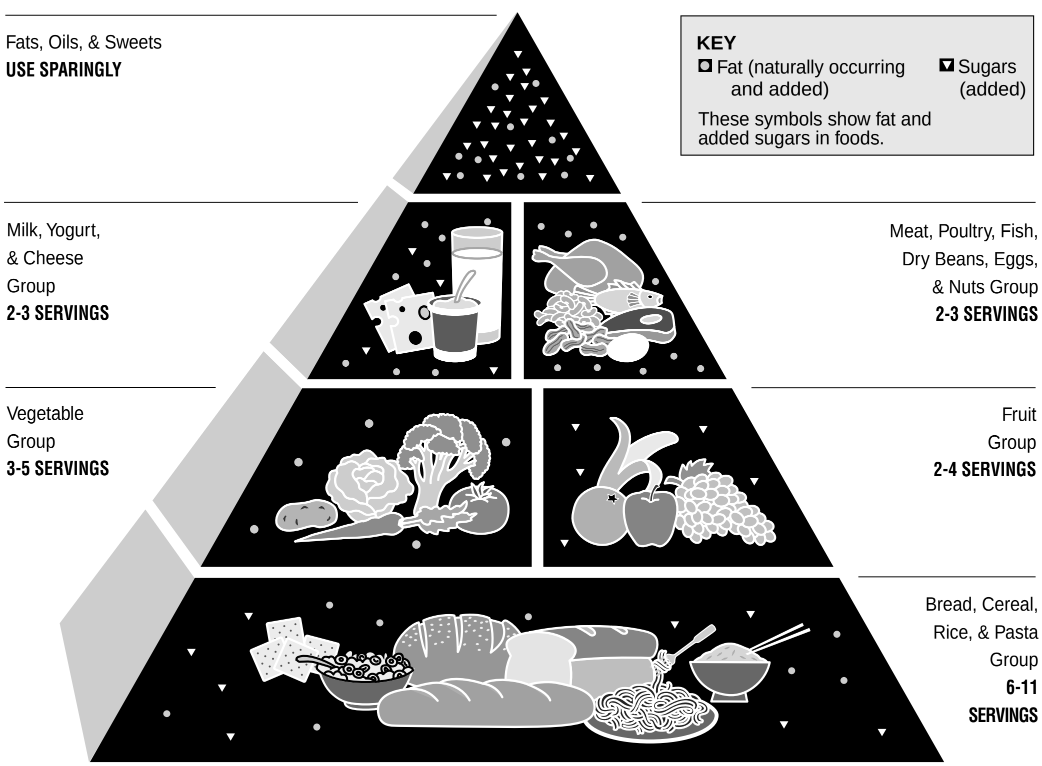
Background on the FSP and WIC

The FSP is the largest Federal nutrition assistance program and one of the largest components of the Federal social safety net. An early Food Stamp Program operated during the 1930's, but it was discontinued during the Second World War. In its current incarnation, the program began in 1962. Initially, not all localities participated in the FSP, but it was extended nationwide during the early 1970's. To qualify for the program, a household must have gross income less than or equal to 130 percent of the official poverty threshold. The household must also have "net" income less than the poverty line, where net income equals gross income minus certain deductions. Finally, the household must meet restrictions on its ownership of certain assets (USDA Food and Nutrition Service, 1999).

The amount of benefits a family receives depends on its net income. If it has no net income, after deductions, the family receives the maximum food stamp benefit. This maximum benefit level equals the value of the Federal Government's "Thrifty Food Plan," which varies according to household size. If the family has some net income, its benefit level is reduced at a rate of 30 cents for every dollar of net income. The average monthly benefit in 1998 was about $71 per person.

Food stamp benefits may legally be used to purchase only food and nonalcoholic beverages. The benefits were traditionally distributed as coupons that could be used at authorized retail stores to purchase food. Currently, the FSP is switching to Electronic Benefit Transfer (EBT) systems, which dispense benefits using plastic cards similar to automatic teller machine cards.

Figure 1
The Food Guide Pyramid



Source: U.S. Department of Agriculture/U.S. Department of Health and Human Services

WIC provides food, nutrition counseling, and access to health services to low-income women, infants, and children. The program began as a pilot in 1972 and was made permanent in 1974. Pregnant or postpartum women are eligible, as are infants and children up to age 5, if they meet income guidelines and are determined to be at "nutritional risk" by a health professional. The income cutoff is 185 percent of the U.S. poverty threshold, somewhat higher than the cutoff for the FSP. The "nutritional risk" determination takes account of both medically based risks such as anemia or underweight, and diet-based risks such as an inadequate dietary pattern.

WIC participants generally receive a voucher or credit, for use in purchasing specific authorized foods selected for their nutritional content. WIC foods are high in one or more of the following nutrients: protein, calcium, iron, vitamin A, or vitamin C. WIC foods include infant formula, cereals, dairy products, peanut butter, and other foods high in the target nutrients. The WIC program also offers a substantial nutrition education program and serves as a gateway to other forms of health services (USDA Food and Nutrition Service, 1999).

Research on Nutrition Programs and Dietary Quality

In a recent article on the U.S. nutrition safety net, Eileen Kennedy observes that the major nutrition problems in the United States have changed over the last 50 years:

> Problems of over-consumption and excesses and imbalances are now, on average, more prevalent than problems of under-consumption and deficiency. For example, childhood obesity is now more common than growth retardation. This is true across all income strata, although the nutrition-related disease burden is substantially greater in low-income groups (Kennedy, 1999, p. 331).

These low-income groups are the target population for the FSP and WIC. Levedahl and Oliveira (1999) note how little is known about the effect of nutrition assistance programs specifically on dietary quality: "[T]heir effect on the quality of the recipient's diet has so far been uncertain" (Levedahl and Oliveira, 1999, p. 322).

A substantial body of applied research has attempted to measure this "uncertain" effect. The line of research pursued most frequently has been to estimate regression models, using survey data, to explain the effects of economic and demographic variables — including program participation and benefit levels — on one or more food consumption variables. Devaney and Moffitt (1991) found that food stamps have a significant and positive effect on the availability of food energy, protein, and nine micronutrients. Rose, Habicht, and Devaney (1997) found that food stamps and WIC both have positive and significant effects on iron and zinc intake for preschool children. By contrast, Butler and Raymond (1996) reported that food stamps have no positive effect on intake of several nutrients, after controlling for endogenous self-selection into the program.

In the 1990's, nutrition scientists with expertise in survey research developed a new method for measuring dietary quality using the same commonsense terms that are employed by the Federal Government in its dietary recommendations and the Food Guide Pyramid (Cleveland and others, 1997a). Krebs-Smith and others (1995) used this type of pyramid servings data to study fruit and vegetable intake. Another study, Krebs-Smith and others (1996) used such data to study food intake by children and adolescents. For adults, Cleveland and others (1997b) found that intake of each of the five main food groups increased as income increased from below 131 percent of the poverty line to 131-350 percent of the poverty line.

The one previous food assistance study that drew on these methods for measuring intake in pyramid servings was by Basiotis and others (1998). That study investigated how economic and demographic characteristics of families influence scores on the USDA's "Healthy Eating Index" (HEI) -- a measure of how well diets adhere to the Federal Government's dietary guidelines. Using data from the 1989-91 CSFII, Basiotis and others found that the HEI increased with food stamp participation if household weekly benefits exceeded $17.54. The HEI increased strongly with WIC participation.

Data and Methods

The study reviewed here and in Wilde, McNamara, and Ranney (1999) employed data from the 1994-96 CSFII. That nationally representative survey collected basic demographic information for all members of each household and used a randomization strategy to select certain members to participate in a complete food intake survey. These "sample persons" were administered two 1-day survey modules about their food intake, in each case asking them to recall all foods and beverages consumed in the preceding 24 hours. The data used in this study represent 3,642 sample persons in 1,901 households with income less than or equal to 130 percent of the poverty line. See USDA (1998) for more detail on the survey design and construction.

The detailed responses about food intake were used to construct the pyramid servings variables used in this study (USDA, 1998). The definition of a serving differs for each food group, but corresponds as closely as possible to common usage. One slice of bread is one serving in the grains group, and so forth for fruits, vegetables, and dairy. The units for the meats group are ounces of lean meat or "ounce equivalents" of meat substitutes, such as eggs or red beans. Added sugars are measured in teaspoons, and total fats are measured in grams.

The 1994-96 CSFII had several characteristics that make it suitable for addressing the three types of complications discussed in the introduction. First, because the survey asked detailed questions about actual food intake, rather than just overall food spending, it permitted investigation of how economic and demographic factors affect the composition of a whole list of food intake variables jointly. Second, because the survey reported program participation and economic variables, and also measured food intake in the same intuitive terms as the Federal Government's "Food Guide Pyramid" and dietary guidelines, this data source lends itself to interdisciplinary approaches drawing on both applied economics and nutrition. Third, because the data contain information on more than one member of many families, they permit an exploration of how food choices are similar or different for members of the same family.

The statistical model used here is a regression model with seven equations, one for each of the seven main food intake variables. It differs from the most familiar ordinary least squares regression model in the way it addresses the "random" aspects of food intake decisions — those characteristics of families and individuals that cannot be observed and explained by the analyst, and that are therefore treated as "random errors" in the statistical model. The model measures how random factors that contribute to food intake outcomes are correlated for individuals in the same families and correlated across food groups. That means, for example, that if one member of a household is more likely to consume high amounts of vegetables, other members of the same household may also consume high amounts. Likewise, if a person is particularly fond of vegetables, the same person might also tend to consume larger amounts of fruit than average. One advantage of taking account of such correlations is that it permits more precise estimates of the effects of food stamps and WIC. However, in this particular study, this gain in precision proved modest. The most important advantage of this statistical model turned out simply to be that the correlations it measures are themselves interesting.

The main explanatory variables in the model are income and two variables indicating whether anyone in the family received FSP or WIC benefits. Other explanatory variables include age, education, sex, race, ethnicity, household structure, smoking habits, homeownership, body mass index, health status, rural residence, and region of the country. Because food intake patterns change with age in a complex way, the effect of age in the model is allowed to be highly nonlinear, and the effect of income on food intake is allowed to be different for people at different ages. Moreover, food intake often does not increase in a linear way with income, so a quadratic term is included to permit the effect of income on food intake to be nonlinear.

The model produces two types of results. The first type of result is the regression parameter estimates. Because of the nonlinear specification for the age and income variables, a table of parameter estimates is not easy to interpret on its own. The most straightforward way of explaining the implications of these parameter estimates is through a simple type of simulation. In this simulation, the model's predictions are illustrated in terms of food intake for a person with "typical" characteristics — mean values of the economic and demographic variables. Then, one can illustrate how food intake would change if the person were older, for example, or if the person had higher income. Most important, one can illustrate how expected food intake patterns would change, according to the model, if the person shifted from nonparticipation in nutrition assistance programs to participation in the FSP or WIC, or both. There are more sophisticated simulations one could run, but this approach suffices to show the most important results. For those who want more detail, the complete table of the parameter estimates is available in Wilde, McNamara, and Ranney (1999).

The second type of result describes the correlations discussed above. The statistical model assumes the "random errors" that influence food intake have one component that is shared by all members of the same household, and another component that is idiosyncratic for each individual. For example, if the main food buyer for a family has a special preference for pork chops, that might show up in the household error component for the meat equation, because it affects the meat intake of each family member. On the other hand, one family member's special preference for milk at lunch might be part of the individual error component, because it is not necessarily correlated with the dairy intake of other family members. Both error components are permitted to be correlated across the seven food equations — so, for example, the family with the pork chops might also have higher intake of total fats. For each error component, cross-equation correlation coefficients show how the random factors influencing intake of each food group are correlated with those for the other food groups. A correlation coefficient of zero means two variables are uncorrelated, while a correlation coefficient of one means the two variables are perfectly correlated.

Effects of Age, Income, and Program Participation on Dietary Quality

The analysis found that age, income, and program participation had significant dietary effects. Moreover, random factors that affected food intake were indeed correlated within families and across pyramid food groups.

Age

Table 1 and figure 2 illustrate how the baseline expected level of food intake for the seven food measures varies with age and compare these levels to the recommendations.[1] Baseline intake of meats and vegetables is highest at age 30. Intake of grains, added sugars, and total fats is highest at age 16, and intake of fruits and dairy is highest at age 7. For fruits and dairy, baseline intake for all ages falls short of even the lower end of the recommended range. By contrast, for added sugars and total fats, baseline intake is quite high relative even to the recommended maximums.

Additional Income

Because of the way income and age variables are specified in the model, the effects of higher income are shown separately for several age groups (table 1, fig. 3). In this simulation, the "very low income" in the baseline case is chosen such that only one-quarter of the low-income sample is poorer (approximately $162 per person per month). "Higher income" is chosen such that only one-quarter of the low-income sample has more income (approximately $375 per person per month). For meats, added sugars, and total fats, the effect of higher income is uniformly positive and in most cases statistically significant. The greatest increases with income, relative to the baseline case, are for intake of added sugar by young people (ages 7 and 16). For the remaining pyramid categories, the income effect varies in sign and is less consistently significant, but positive effects still predominate.

Program Effects

As with income, FSP participation has a significant positive effect on meats, added sugars, and total fats (table 1, fig. 4). The corresponding effect of FSP participation for the remaining food groups varies in sign and is not statistically significant. WIC participation appears to have a positive effect on intake of fruits and dairy. However, these parameter estimates are not statistically significant. Thus, these positive results could be due to random sampling variation. The one statistically significant effect for the WIC participation variable is a negative effect on intake of added sugars.

Correlations Within Families

Finally, consider some patterns in the "random error" that the statistical model cannot explain. With regard to correlations in food intake for members of the same family, the key results may be seen in the variances of the household error component and the individual error component for each equation.[2] If there were no correlations within households — that is, if the random factors affecting food intake for two people in the same household were no more related than the factors for two people in different households — then the variance of the household error component would be near zero and the variance of the individual error component would constitute the total variance. Instead, however, the variance of the household error component is at least a third as large as the variance of the

[1]The recommended maximum for total fats in the Dietary Guidelines is expressed in terms of a proportion of total calories — 30 percent — not in terms of grams. In table 1, this recommendation is converted into a range of recommended grams of intake of total fats, using the same range of benchmark caloric intake that is used in the Food Guide Pyramid to construct the recommended ranges for the five main pyramid food categories: 1,600 calories to 2,800 calories.

[2]Not all households report food intake observations for multiple "sample persons." Some households have only one person. For other households, only one person was randomly chosen to receive the full food intake survey instrument. The statistical model is estimated using the full sample, but these results for intrahousehold correlations are fully determined by food intake patterns in just those households with more than one sample person.

Table 1—Effects of income and program participation on food intake

	Meats	Fruits	Vegetables	Grains	Dairy	Added sugars	Total fats
	Ounces	*Servings*				*Teaspoons*	*Grams*
Reference amounts	5 to 7	2 to 4	3 to 5	6 to 11	2 to 3	6 to 18	53 to 93
Baseline servings:							
Age 7	3.26	1.38	2.10	5.51	1.85	17.05	60.56
Age 16	5.05	1.24	3.24	7.54	1.65	24.52	84.31
Age 30	5.50	1.14	3.49	6.79	1.21	20.77	76.62
Age 50	5.00	1.21	3.10	6.05	1.04	14.81	68.11
With higher income:							
Age 7	+.35 *	+.08	-.06	+.16	-.02	+2.96 **	+2.84
Age 16	+.36 **	-.36 *	+.18 **	-.07	-.02	+6.32 **	+4.96 **
Age 30	+.42 **	+.14	+.16 **	+.24 **	+.15 **	+1.41 *	+6.96 **
Age 50	+.26 *	+.02 **	+.12	+.08	+.10 *	+1.10	+4.52 **
With food stamps:	+.25 *	-.06	+.10	-.02	+.07	+1.99 **	+4.00 **
With WIC	-.24	+.18	-.03	-.31	+.11	-2.36 **	-2.11

Notes: Reference amounts for meats, fruits, vegetables, grains, and dairy are target intake levels for most consumers, while reference amounts for sugars and fats are recommended maximums. In the Food Guide Pyramid, the low end of the range of recommended servings is appropriate for somebody with a diet of 1,600 calories, and the high end of the range is appropriate for somebody with a diet of 2,800 calories. Baseline servings are expected values for a person with the given age, income equal to the first quartile of the low-income sample ($162 per adult male equivalent per month), no program participation, and mean values of all other variables. Higher income equals the third quartile of the low-income sample ($375 per adult male equivalent per month). Entries for higher income and program participation are reported in comparison with the baseline case. Asterisks denote significance: * = 10-percent level; ** = 5-percent level. The test statistic is a Wald chi-square statistic with one degree of freedom in the case of the food stamp and WIC parameters and two degrees of freedom in the case of the income parameters (which include a quadratic term).

Data source: Continuing Survey of Food Intakes by Individuals, 1994-96.

individual error component in each equation (table 2). This result implies that the household error component, which represents unobserved random factors that are shared by members of the same household, contributes substantially to the unexplained random variation in food intake overall.

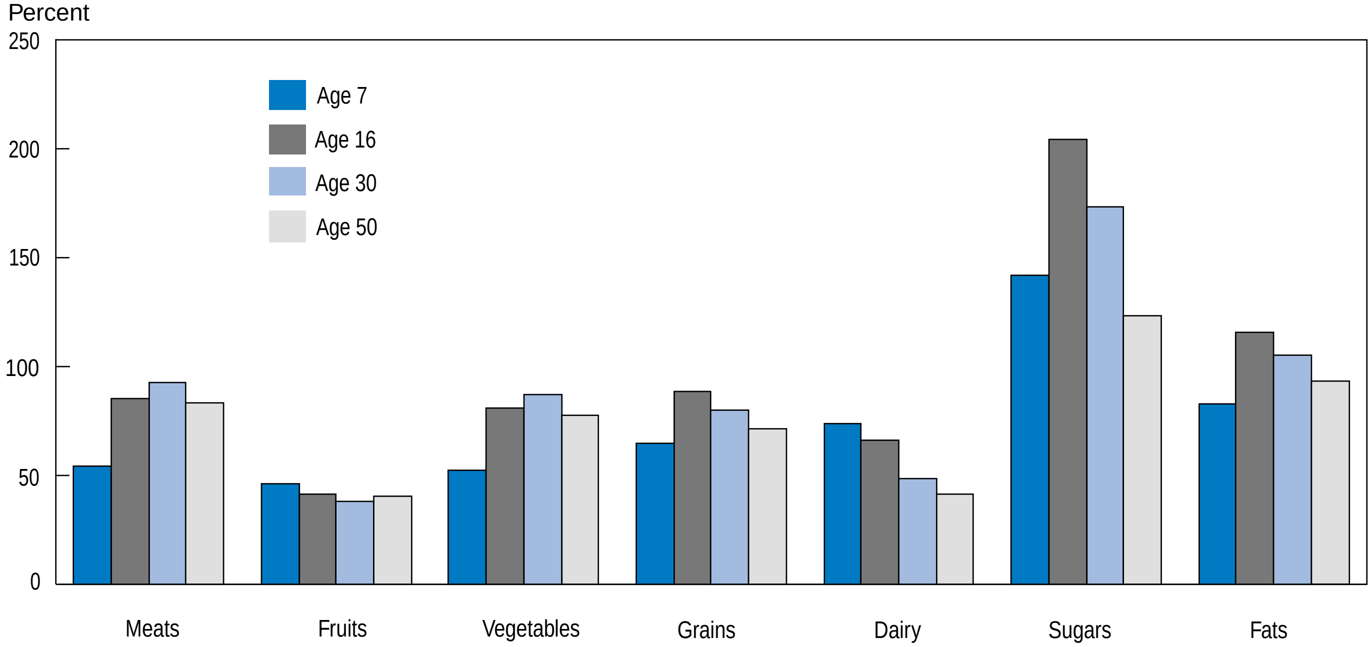
Correlations Across Food Groups

With regard to correlations across food groups, the most striking contrast is between the cross-equation correlations for total fats and for fruits (table 2).[3] For both the household and the individual error components, the three largest correlations are in the total fats column. The error components for total fats appear to be strongly correlated with those of every category except fruits. Thus, a household with higher intake of total fats (above the level that one would expect based on its observed characteristics) tends also to have higher intake from these categories. On the other hand, for both the household and the individual error components, the three smallest correlations are all found in the fruits category. The random error for intake of fruits is quite independent of the random error for intake of the other food categories. This means that a household with higher intake of fruits (above the level that one would expect based on its observed characteristics) does not tend in general to have either higher or lower intake from these categories.

[3]These correlations are computed from the variance-covariance matrices for the household and individual error components, across all seven equations. The variance-covariance matrices are reported in appendix table 1, and the corresponding estimated standard errors are reported in appendix

Figure 2

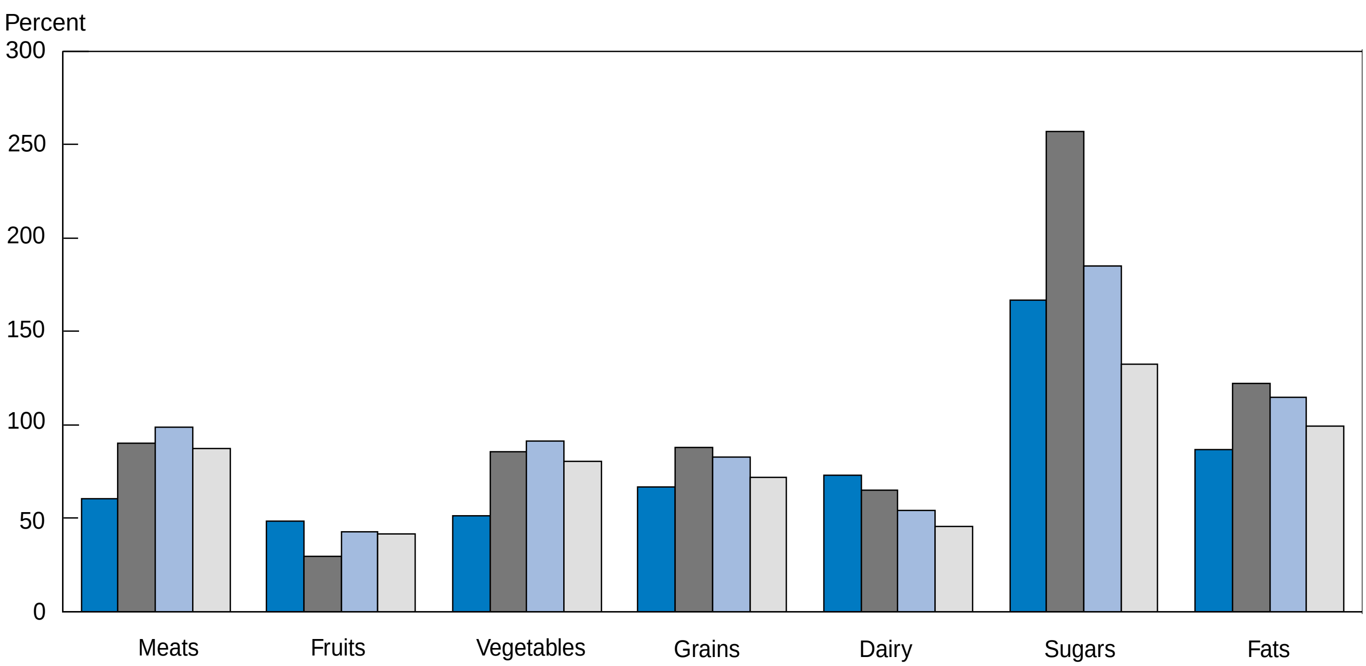
Predicted food intake for individuals with very low (baseline) income



Note: Each column represents food intake as a proportion of the midpoint of the recommended range.
Data source: Derived from table 1. Continuing Survey of Food Intakes by Individuals, 1994-96.

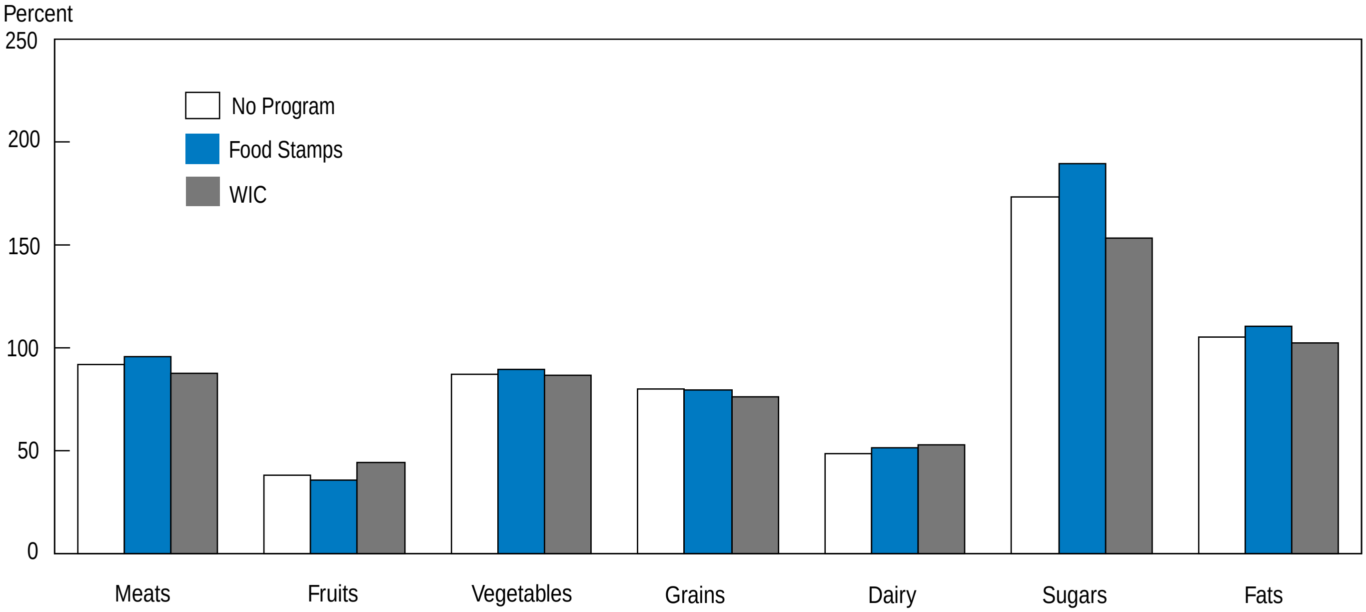
Figure 3

Predicted food intake for individuals with "higher" income



Note: Each column represents food intake as a proportion of the midpoint of the recommended range.
Data source: Derived from table 1. Continuing Survey of Food Intakes by Individuals, 1994-96.

Figure 4
Predicted food intake for adult nonparticipants and participants in food and nutrition programs



Note: Each column represents food intake as a proportion of the midpoint of the recommended range.
Data source: Derived from table 1. Continuing Survey of Food Intakes by Individuals, 1994-96.

Implications for Nutrition Assistance Programs

This study finds that FSP and WIC participation have substantially different implications for dietary quality. Like increased income, FSP participation permits low-income households to purchase greater amounts of food. For three of the seven categories — meats, added sugars, and total fats — intake increases significantly with FSP participation. These results are encouraging to the extent that some low-income households may be short of food and need the additional calories and other nutrients from these categories. The results are less encouraging to the extent that public policy is concerned about program effects on the composition of the dietary bundle for low-income families, beyond the problem of simply having sufficient food. The two categories where intake falls most short of the recommendation — fruits and dairy — do not appear in this study to respond significantly to FSP participation, although in the case of dairy there is a small and statistically insignificant estimated positive impact. Meanwhile, intake of the two categories that most directly represent excess consumption and/or poor dietary quality — added sugar and total fats — does appear to increase significantly with FSP participation.

WIC participation is associated with significantly lower intake of added sugars, which makes sense if WIC-authorized fruit juices and cereals substitute for colas and sweet cereals. For the other categories, the effect of WIC participation is not significantly different from zero, which may reflect the imprecision of measuring WIC effects with this model and this data source rather than a true lack of effect. Though they could be due to sampling variation, the positive signs for WIC's effects on fruit and dairy intake appear reasonable.

Income and program participation are not the only factors that affect food intake. Indeed, the whole list of economic and demographic variables is capable of explaining only a portion of the diversity in food intake that one observes in real-world data. A distinctive feature of the present study is its investigation of patterns in the distribution of these other factors — the "random error" in statistical terminology.

The results suggest a substantial correlation in the random error for individuals in the same household. One interpretation of this finding — though not the only possible interpretation — would suggest that decisions at the household level go a long way toward determining food intake by household members. If household decisions are important, then nutrition education efforts might be advised to focus especially on the

Table 2—Estimated variances and cross-equation correlations for error components

	Meats	Fruits	Vegetables	Grains	Dairy	Added sugars	Total fats
Variance for individual and household error components:							
Individual component	5.20 **	1.77 **	2.97 **	6.75 **	.93 **	1.25 **	8.10 **
(Standard error)	.17	.06	.10	.22	.03	.04	.26
Household component	2.22 **	.77 **	1.15 **	2.78 **	.36 **	.51 **	2.75 **
(Standard error)	.19	.07	.11	.24	.03	.04	.28
Correlation matrix for individual error component:							
Meats	1.00	.04	.32	.34	.15	.17	.65
Fruits	.04	1.00	.06	.06	.05	.07	.07
Vegetables	.32	.06	1.00	.24	.11	.14	.47
Grains	.34	.06	.24	1.00	.27	.30	.61
Dairy	.15	.05	.11	.27	1.00	.15	.46
Added sugars	.17	.07	.14	.30	.15	1.00	.35
Total fats	.65	.07	.47	.61	.46	.35	1.00
Correlation matrix for household error component:							
Meats	1.00	.06	.15	.09	-.10	.12	.44
Fruits	.06	1.00	.26	.05	.14	-.10	.01
Vegetables	.15	.26	1.00	.18	.08	.17	.33
Grains	.09	.05	.18	1.00	.23	.43	.56
Dairy	-.10	.14	.08	.23	1.00	.15	.34
Added sugars	.12	-.10	.17	.43	.15	1.00	.53
Total fats	.44	.01	.33	.56	.34	.53	1.00

Notes: Each entry in a correlation table takes a value between -1 and 1. An entry of zero means that the error component referenced in the column heading is uncorrelated with the component referenced in the row heading. An entry of 1 means that the two components are perfectly correlated (as is the case automatically for the correlation between any variable and itself). Asterisks denote whether the variances of the individual and household error components are significantly different from zero: * = 10-percent level; ** = 5-percent level. The test statistic is a Wald chi-square statistic with one degree of freedom. Standard errors for the cross-equation correlations are available in the appendix.

Data source: Continuing Survey of Food Intakes by Individuals, 1994-96.

principal food purchaser or food preparer in the household. On the other hand, if individual decisions dominate, then nutrition education efforts may have to reach each household member to be effective, perhaps at greater expense to the program.[4]

What are the implications of the large positive observed correlations between total fats and the five main pyramid food categories, except fruits? One could argue that over-consumption from these categories is not a major concern. Intake from the main pyramid categories is not higher than the recommended range, assuming that under-reporting is not too severe. Moreover, consumers may in principle reduce consumption of total fats without reducing the number of servings in these main pyramid food categories, by choosing smaller amounts of discretionary fats (for example, by choosing leaner meats). This possibility is reflected in the HEI, which measures over-consumption of fats through components for fats and saturated fats, but which defines components for the five main

[4]See Bradbard and others (1997) for an interesting discussion of how parents (the principal food shoppers) respond to the food tastes of their children in selecting foods for the household: "Respondents in all ethnic groups agreed it does not make sense to purchase food that children will not eat" (Bradbard and others, 1997, p. 7).

pyramid food groups to measure only under-consumption, not over-consumption. However, the cross-equation correlations between total fats and the main pyramid food groups, except fruits, do raise the reasonable concern that nutrition education efforts may have a difficult time achieving lower intake of total fats without focusing also on consumption from the main pyramid food categories. In evaluating nutrition assistance programs, even for low-income Americans, it may be important to monitor both under-consumption and over-consumption of most of the major pyramid food categories, even though the best current survey evidence indicates that intake from these categories is not excessive on average.

Nutrition monitoring and nutrition education are both major priorities for the U.S. Department of Agriculture, and this emphasis has implications for nutrition assistance programs. As Kennedy concluded in her survey of public policy in nutrition, "Aggressive nutrition promotion programs need to be built into the food assistance and nutrition programs to increase the likelihood of sustained effectiveness. Newer paradigms of education including the use of social marketing need to be woven into the development of nutrition promotion programs" (Kennedy, 1999, p. 332). This study provides some background information for building this type of nutrition promotion emphasis into food assistance and nutrition programs.

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Appendix table 1—Estimated variance-covariance matrices for error components

	Meats	Fruits	Vegetables	Grains	Dairy	Added sugars	Total fats
Individual error component:							
Meats	5.196*	0.130	1.263*	1.999*	0.329*	0.444*	4.196*
Fruits	.130	1.768*	.130*	.224*	.069*	.098*	.254*
Vegetables	1.263*	.130*	2.973*	1.083*	.175*	.262*	2.311*
Grains	1.999*	.224*	1.083*	6.746*	.686*	.875*	4.477*
Dairy	.329*	.069*	.175*	.686*	.928*	.157*	1.268*
Added sugars	.444*	.098*	.262*	.875*	.157*	1.250*	1.115*
Total fats	4.196*	.254*	2.311*	4.477*	1.268*	1.115*	8.098*
Household error component:							
Meats	2.218*	.079	.232*	.216	-.087	.128	1.097*
Fruits	.079	.769*	.246*	.069	.075*	-.062	.010
Vegetables	.232*	.246*	1.153*	.321*	.052	.127*	.585*
Grains	.216	.069	.321*	2.783*	.227*	.515*	1.559*
Dairy	-.087	.075*	.052	.227*	.356*	.062*	.341*
Added sugars	.128	-.062	.127*	.515*	.062*	.507*	.625*
Total fats	1.097*	.010	.585*	1.559*	.341*	.625*	2.748*

Notes: Asterisks denote significance: * = 5-percent level, two-tailed test. The test statistic is the absolute value of the variance-covariance in appendix table 1, divided by the corresponding estimated standard error in appendix table 2.

Data source: Continuing Survey of Food Intakes by Individuals, 1994-96.

Appendix table 2 -- Standard errors of estimated variance-covariance matrices for error components

	Meats	Fruits	Vegetables	Grains	Dairy	Added sugars	Total fats
Individual error component:							
Meats	0.169	0.071	0.095	0.142	0.051	0.059	0.176
Fruits	.071	.059	.054	.080	.030	.034	.088
Vegetables	.095	.054	.098	.105	.039	.045	.124
Grains	.142	.080	.105	.217	.059	.069	.197
Dairy	.051	.030	.039	.059	.030	.025	.069
Added sugars	.059	.034	.045	.069	.025	.040	.077
Total fats	.176	.088	.124	.197	.069	.077	.262
Household error component:							
Meats	.191	.081	.104	.156	.056	.066	.185
Fruits	.081	.069	.062	.091	.034	.039	.097
Vegetables	.104	.062	.109	.116	.043	.050	.131
Grains	.156	.091	.116	.240	.065	.078	.211
Dairy	.056	.034	.043	.065	.033	.027	.073
Added sugars	.066	.039	.050	.078	.027	.044	.086
Total fats	.185	.097	.131	.211	.073	.086	.275

Data source: Continuing Survey of Food Intakes by Individuals, 1994-96.