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.

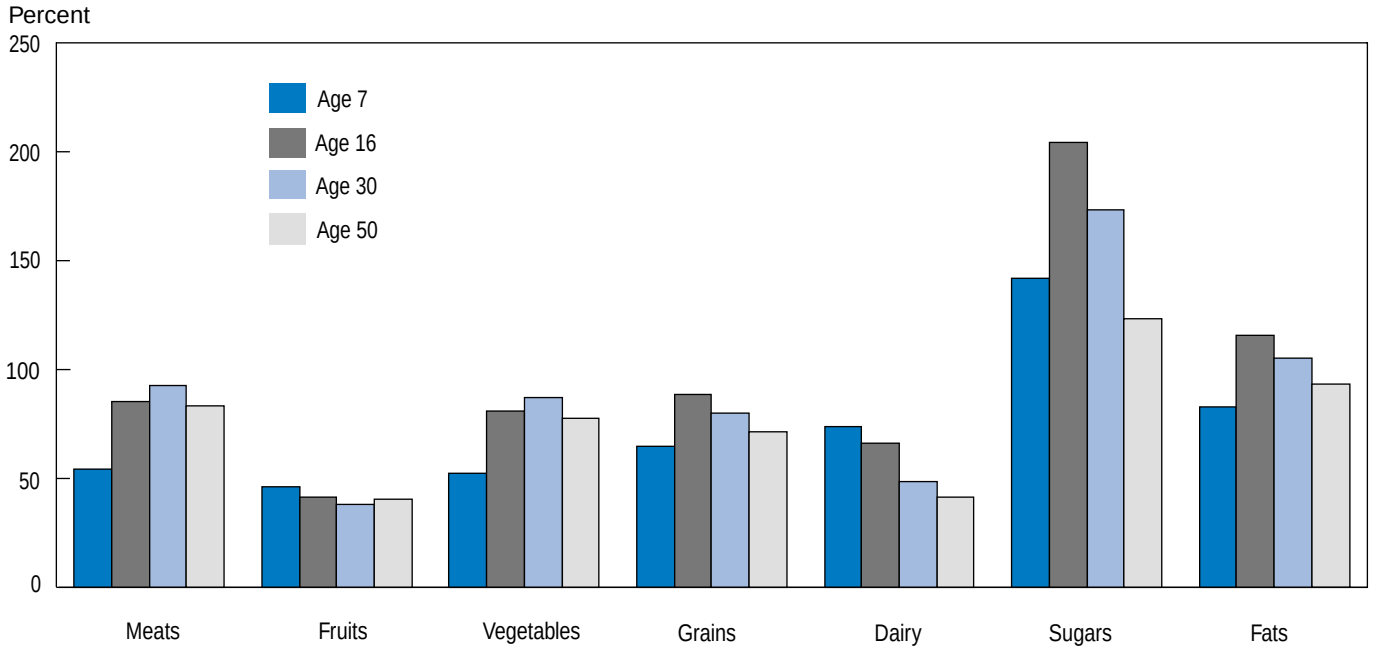
Correlations Across Food Groups

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

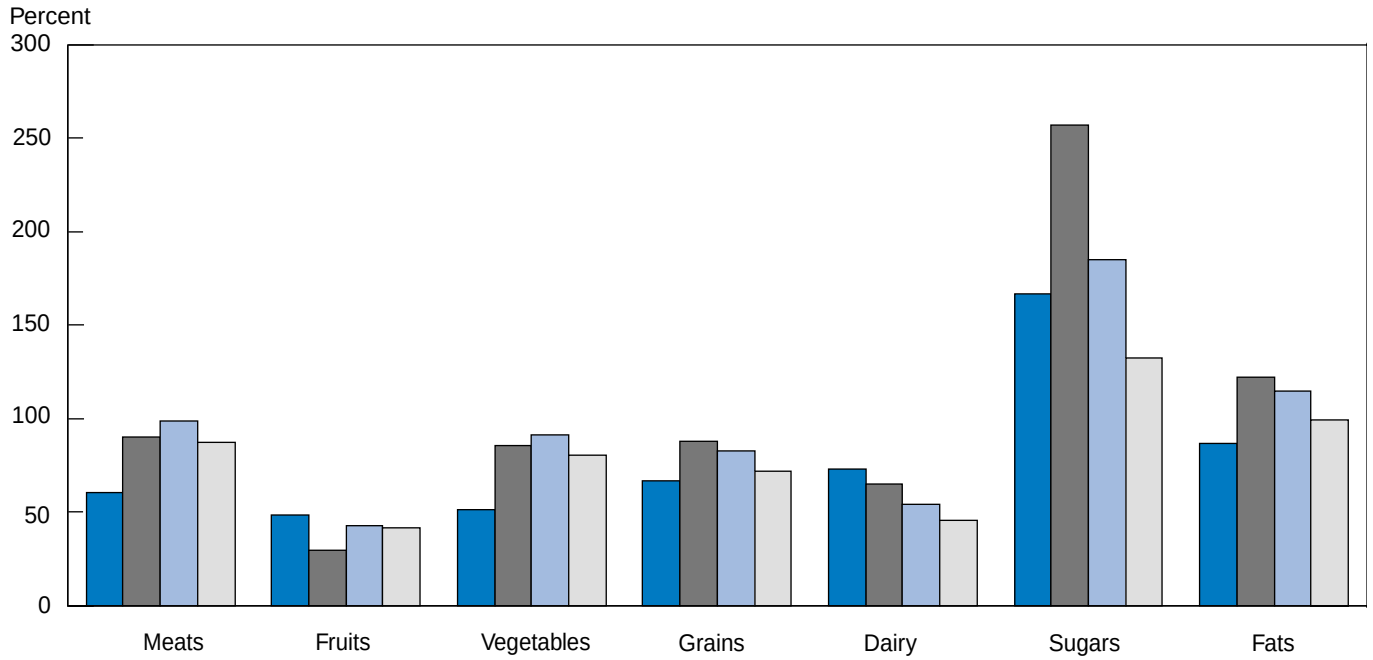
Predicted food intake for individuals with very low (baseline) income



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.