

Characteristics Associated with Adequate Folic Acid Supplementation in a Multicultural Urban Setting

Ema Ferreira, Suzanne Atkinson, Lise Gauthier, Jean-François Bussières, Evelyne Rey, and Marc Dumont

ABSTRACT

Objective: To determine the proportion of pregnant women taking folic acid supplementation as recommended and to determine their demographic characteristics.

Methods: From June to December 2002, women attending their first prenatal visit to an outpatient clinic at a 500-bed tertiary mother-child hospital in Montréal were surveyed about their use of folic acid. Demographic data, including age, country of origin, education level, maternal diseases, parity, marital status, and family income, were recorded. The hospital serves a multicultural local population and the high-risk population in a larger geographic area.

Results: Of the 75 women recruited, only 29 (39%) were taking adequate folic acid supplementation. Four demographic differences were observed between those taking folic acid as recommended and those who were not. The proportion born in Canada was higher among those with adequate folic acid supplementation than among those with inadequate supplementation (76% and 43% respectively, $p = 0.008$), as were the proportions involved in a stable relationship (100% and 80%, $p = 0.006$), with a postsecondary education (86% and 46%, $p = 0.001$), and with a household income of \$40 000 or more (72% and 37%, $p = 0.004$).

Conclusion: Just over one-quarter of the women in this sample were taking folic acid supplementation adequate to prevent neural tube defects. More effort is required to inform the public of the need for and proper use of folic acid. Such efforts should focus on identified groups who tend not to take folic acid or who take such supplements incorrectly.

Key words: folic acid, pregnancy, neural tube defects

RÉSUMÉ

Objectif : Déterminer la proportion de femmes enceintes qui prennent des suppléments d'acide folique, comme recommandé, ainsi que leurs caractéristiques démographiques.

Méthodes : De juin à décembre 2002, les femmes qui se présentaient à leur première visite de suivi prénatal en consultation externe dans un hôpital de soins tertiaires mère-enfant de 500 lits à Montréal ont fait l'objet d'un sondage à propos de leur utilisation d'acide folique. Les données démographiques, y compris l'âge, le pays d'origine, le niveau de scolarité, les maladies maternelles, la parité, l'état matrimonial et le revenu familial ont été recueillies. L'hôpital dessert une population locale multiethnique et la population à haut risque dans une zone géographique plus étendue.

Résultats : Des 75 femmes sondées, seulement 29 (39 %) prenaient un supplément adéquat d'acide folique. Quatre différences au plan démographique ont été observées entre les femmes qui prenaient leur supplément d'acide folique comme recommandé et celles qui ne le prenaient pas comme recommandé. En comparaison avec celles dont la supplémentation était insuffisante, une plus grande proportion des femmes qui prenaient un supplément suffisant d'acide folique étaient nées au Canada (respectivement 76 % vs 43 %, $p = 0,008$), vivaient une relation stable (100 % vs 80 %, $p = 0,006$), avaient une formation postsecondaire (86 % vs 46 %, $p = 0,001$) et avaient un revenu familial supérieur à 40 000 \$ (72 % vs 37 %, $p = 0,004$).

Conclusion : Un peu plus du quart des femmes de cet échantillon prenaient un supplément adéquat d'acide folique afin de prévenir les anomalies du tube neural. Plus d'efforts devront être investis pour informer la population du besoin de prendre des suppléments d'acide folique de façon adéquate. Ces efforts devront être dirigés sur des groupes ciblés qui ont tendance à ne pas prendre de suppléments d'acide folique ou à en prendre incorrectement.

Mots clés : acide folique, grossesse, anomalies du tube neural

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INTRODUCTION

The neural tube closes at multiple sites between 26 and 28 days after conception.^{1,3} Failure of closure at any of these sites is the cause of most neural tube defects, such as spina bifida and anencephaly.^{2,3} Worldwide, isolated neural tube defects occur at a rate of 1.4 to 2 per 1000 pregnancies; together, they constitute the second most common type of major congenital anomaly (after cardiac malformations).³ In the United States and Canada (excluding Nova Scotia), the incidence of neural tube defects is reportedly 1.4 to 1.6 per 1000 total births (live births and stillbirths) and 0.56 per 1000 total births, respectively.^{1,4} In the province of Quebec, the incidence of neural tube defects has reportedly been as high as 4 per 1000 total births, but the rate has been declining and was reported at 1.28 per 1000 total births over a 3-year period (1998 to 2000).^{4,5} A decrease in the incidence of neural tube defects has been reported nationwide and in other provinces.¹ For example, the nationwide incidence (excluding Nova Scotia) of neural tube defects declined from 1.1 to 0.56 per 1000 total births from 1989 to 1999. This decline is partly explained by an increase in prenatal diagnosis with subsequent pregnancy termination and may also be related to an increase in folate supplementation and fortification.^{1,4}

Folic acid is an essential B vitamin also known as folate or pteroylmonoglutamic acid. Unlike most animals, humans depend entirely on an exogenous supply because they are unable to synthesize this vitamin.² Folic acid is necessary for DNA and RNA synthesis, and folate deficiency has been associated with neural tube defects.^{2,4,6} The exact biochemical mechanism by which folic acid affects fetal development is not clearly defined; however, it is known that folic acid must be present during the first 28 days of gestation to contribute to the prevention of neural tube defects.^{2,3}

Maternal folic acid supplementation reduces both the occurrence and the recurrence of neural tube defects. In 1991, the Medical Research Council Vitamin Study Research Group published the results of a large multicentre, prospective, randomized, double-blind study on folic acid supplementation.⁷ Women with a previous pregnancy affected by a neural tube defect were randomly assigned to receive folic acid, other vitamins, both, or neither, starting before and continuing until the 28th day of pregnancy. Among women who took 4 mg of folic acid daily, the rate of recurrence of neural tube defects was 72% lower than in the other groups (relative risk 0.28, 95% confidence interval

0.12–0.71).⁷ In 1992, a double-blind, placebo-controlled, randomized trial showed that periconceptional folic acid (0.8 mg daily) decreased the risk of a first occurrence of neural tube defects by 95% ($p = 0.029$).⁸ A 0.4-mg dose of folic acid was associated with a reduction of 40% to 85% in the risk of neural tube defects.⁹ The efficacy of periconceptional folic acid supplementation has been confirmed in other studies.^{10–15} Some studies have found a protective effect of folic acid with respect to other congenital malformations, and it has been estimated that 50% of all congenital malformations could be prevented if women of reproductive age consumed adequate folic acid.^{2,4,16}

Because up to 50% of pregnancies are unplanned, interventions promoting use of folic acid must target all women of child-bearing age, not just those who are planning a pregnancy.^{2,4,17} As a preventive measure, folic acid fortification of enriched grain products has been mandatory in the United States and Canada since 1998. However, at the current fortification level of 0.14 to 0.2 mg of folic acid per 100 g of flour, the daily intake of folic acid among women of child-bearing age is increased by an average of only 0.1 to 0.2 mg, which is not sufficient to prevent neural tube defects.^{2,3} An analysis of serum folate levels of women from western countries determined that an additional 0.2 mg of folic acid would reduce the incidence of neural tube defects by only approximately 20%.¹⁸ These results have been confirmed by US public health data, which indicate that since grain fortification began, the incidence of neural tube defects in the United States has decreased by 19%.¹⁹ In Canada, Ray and others²⁰ reported a significant decrease in the relative risk of neural tube defects after folate fortification began. It is currently recommended that women of child-bearing age take a 0.4-mg folic acid supplement daily, and women at high risk of neural tube defects should take at least 4 mg daily.^{2,4}

The objective of this study was to determine the proportion of pregnant women taking folic acid supplementation as recommended and to identify their demographic characteristics.

MATERIALS AND METHODS

The study took place at Sainte-Justine Hospital, a 500-bed tertiary mother-child hospital that serves a multicultural local population as well a wider high-risk population. The obstetrics and gynecology department covers 100 inpatient beds and several outpatient clinics with a total of 3500 deliveries per year. In Quebec, prenatal visits are covered by the provincial medical care plan, and all women have access to free prenatal care.

From June to December 2002, at their first prenatal visit to the outpatient clinic of Sainte-Justine Hospital, women were asked by a study investigator (S.A.) or a research assistant (the interviewers) to anonymously answer questions about folic acid use. A consent form was signed by each woman. A standardized questionnaire of 23 questions was used. The institutional review board of Sainte-Justine Hospital approved the research protocol, the questionnaire, and the written consent form.

Women were asked whether they had taken any folic acid supplementation before or during the current pregnancy and if so, were asked to report the daily dose and duration of supplementation, as well as the identity of other medications taken (some of which contained folic acid). Adequate folic acid intake was defined as at least 0.4 mg (low-risk women) or 4 mg (high-risk women) for at least 1 month before pregnancy and during the first trimester. High-risk women were defined as those with a first-, second-, or third-degree relation with a neural tube defect, type 1 diabetes, or epilepsy; those taking valproic acid, carbamazepine, or a folic acid antagonist; and those with a previous pregnancy affected by a neural tube defect. Patients who were unable to speak either French or English and those unable or unwilling to give informed consent were excluded. Demographic data, including age, country of origin, education level, maternal diseases, parity, marital status, and family income, were recorded.

Statistical Analyses

The results are presented as means \pm standard deviations when appropriate. Preliminary univariate comparisons of women with adequate and suboptimal folic acid intake were conducted using *t* tests (or nonparametric Mann–Whitney *U* tests) and chi-square tests (or Fisher's exact test). Block logistic regression was then used as a multivariable modelling tool allowing further exploration of the role and relative contribution of the various factors that were linked to appropriate folic acid intake on the basis of the preliminary univariate analyses. The results are reported as odds ratios and 95% confidence intervals. All analyses were considered significant at the 0.05 alpha level (uncorrected). SPSS version 11.5 (SPSS Inc, Chicago, Illinois) was used for all data management and analysis.

RESULTS

During the study period, 75 women were interviewed. This number represents approximately 25% of all prenatal visits (calculated from the monthly roster

of appointments at the outpatient prenatal clinic). The interviewers were not on site every day and did not approach every woman because of time constraints. Moreover, since several first prenatal visits are usually scheduled in the same time slot, it was difficult to interview all patients. Among the 75 women who answered the standardized questionnaire, 29 (39%) were taking or had taken folic acid supplementation as recommended, in the form of multivitamins (24/29) or as folic acid tablets (5/29). Forty-six women had inadequate folic acid intake (18 with a suboptimal dose or inadequate timing and 28 who did not take any folic acid). None of the women interviewed had a personal or family history of neural tube defects. Two patients had type 2 diabetes and took the recommended dose of folic acid.

Women with adequate and inadequate folic acid supplementation were similar with respect to maternal and gestational age at the time of the interview, parity, and pregnancy planning (Table 1). A total of 55 (73%) women had planned their pregnancies, 24 (44%) who were taking adequate folic acid supplementation and 31 (56%) who were taking inadequate or no supplementation ($p = 0.14$). Two of the 5 women who had undergone in vitro fertilization were not taking adequate folic acid supplementation.

The proportion of participants born in Canada was higher among women with adequate folic acid supplementation than among those with inadequate supplementation (76% and 43%, $p = 0.008$) (Table 2). All of the women taking adequate folic acid supplementation were in a stable relationship, but only 80% of those taking inadequate or no folic acid supplementation were in a stable relationship ($p = 0.006$) (Table 2).

Women with appropriate folic acid supplementation had higher academic achievement: 86% of women with adequate supplementation but only 46% of those with inadequate or no supplementation had a postsecondary education ($p = 0.001$) (Table 2).

Yearly household income was also linked to folic acid supplementation. Seventy-two percent of the women with adequate folic acid supplementation reported a household income above \$40 000, whereas only 37% of those with inadequate or no folic acid supplementation had this level of household income ($p = 0.004$) (Table 2).

Women born in Canada had a greater chance of adequate folic acid supplementation than immigrant women (OR 3.00, 95% CI 1.00–9.01; $p = 0.05$), and women with a postsecondary education had a greater chance of adequate supplementation than those with



Table 1. Demographic Characteristics of Women Seen in an Urban Prenatal Clinic

Characteristic	Mean ± SD or No. (%) of Women			p Value
	All Subjects (n = 75)	Adequate FA Supplementation (n = 29)	Inadequate or No FA Supplementation (n = 46)	
Age				
Maternal age (yr)	28.4 ± 5.2	29.2 ± 4.0	27.9 ± 5.9	0.27*
Gestational age at interview (wk)	11.9 ± 2.5	11.4 ± 1.9	12.2 ± 2.8	0.17*
Pregnancy characteristics†				
Pregnancy planning	55 (73)	24/55 (44)	31/55 (56)	0.14‡
Fertility treatments	5 (7)	3/5 (60)	2/5 (40)	0.37§
First pregnancy	37 (49)	18/37 (49)	19/37 (51)	0.10‡

FA = folic acid.

*Two-sided Student *t* test comparing women who had adequate supplementation with those who had inadequate or no supplementation.

†For pregnancy characteristics, the percentages are calculated on the basis of the numbers shown in column 2.

‡Chi-square test comparing women who had adequate supplementation with those who had inadequate or no supplementation.

§Fisher's exact test comparing women who had adequate supplementation with those who had inadequate or no supplementation.

Table 2. Maternal Factors Influencing Adequate Folic Acid (FA) Supplementation

Variable	No. (%) of Women			p Value
	All Subjects (n = 75)	Adequate FA Supplementation (n = 29)	Inadequate or No FA Supplementation (n = 46)	
Born in Canada	42 (56)	22 (76)	20 (43)	0.008*
In a stable relationship	66 (88)	29 (100)	37 (80)	0.006*
With postsecondary education	46 (61)	25 (86)	21 (46)	0.001†
Yearly household income = \$40 000	38 (51)	21 (72)	17 (37)	0.004*

*Chi-square test comparing women who had adequate supplementation with those who had inadequate or no supplementation.

†Fisher's exact test comparing women who had adequate supplementation with those who had inadequate or no supplementation.

Table 3. Results of Logistic Regression on Use of Folic Acid Supplementation

Variable	Odds ratio (95% CI)	p Value*
Born in Canada	3.00 (1.00–9.01)	0.05
Postsecondary education	5.99 (1.74–20.65)	0.005

CI = confidence interval.

*Chi-square test.

less education (OR 5.99, 95% CI 1.74–20.65; $p = 0.005$). Because of the limited sample size and the interaction between some of the factors, the multivariable regression model was limited to 2 factors: education level (high school or less versus college or more) and place of birth (Canada versus foreign). The results indicated that both variables could be integrated in the model. The model allowed accurate identification of 78% of the women who had inadequate folic acid supplementation and 72% of those who had adequate supplementation; overall, the precision of the model was 76%. Age and family income were closely associated and were therefore omitted from the model. Although these variables showed a clear univariate association with the risk of suboptimal folic acid intake, they did not

provide any information additional to education and birthplace.

All patients had some knowledge about folic acid and pregnancy. Thirty-one (41%) of the women had been told about folic acid before getting pregnant. Of these 31 women, 24 (77%) took adequate folic acid supplementation, but only 5 (11%) of the 44 women who received the information after they became pregnant took adequate supplementation ($p < 0.0001$). Eighteen (24%) of the 75 women received information about folic acid from their physician. Patients indicated that the best sources of information on folic acid were the media (42/75 or 56%), health care professionals (37/75 or 49%), and educational institutions (6/75 or 8%).

DISCUSSION

It is now well established that adequate maternal folic acid supplementation reduces both the occurrence and the recurrence of neural tube defects. Folic acid should be started before conception, since the neural tube is formed within the first 28 days of gestation, often before a pregnancy is recognized.^{2,3} The optimal dose

required to reduce the occurrence and recurrence of neural tube defects is still unknown.

In the study reported here, adequate folic acid intake was defined as at least 0.4 mg (for low-risk women) or 4 mg (for high-risk women) for at least 1 month before pregnancy and throughout the first trimester. Only 29 (39%) of the women had adequate supplementation according to this definition. These results are slightly better than reported in previous studies^{17,21} but are not optimal. In a study population similar to this one, Morin and others¹⁷ found that 13.5% of all fetuses were exposed to ideal doses of folic acid during the entire period of neural embryogenesis; an additional 40.1% were exposed to some form of folic acid supplementation. In Norway, where folic acid supplements have been recommended since 1998, only 17% of all women had started folic acid before conception (22% of nonimmigrant women and 2% of immigrant women).²¹ In these 2 studies, the interview was performed at the time of prenatal ultrasonography, at about 18 weeks gestational age.^{17,21} In the study reported here, the interview was performed at the first prenatal visit, which reduced the possibility of failure of recollection, which might occur later in the pregnancy.

Because of time constraints, only about 25% of women seen at the clinic were interviewed for the study reported here. This might limit the ability to generalize these results to the entire Canadian population. However, the authors believe that this sample is representative of the local population because the women were not selected by the interviewers but were chosen according to appointment lists. Women who could not speak French or English were excluded; this exclusion criterion probably influenced study results, because the hospital is situated in a multicultural part of Montréal. Other than the small sample size and the exclusion of women who spoke neither French nor English, it is unlikely that the study was hampered by any additional selection bias, because prenatal visits are free for every woman. It is possible that the inclusion of women who spoke a language other than French or English might have led to an even lower percentage of adequate folic acid supplementation, since being born outside Canada negatively influenced the appropriate intake of folic acid. Moreover, a large proportion of pregnant women who deliver their babies at the authors' hospital have their prenatal visits in private clinics.

The factors that were significantly associated with adequate folic acid supplementation were having been born in Canada, having a stable relationship, having a postsecondary education, and having a higher

family income. Young age, smoking, low educational level, low income, multiparity, and unplanned pregnancy have been identified as significant predictors of failure to use folic acid in other countries.⁴ In Canada, higher educational level, higher income, and being married were associated with folic acid use.²² Since the Canadian population varies from coast to coast, it is not known whether these results can be extrapolated to pregnant women in other provinces.

Three-quarters of the patients in this study had planned their pregnancies, a slightly higher percentage than previously reported for this province.¹⁷ In the current study, the percentage of women receiving adequate folic acid supplementation was not significantly different between those who had and those who had not planned their pregnancies (44% and 25%, respectively; $p = 0.184$). Morin and others¹⁷ reported that pregnancy planning was a significant predictive factor for folic acid intake; these authors stated that supplementation doubled in the "most planned" pregnancy group, but the proportion was still only 38%. The population in that study came from a less urban area of Quebec,¹⁷ which might explain the difference in results.

To increase folic acid supplementation, proper information must reach all women of child-bearing age through local newspapers, local organizations, and community programs. Other studies have identified similar demographic characteristics in a higher-risk population²²; therefore, efforts should be made to disseminate information to a wider range of women, including immigrants, women with a lower level of education, those with lower socioeconomic status, and single women. The effects of current information efforts have been small.²³ Given that only 24% of women in this study received information on folic acid and pregnancy from their physician, other types of information dissemination should be developed.

Despite the low cost, easy availability, and convincing published data on the importance of periconceptional folic acid in the prevention of neural tube defects and possibly other congenital anomalies and extensive educational efforts in the past decade across Canada and worldwide, the challenge remains to convey the message to women of reproductive age and to health care professionals. The authors of this study have been educating health care professionals and women on the importance of folate use, through seminars, university courses, pamphlets, and other educational materials, but the impact of these measures has not yet been evaluated.



Fortification of flour has helped to decrease the incidence of neural tube defects in the province of Quebec and other parts of Canada^{5,20}; hence, some authors have suggested that an increase in the level of folic acid fortification would further decrease the rate of neural tube defects.⁵ Yet other authors have suggested that all women planning a pregnancy should take folic acid 5 mg, which they predict would prevent 85% of all cases of neural tube defects.²⁴

CONCLUSIONS

A minority of women interviewed in this study were taking adequate folic acid supplementation to prevent neural tube defects. More effort is required to inform the public of the need for and proper use of folic acid. This effort should concentrate on the identified demographic groups that are likely to not take folic acid or to take folic acid incorrectly.

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