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# Folate Intake by Women of Child-Bearing Age: The Impact of Fortification

## Nutrition Insight 30

In 1994-95, 50 to 75 percent of men and 75 to 90 percent of women, depending on age, had usual intakes of folate below their folate requirement (Institute of Medicine, 1998). In 1998, folate fortification of enriched breads, breakfast cereals, pasta, rice, and flour became mandatory. This policy was established by the Food and Drug Administration to increase folate intake among women of child-bearing age and thereby to reduce the incidence of neural tube defects in newborns.

One of the key recommendations of the *Dietary Guidelines for Americans 2005* applies to women of child-bearing age who may become pregnant and those in the first trimester of pregnancy: "Consume adequate synthetic folic acid daily (from fortified foods or supplements) in addition to food forms of folate from a varied diet." Good sources of the food forms, or naturally occurring forms, of folate include dark-green vegetables, such as broccoli, romaine lettuce, spinach, and other dark leafy greens; dried peas and beans, such as those used in baked beans and black-eyed peas; citrus fruits and juices; peanuts; and liver.

The purposes of this research were to determine (1) the proportions of low- and higher income women of child-bearing age having folate intakes below their requirements and (2) if low-income women, compared with higher income women, get a greater proportion of their total folate intake from synthetic folic acid, which is used in fortified foods. We were interested in learning whether or not the fortification policy benefits low-income women more than it does higher income women.

### How the Data Were Collected and Analyzed

We used 1-day food intake data from the 1999-2002 National Health and Nutrition Examination Survey (NHANES) in our study. The subjects were 1,921 low-income women, age 14 to 50 years, who had household incomes less than 185 percent of the Federal poverty level and were not pregnant or breast-feeding; and 2,814 higher income women of the same age, also not pregnant or lactating. Because we wanted to estimate the distribution of usual, or long-run average, folate intakes, we needed to remove day-to-day variation in diets (Guenther, Kott, & Carriquiry, 1997). For that purpose, we used intake information from 2,947 women of the same age who were participants

in the 1994-96 USDA Continuing Survey of Food Intakes by Individuals (CSFII).

The 1999-2002 food intake data were collected in mobile examination centers by interviewers who asked each subject to recall everything he/she had eaten and drunk the previous day. The 1994-96 data were collected in the respondents' homes by interviewers collecting the same type of information on dietary intake for 2 nonconsecutive days.

The nutrient database used in the 1999-2000 NHANES contained only total folate, measured in micrograms (mcg). The USDA Food and Nutrient Database for Dietary Studies (FNDDS), version 1, was used to code the 2001-2002 data. It contains total folate (both as mcg and as mcg of dietary folate equivalents [DFE]), naturally occurring folate (mcg), and the synthetic form of folate, folic acid (mcg), which is used in food fortification. Because the synthetic form has greater bioactivity, we multiplied the folic acid values (mcg) by 1.7 to convert them to DFE.

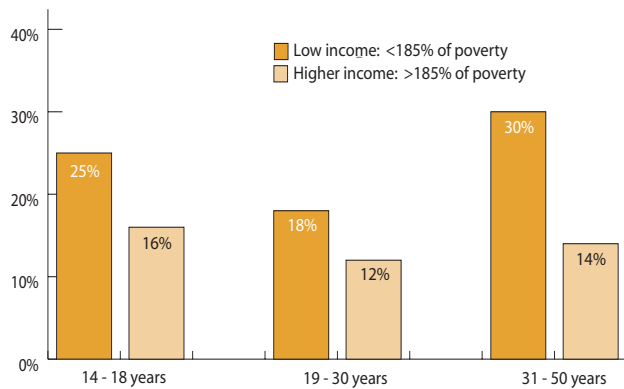
We linked the food codes used in coding the food intakes reported in 1999-2000 to the nutrient values for those same codes found in the FNDDS. For the food codes used in the 1994-96 and 1999-2000 surveys, but not in 2001-2002, we found the best matches and linked to those.

Our estimates for the population are weighted to account for the survey sample designs and non-response. We estimated the percentage of the age-income groups having usual intakes of total folate below their estimated average requirement (EAR) by using the method developed at Iowa State University (C-SIDE, version 1.02, Iowa State University Statistical Laboratory, Ames). The software allows importing within-person variances from an external source, in this case the CSFII. We determined the differences in intake between income groups by using analysis of variance (WesVar, version 4.2).

### Results

Because food choices vary by age and the estimated average requirements also vary somewhat by age (330 mcg for 14- to 18-year-old girls and 320 mcg for 19- to 50-year-old women),

**Figure 1. Estimated percentage of women of child-bearing age having usual total folate intakes below their estimated average requirement, by household income level, United States, 1999-2002**



we divided our subjects into three age groups: 14-18 years, 19-30, and 31-50. Fewer higher income women, compared with low-income women, failed to have usual intakes of folate that met their estimated average requirement (fig. 1). Only 12 to 16 percent of higher income women, depending on age, failed to meet their requirements; whereas, 18 to 30 percent of low-income women had inadequate intakes.

In general, higher income women, compared with low-income women, also had higher average daily intakes of total folate and of both the naturally occurring and the synthetic forms (table 1). However, the differences that were statistically significant between income groups were mixed. For total folate, the higher income teenage girls had intakes that were 21 percent higher than those of the low-income girls. Among the oldest group of women, the intakes of total folate by higher income women were 14 percent higher than by the low-income women. For natural folate, the intakes by higher income women age 19 to 30 and 31 to 50 were 22 to 23 percent higher than by low-income women of the same age. For synthetic folic acid, the differences by income were found only among the teenage girls with the higher income girls having intakes that were 31 percent higher than those of the lower income girls. This difference resulted in the higher income teenage girls getting a slightly greater proportion of their total folate from the synthetic form.

## Conclusions

The amounts and sources of folate (from fortification and from naturally occurring folate) by income level illustrate the important role of fortification in the diets of both low-income

**Table 1. Estimated mean daily intakes of total folate, natural folate, and synthetic folic acid and mean daily proportions of total folate coming from folic acid, women of child-bearing age, United States, 1999-2002**

Age (years)	Total folate (DFE)		Natural folate (DFE)		Synthetic folic acid (DFE)		Folic acid/total folate (%)	
	Income level							
	Low	Higher	Low	Higher	Low	Higher	Low	Higher
14-18	439*	533*	146	148	293*	383*	61.7*	64.8*
19-30	459	516	150*	185*	304	329	61.2	58.6
31-50	430*	492*	171*	208*	258	282	53.7	52.0

Excludes pregnant and lactating women.

\*Intakes by higher income women are significantly different from those of low-income women within age groups ( $p < .05$ ).

and higher income women of child-bearing age. However, since many women still have folate intakes below their estimated requirements, fortification alone may not be responsible for the recent decline in neural tube defects (Mills & Signore, 2004). Although information on amounts of folic acid that our subjects received from supplements is not available, we believe that public health efforts to encourage use of folic acid supplements also are likely to have contributed to folate intake.

## References

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