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Neural Tube Defects: Knowledge and Preconceptional Prevention Practices in Minority Young Women

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ABSTRACT. *Objective.* To assess 1) knowledge of neural tube defect (NTD) prevention by folic acid, 2) frequency of intake of multivitamins and folate- and folic acid-fortified food, and 3) factors associated with knowledge and prevention practices among sexually active minority adolescent and young adult women.

Methods. Young minority women were enrolled in a folic acid program at 3 urban Houston, Texas, reproductive health clinics and assessed for NTD knowledge and preventive practices. A 3-month supply of multivitamins was also dispensed at enrollment. A 3-month program follow-up survey of a randomly selected sample at 2 sites was conducted.

Results. Of 387 women (mean age: 18 ± 1.9 years), 72% were black and 28% were Hispanic. At enrollment, clinics were a major source of information of NTD prevention (44%); 52% had heard of folic acid, 45% had heard of NTDs, and 50% had heard of birth defects prevention by multivitamins. Significantly more Hispanic than black young women had heard of NTDs (59% vs 39%). Pregnancy history, regular birth control use, and education level for age were independently associated with knowledge. In young women with low education level for age, regular birth control use was significantly associated with knowledge. At enrollment, daily multivitamin intake was very low (9%) and folate-rich foods were consumed in inadequate amounts. Adequate folate diet was not associated with knowledge. The program follow-up survey indicated that 88% to 92% had knowledge of NTDs and folic acid, and 67% reported taking a daily multivitamin.

Conclusions. Publicly funded clinics may be the only source of information on NTD prevention for many minority young women. Preliminary evidence suggests that a promotion program improves knowledge, and dispensing of multivitamins increases multivitamin use. However, clinicians in such programs need to reinforce daily adherence to multivitamins in young women. *Pediatrics* 2003;112:536–542; *neural tube defects, spina bifida, folic acid, folate.*

ABBREVIATIONS. NTD, neural tube defect; SB, spina bifida; OR, odds ratio; CI, confidence interval.

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Folic acid deficiency is linked to the development of neural tube defects (NTDs), including spina bifida (SB) and anencephaly. Although a complex cause exists with regard to a folic acid deficiency state versus a genetically based error in folic acid metabolism, folic acid supplementation during the preconception period has been found to reduce significantly the occurrence of NTDs.^{1–5} In 1992, the US Public Health Service recommended that to achieve the desired level of folic acid, women of childbearing age and women who were capable of becoming pregnant should consume 400 µg of folic acid per day.⁶ Also, because more than half of all pregnancies in the United States are unplanned and NTDs develop before most women know that they are pregnant, it is recommended that women consume this amount routinely in the form of 1 multivitamin per day.⁶ In addition, the US Public Health Service has recommended that women consume foods fortified with folic acid and increase their consumption of foods rich in naturally occurring folate compounds.⁶ Since 1992, the US Public Health Service recommendations have been endorsed by the Institute of Medicine, American Academy of Pediatrics, and American College of Preventive Medicine.^{7–9}

Between 1996 and 1997, SB and anencephaly affected 4.46 cases per 100 000 live births in Texas; Hispanics were at greatest risk for NTDs.¹⁰ These published rates are considered to be spuriously low as they do not include fetal deaths or elective terminations before 20 weeks' gestation. Because Texas has been identified as a region with a high prevalence of NTDs, folic acid promotion programs in the region are important.^{10,11}

Regardless of the method chosen to increase folic acid intake, the challenge facing medical and public health professionals is to improve knowledge and the prevention of NTDs in women of childbearing age. In addition because 78% of 15- to 19-year-old young women and 59% of 20- to 24-year-old women who become pregnant report an unintended pregnancy, it is a challenge to change the habits of women who might get pregnant to take a multivitamin daily and increase folate- and folic acid-fortified food intake.¹²

Several studies describing knowledge and behavior of NTD prevention have been reported among pregnant and nonpregnant women of childbearing age.^{13–17} A 1998 telephone Gallup survey of women 18 to 45 years of age in the United States found that

awareness was lowest among women younger than 24 years (50%), and only 13% knew that folic acid helped to prevent birth defects.¹⁵ There are limited data, however, on knowledge and behavior of NTD prevention in nonpregnant, sexually active adolescent and young adult women in the United States. A recent study found that 29% of white adolescents in a Utah public high school were aware that folic acid is recommended to prevent birth defects.¹⁸ Factors that influence women's knowledge include a history of pregnancy, older age, and a high school or higher educational level.^{17,19-23} Being Spanish speaking is associated with less awareness of prevention of NTDs by folic acid.²³

Despite the increasing awareness of NTD prevention in young women, studies report that <20% of nonpregnant women younger than 25 years take a daily multivitamin.¹³⁻¹⁷ Only 2.5% of Mexican-American women of all reproductive ages along the Texas-Mexico border with NTD-affected pregnancies and 2% with history of normal live births reported daily preconceptional multivitamin supplementation.²⁴

Studies assessing intake of folate- and folic acid-fortified foods indicate that folic acid consumption patterns are influenced by a variety of factors. It has been estimated from the 1994 Continuing Survey of Food Intake that the dietary intake of folate is inadequate in adolescents, and those with the poorest dietary quality are those least likely to use supplements.²⁵ Dietary patterns often reflect poor intake of naturally occurring food folate, such as fruits and vegetables. National surveys demonstrate that only 23% of girls ages 12 to 19 eat 2 servings of fruit per day and that 38% of girls eat at least 3 servings of vegetables per day.²⁵ Data from the 2001 Youth Risk Behavior Surveillance Survey indicates that fewer than 20% of girls in grades 9 to 12 ate at least 5 servings of fruit and vegetables during the week preceding the survey.²⁶ The purpose of this study is to assess 1) knowledge of NTDs and prevention by folic acid, 2) intake of a daily multivitamin and folate- and folic acid-fortified food, and 3) factors associated with knowledge and prevention practices among sexually active minority young women.

METHODS

Study Population and Procedure

The population included low-income adolescent and young adult women between 13 and 22 years of age. These adolescent and young adult women were seeking free and confidential services between 1999 and 2000 at 1 of 3 reproductive health clinics in a large city in Texas. Clinic services were supported by state funds, including Titles X, XIX, and XX. Participants were approached for voluntary participation by the health educator of a folic acid promotion program.

Folic Acid Promotion Program

A folic acid promotion program was implemented between 1999 and 2000 at 3 clinics. The ultimate goal of the program was to reduce the prevalence of SB/NTDs by primarily promoting daily multivitamin intake and secondarily improving consumption of folate- and folic acid-fortified foods in young women who seek services. The program was implemented at the sites in sequence by a trained health educator who first spent 6 months at the hospital-based clinic, followed by 5 months at a community-based

clinic and 4 months at another community-based clinic. The hospital-based clinic was open 4 half days a week, and the community clinics were open 3 full days a week. To maintain the same number of sessions at all sites, the health educator implemented the program 4 sessions a week at each site. At the community clinics, this was accomplished by selecting 4 of 6 sessions using a random-numbers table.

After clinic registration, young women were consecutively seen and written consent was obtained from those who were interested in participating in the program. English-speaking young women were then asked to complete an assessment questionnaire. The questionnaire assessed a young woman's baseline knowledge of NTDs, NTD prevention by folic acid, source of information, current intake of daily multivitamin, and frequency of folate- and folic acid-fortified food intake. The responses on the assessment questionnaire assisted the health educator with providing immediate and personalized education on NTDs, prevention of NTDs by folic acid, the importance of taking 1 daily multivitamin supplement, and increasing consumption of folate- and folic acid-fortified food. When a young woman indicated interest in taking a daily multivitamin, a 3-month supply of multivitamin tablets was given to her by the nurse.

Assessment Questionnaire

The responses provided in the assessment questionnaire form the basis of this study. The questionnaire included items such as demographic information (age, race/ethnicity, and highest grade completed), sexual activity in the previous 3 months, pregnancy history, and contraceptive use. Questions to assess knowledge and prevention practices of NTDs were developed by the investigators and pilot-tested for face validity with 10 young women before starting the program (Table 1). Questions used in previously reported Centers for Disease Control and Prevention surveys were used to guide development of the questions on awareness of birth defects such as SB or NTDs.¹⁵ Responses to demographic items were obtained directly from the young women. Questions pertaining to sexual activity in the previous 3 months, contraceptive use, knowledge of birth defects such as SB or NTDs, and knowledge of prevention of birth defects were closed ended with nominal or categorical (yes or no) responses. Questions pertaining to reasons for taking or not taking multivitamins were closed ended with ordinal responses.

The assessment questionnaire also included a 29-item food-frequency questionnaire to assess the frequency of adequate folate/folic acid-fortified food intake. The frequency of foods consumed was assessed using a Likert scale of "none," "less than once a week," "once a week," "2 to 3 times a week," "4 to 6 times a week," and "every day" for each food item. The food-frequency questionnaire was developed and piloted at the first implementation site by determining frequently consumed foods from this population and researching names of poor to rich folate/folic acid-fortified foods from standard references.^{27,28} The categorization of the definition of a folate/folic acid-poor, -good and -rich food was based on the Nutrition Facts label on food products or the Supplement Facts label on vitamins. To claim that adequate food folate/folic acid may reduce the risk of NTDs, a product must have 10% or more (40 µg) of the daily value for folic acid. A good source of food folate/folic acid is 10% to 19% of the daily

TABLE 1. Assessment Questionnaire for the Folic Acid Promotion Program

1. Do you have multivitamins at home for yourself? Yes or no
2. Do you take daily multivitamins?
If yes, please give reasons for taking multivitamins.
If no, please give reasons for not taking multivitamins.
3. Have you ever heard that taking multivitamins before or after conception/pregnancy can prevent birth defects in babies?
Yes or no
4. Have you ever heard of folic acid or folate? Yes or no
5. Have you ever heard of birth defects called spina bifida or neural tube defects in babies? Yes or no
6. Where did you learn about birth defects called spina bifida or neural tube defects and how to prevent them?
7. Are you interested in taking a daily multivitamin pill to prevent birth defects? Yes or no

value and high/rich source of food folate/folic acid is >20% (80 µg) of the daily value for folic acid.²⁹ The tool did not assess for number of servings per day if “every day” was checked.

On the basis of these definitions, the food items were categorized into folic acid/folate-poor (<40 µg folate/serving) foods, folate-good (40–79 µg folate/serving), and folate-rich (>80 µg folate/serving). However, using this definition, some grain-based foods, although fortified, may be categorized as a poor source of folate/folic acid per serving. For example, bread that contains 23 to 38 µg of folate/folic acid may contribute significantly to total daily intake only if multiple servings are consumed.²⁹ Folate/folic acid-poor foods listed in the food-frequency questionnaire were bananas, chili without beans, broccoli, milk, yogurt, eggs, white bread, whole wheat bread, corn meal, corn bread, rice, peanuts, grits, and oatmeal. Folate/folic acid-good foods were oranges and greens; and folate/folic acid-rich foods listed were orange juice, avocados, beans, spinach, asparagus, black-eyed peas, liver, macaroni, spaghetti, burritos, enchilada, flour, and cereal.

Assessment of Adequate Folate-Food Intake

For the purposes of this study, the investigators defined adequate folate-food intake as consuming at least 1 folate-rich food at least 4 to 6 times a week. “Inadequate” intake was defined as consuming at least 1 folate-high/rich/excellent food fewer than 2 to 3 times a week. The investigators based the definition of adequate folate/folic acid-food intake on a Framingham study that found that the consumption of folate-rich foods (cereal and 5 servings of fruits and vegetables a day) an average of 6 times a week in the elderly was associated with higher plasma folate levels as compared with less frequent consumption or nonconsumers.³⁰

Follow-up Assessment of Knowledge and Prevention Practices

As part of program evaluation but not a primary aim of the study, a telephone follow-up survey of young women of all racial/ethnic groups was conducted 3 months into implementation of the program at 2 sites, the hospital-based clinic and the second community-based clinic. As a result, the duration of enrollment of the young women at the time of the follow-up survey varied. The follow-up survey was conducted by first randomly selecting (using a random-numbers table) approximately 25% of young women of all racial/ethnic groups. Initial contact was made by letter; a telephone interview followed. The telephone survey questions were not the same as the questions asked at baseline. Multiple-choice questions were administered to assess young women’s depth of knowledge of NTDs and NTD prevention; open-ended questions were administered to assess reasons for and against taking a daily multivitamin.

Data Analysis

Data were entered into SPSS 10.0 for Windows and analyzed using SAS-PC. Frequencies were calculated for demographic, reproductive health information, knowledge of SB/NTDs, knowledge of prevention of birth defects by daily multivitamins, and current multivitamin use. To assess the impact of education, a grade level-appropriate to current age variable was created. The variable was nominal to indicate appropriate grade, yes or no, and defined as follows: if current age was 10 to 11 years, then the

young woman should have completed at least grade 5; 11 to 12 years, at least grade 6; 12 to 13 years, at least grade 7; 13 to 14 years, at least grade 8; 14 to 15 years, at least grade 9; 15 to 16 years, at least grade 10; 16 to 17 years, at least grade 11; 17 to 18 years, at least grade 12 or GED.

χ^2 analysis was used to investigate the relationship between demographic, reproductive characteristics with knowledge of NTDs, and folate-food consumption. Variables significantly associated with knowledge of NTDs in the univariate analyses as well as their 2-way interaction terms were included in the logistic regression models to assess multivariate influences on the primary outcomes. Separate models were created for each knowledge outcome. Backward elimination was used for model selection with exclusion of variables at $P = .1$ or greater. The goodness-of-fit statistic was used to determine whether the null hypothesis that the model provided a good fit to the data should be accepted or rejected. The Baylor College of Medicine Institutional Review Board for Human Subjects approved implementation of the folic acid program.

RESULTS

Of 481 sexually active nonpregnant young women approached, 434 (90%) consented to participate in the folic acid program and completed assessment questionnaires. Of 434 young women, 286 (66%) were black, 112 (25%) were Hispanic, 22 (5%) were white, 13 (3%) were other, and 1 (<1%) was Asian. Because of the small number of white, other, and Asian groups, the focus of this report is knowledge and preventive practices of minority young women of black (278) and Hispanic origin (109) with complete data ($N = 387$).

Demographic and Reproductive Health Characteristics

Of 387 minority young women enrolled, 173 (44%) were seen at the hospital-based clinic, and 144 (39%) and 70 (17%) were seen at the 2 community-based clinics, respectively. The young women were predominantly single (93%), 72% were black, and 28% were Hispanic. The mean age was 18 (± 1.9) years. Significantly more black young women were likely to be single than Hispanic young women (98% vs 81%; $P = .001$). Grade-level appropriate for current age was reported by 58.5% of the sample. A previous pregnancy was reported by 43%, sexual activity in the previous 3 months by 86%, and regular birth control use by 57%. Significantly more black young women reported a history of regular birth control compared with Hispanic young women (60% vs 49%; $P < .05$; Table 2).

TABLE 2. Reproductive Characteristics and Knowledge of Folic Acid, SB, and NTDs in Young Women

Characteristics	Total ($N = 387$; n [%])	Black ($N = 278$; n [%])	Hispanic ($N = 109$; n [%])
History of pregnancy	165 (43)	111 (40)	54 (49)
History of regular birth control	220 (57)	167 (60)	53 (49)*
Sexual activity in previous 3 mo	333 (86)	239 (86)	94 (86)
Heard of folic acid	201 (52)	144 (52)	57 (52)
Heard of SB and NTDs	173 (45)	109 (39)	64 (59)†
Heard BDs preventable by multivitamins	195 (50)	136 (49)	59 (55)

BD indicates birth defects.

* $P < .05$; blacks versus Hispanics.

† $P < .001$; blacks versus Hispanics.

Baseline Knowledge of NTDs and Folic Acid

Fifty-two percent of young women had heard of folic acid, and 45% had heard of birth defects called SB or NTDs. Fifty percent had heard that taking multivitamins before and after conception/pregnancy can prevent birth defects in infants. Clinics were reported as the major source of information regarding NTDs and NTD prevention (44%) followed by health care professionals (27%), school (14%), family/friends (7%), and television (7%; Table 2).

Factors Associated With Baseline Knowledge and Prevention Practices

There were no significant differences between the 2 race/ethnicity groups and their responses regarding having heard of folic acid or having heard that birth defects are preventable by multivitamins. However, significantly more Hispanic than black young women had heard of birth defects called SB or NTDs (59% vs 39%; $P = .001$; Table 2).

Young women categorized as having an education level (highest grade attained) appropriate for age were more likely to have heard of folic acid ($P = .004$) and of SB or NTDs ($P = .035$) compared with young women with a low education level for age. Young women with a history of pregnancy were also significantly more likely to have heard of folic acid ($P = .001$), of SB or NTDs ($P = .004$), and that birth defects could be prevented by multivitamins ($P = .001$) compared with young women with no history of pregnancy. Young women who reported regular birth control use were also significantly more likely to have heard of folic acid ($P = .002$) and that birth defects could be prevented by multivitamins ($P = .001$) compared with young women who reported no regular birth control use.

Logistic regression analysis was used to investigate further the variables that were independently associated with knowledge while controlling for covariates. Race, history of pregnancy, regular birth control use, and appropriate grade for age were entered as independent variables in separate models for the 2 outcomes of having heard of folic acid and having heard of SB or NTDs. A history of pregnancy (odds ratio [OR]: 2.0; 95% confidence interval [CI]: 1.3–3.0), regular birth control use (OR: 1.7; 95% CI: 1.1–2.6), and appropriate grade for age (OR: 1.6; 95% CI: 1.0–2.4) were independently associated with having heard of folic acid. Similarly, a history of pregnancy (OR: 1.8; 95% CI: 1.2–2.7), regular birth control use (OR: 2.3; 95% CI: 1.2–4.7), appropriate grade for age (OR: 3.0; 95% CI: 1.5–5.9), and the interaction term of regular birth control and education (OR: 0.3; 95% CI: 0.1–0.8) were independently associated with having heard of SB or NTDs.

For further investigating the significant interaction term, the study population was stratified by the appropriate education level (yes/no) variable and the regular birth control (yes/no) variable. Within the low education level stratum, regular birth control was significantly associated with knowledge of SB or NTDs. Within the not regular birth control stratum, appropriate education level was significantly associated with knowledge of SB or NTDs.

Baseline Multivitamin Intake

Daily multivitamin intake was reported by 9%; the most common reason for currently taking multivitamin tablets was "for anemia" (37%), "to be healthy" (34%), "a balanced diet" (15%), "to prevent birth defects" (7%), and "other reasons" (5%). Reasons for not taking a daily multivitamin included "never thought about it" (57%), "no reason" (26%), "other reasons" (10%), "cost too much" (5%), and "don't need them" (1%). The majority of young women (89%) indicated interest in starting daily multivitamins.

Baseline Folate- and Folic Acid-Fortified Food Intake

As seen in Table 3, 1% to 37% ate folic acid/folate-rich food at least 4 to 6 times a week. The top 6 most frequently eaten folate-rich foods were similar for blacks and Hispanics: cereal, orange juice, beans, flour, spaghetti, and macaroni. Folic acid/folate-good foods were consumed >4 to 6 times a week by 5% to 6%, and folic acid/folate-poor foods (oatmeal and white bread) were consumed >4 to 6 times a week by 3% to 46%. Among the folic acid/folate-poor foods, white bread was the most frequently consumed food.

Factors Associated With Prevention Practices

The sample size was too small to assess factors associated with daily multivitamin intake. However, consuming at least 1 folate-rich or folic acid-fortified food in adequate amounts (4–6 times a week) was not significantly associated with age, knowledge of SB or NTDs, or knowledge of birth defects prevention by daily multivitamin intake.

Follow-up Assessment of Knowledge and Preventive Practices

Three months into program implementation, 135 young women had enrolled at the first site (the hospital-based clinic) and 70 had enrolled at the second site (the community-based clinic). Of the 205 young women enrolled from both sites at the time of the 3-month program follow-up, 25% (53 of 205) of young women of all racial and ethnic groups were randomly selected: 20% (34 of 135) at the hospital-based clinic and 27% (19 of 70) at the community-based clinic. Of 33 (62%) of 53 young women reached

TABLE 3. Percentage Frequency of Folate-Rich Foods Consumed at Least 4 to 6 Times a Week by Black and Hispanic Young Women

Food	Black	Food	Hispanic
Cereal	36.9	Cereal	36.5
Flour	17.8	Flour	18.1
Orange juice	16.2	Orange juice	20.9
Macaroni	10.7	Macaroni	3.8
Spaghetti	7.7	Spaghetti	4.8
Beans	5.2	Beans	18.8
Burritos	4.5	Burritos	2.8
Enchilada	2.2	Enchilada	1.9
Spinach	1.8	Spinach	0.9
Liver	1.5	Liver	0.9
Black-eyed peas	1.1	Black-eyed peas	0.9
Avocado	0.7	Avocado	0.9
Asparagus	0.4	Asparagus	2.8

by telephone, 52% were black, 39% were Hispanic, 6% were white, and 3% were other. Data for the 3-month follow-up survey are reported for 30 (16%) of 189 black and Hispanic young women.

Of 30 black and Hispanic young women, the question, "What is spina bifida?" was correctly answered by 91%, and, "What is folic acid?" was correctly answered by 86%. In response to the question, "Who should take folic acid?" 45% said "everyone," 38% said "all women of childbearing age," and 17% said "only women planning to have a infant." Ninety-seven percent reported receiving multivitamin tablets from the clinic, and 20 (67%) reported that they were taking their multivitamins daily. However, when asked how often they took their multivitamins in the previous month, <5 times was reported by 9%, 6 to 10 times by 18%, at least 11 to 20 times by 46%, 21 to 30 times by 18%, and 30 times by 9%. Reasons given for taking multivitamins included "to be healthy" by 48%, "to prevent birth defects" by 29%, "to have a balanced diet" by 15%, and "for anemia" by 8%. Reasons given for not taking daily multivitamins included "forgotten" by 82%, "lost or misplaced their tablets" by 9%, and "other reasons" by 9%.

DISCUSSION

Significantly more Hispanic than black young women in this study had heard of birth defects called SB or NTDs. This may be attributable to Texas Hispanics being targeted as a result of the high prevalence of SB or NTDs along the Texas-Mexico border.^{9,10} Alternatively, SB or NTDs may not be perceived as a major public health issue in the black community.

Half of the young women in this study had heard of SB or NTDs and folic acid. This rate is higher than in the Johnson et al¹⁸ report, which involved predominantly white female and male high school students. However, the rate is similar to the 1998 Gallup telephone survey.¹⁵ Half of the young women in our study had also heard of the role of multivitamins in the prevention of birth defects. In contrast, a report from Canada found that only 12% of 16- to 24-year-olds were aware of the need for folic acid or multivitamin supplementation before conception, and 2% were aware of the link between periconceptional folic acid intake and NTDs.²⁰ A study in the United States reported that 26% of predominantly young adult and adult pregnant black women were aware that folic acid helped to prevent NTDs.²¹ It is difficult to compare the rates between these studies because of differences in formatting questions and in terminology. For example, use of the term "SB or NTDs" versus "birth defects" as used in our study may have been less known.^{20,21}

Young women with a history of pregnancy, regular birth control, and appropriate education for age were significantly more likely to have heard of folic acid and SB or NTDs. A history of pregnancy in women of all reproductive ages has been previously reported to be associated with a high awareness of folic acid and SB or NTDs (78%–91%) in the United States and other countries and suggests that women

had probably been made aware of NTDs when receiving prenatal care.^{17,20,22} However, in 1 report, less awareness was noted in young women who were younger, were of high school education or less, were of a minority group, had a history of an unintended pregnancy, entered prenatal care after the first trimester, received prenatal care from the health department, and were supported by Medicaid during the pregnancy.¹⁷ It is interesting that in our study, low education level with regular birth control use was significantly associated with having heard of SB or NTDs. This is perhaps related to clinics and health professionals being reported by young women in our study as the top 2 sources of information, 44% and 27%, respectively. This may suggest that the clinics where this study was conducted were the primary source of health education for the young women, who were no longer receiving formal education.

In contrast to the rates of awareness of NTD prevention, only 9% of young women in our study reported taking a daily multivitamin; a very small number took daily multivitamins to prevent birth defects, and the vast majority indicated that they had "never thought about it." A low perceived pregnancy risk may have influenced this rate, because 57% reported regular birth control and suggested little need for a daily multivitamin. Absence of a family history of NTDs or a previous pregnancy affected by NTDs may have influenced these rates as well. Unfortunately, this information was not obtained from young women in our study. However, recent studies report that among women with a pregnancy affected by an NTD, a very small percentage had taken a daily multivitamin before conception.^{24,31} Because 68% of young women 15 to 24 years of age report an unplanned pregnancy, the disparity between folic acid knowledge and prevention practices is of concern and demonstrates a need for strategies to promote daily multivitamin use in this population.¹²

The rates of consumption of folic acid/folate-rich foods reported in this study were poor. Although cereal was found to be the most frequently consumed folic acid/folate-rich food in our study, only 37% reported cereal intake in adequate frequency. Coupled with poor food-folic acid/folate intake is the variability in the bioavailability of folate from food. It is estimated that only 50% of naturally occurring food folate is available.³² Before the mandatory fortification of grains, the average consumption of folic acid was estimated to be 0.25 mg/d and the fortification is estimated to add 0.1 mg/d, leaving many women of childbearing age under the recommended levels. Synthetic folic acid is approximately 100% bioavailable under fasting conditions, and the bioavailability drops to 85% when consumed with food.³² Recent work by Boushey et al³³ indicated that 61% of women of childbearing age after fortification had intakes of folic acid below recommended levels and that those who achieved the guidelines were those who consumed supplements. As a result, some have recommended further increasing the fortification level of grains.^{34,35} Until such a strategy is taken,

the poor intake of folate-rich foods and folic acid-fortified grains reported in our study not only validates the need for the public health strategy of promoting grains and cereal every day but also supports the need for daily multivitamin supplementation in sexually active young women. Of note, the top 6 folate/folic acid-rich foods were similar for both black and Hispanic young women. Because this study was limited to English-speaking Hispanics, this finding probably reflects the diet of acculturated Hispanic young women.

Eighty-nine percent of young women in our study were interested in taking a daily multivitamin. Although the telephone follow-up survey indicated that knowledge of NTDs and prevention by folic acid was very high, daily adherence to daily multivitamins remained a challenge despite a 3-month supply of multivitamins being given to the young women. Thus, health care providers in programs that dispense multivitamin tablets will need to counsel young women regarding daily adherence to multivitamins. Health care providers in programs that do not dispense multivitamins will need to provide information to young women on how to gain access to affordable multivitamins in addition to counseling them on daily adherence to multivitamins.

One limitation of this study is that the sample represents minority young women who sought free reproductive health services and therefore is not representative of all minority young women. A second limitation was the use of dietary methodology that required young women to recall dietary intake. The food frequency questionnaire is unable to determine meal patterning and cannot provide valid estimates of absolute intake of energy or nutrients. Therefore, the definitions of adequate folate consumption was based not on quantifying folate intake but rather on desirable patterns of intake. Although an accurate assessment of diet is inherently difficult, the strengths of the food frequency questionnaire are the ease of administration and the assessment of both present and past dietary intake. It is therefore often considered the method of choice for evaluating diet-disease relationships.³⁶ A third limitation was a dearth of information in the literature regarding the definition of adequate folate/folic acid-food intake for adolescent and young adult women. A fourth limitation was the design and sample size of the program follow-up telephone survey, which made it difficult to compare initial and follow-up survey data. However, the follow-up survey was not a primary aim of the study.

CONCLUSIONS

This study supports the need for folic acid promotion programs at publicly funded clinics for sexually active adolescent and young adult young women who seek reproductive health care. For many young women, such clinics may be their only source of education and services. In addition, appropriate counseling can be provided only when health care providers including pediatricians screen young women for their knowledge of folic acid and NTD prevention. A survey of obstetrician-gynecologists in

the United States found that those who screened for folic acid intake were more likely to counsel their patients about folic acid and SB or NTDs prevention.³⁷ Thus, pediatricians who interface with adolescents and mothers are in a good position to promote daily multivitamin intake to prevent NTDs.⁸ The intake of folate-rich and folic acid-fortified foods in young women was very poor in this study. Despite mandatory fortification of foods with folic acid, the research indicates that more than half of women of childbearing age cannot meet the public health requirement of 400 μg of folic acid.³³ Our study suggests that practitioners should promote daily multivitamin intake among young women. In addition, efforts need to be made to provide counseling tips on cues to promote daily adherence to multivitamins.

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STATISTICALLY SIGNIFICANT

“... As long ago as 1963, statisticians at the University of Michigan issued a warning that the methods used to gauge the statistical significance of findings were ‘startlingly prone’ to exaggerate real significance.

At the heart of these methods is the so-called *P* value. By time-honored tradition, *P* values below 0.05 are deemed ‘statistically significant,’ as they seem to imply that there is just a 1 in 20 chance of the results being flukes. In fact, because *P* values take no account of the inherent plausibility of the hypothesis being tested, it is in fact 4 times as likely that the result is a fluke. In other words, a substantial proportion of ‘statistically significant’ findings are meaningless flukes—scientific fool’s gold that lures others to waste time and money in attempts to replicate findings.”

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