Pregnancy Planning: A Determinant of Folic Acid Supplements Use for the Primary Prevention of Neural Tube Defects

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ABSTRACT

Objective: Daily consumption of supplements containing 400 µg of folic acid in the periconception period may reduce the risk of neural tube defects (NTDs) by as much as 70%. However, despite explicit recommendations, folic acid consumption among women likely to become pregnant remains low. The objectives of this study were: to evaluate women's knowledge and beliefs with regard to folic acid; to estimate the frequency of vitamin supplement consumption; and to identify its determinants during the periconception period.

Methods: In 1999-2000, a questionnaire was completed by 1,240 pregnant women in 10 Quebec hospitals.

Results: Seventy percent of the respondents were aware of the preventive role of folic acid but only 25% had taken the recommended dose of supplements during the periconception period. Supplement consumption is associated with the pregnancy planning intensity score (OR: 1.06; 95% CI: 1.02 - 1.11), knowledge score (OR: 1.11; 95% CI: 1.07 - 1.16) and belief in the usefulness of supplements (OR: 1.56; 95% CI: 1.02 - 2.39).

Conclusion: These results indicate that further efforts are needed to inform the population and promote the optimal use of folic acid supplements.

La traduction du résumé se trouve à la fin de l'article.

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The prevalence of neural tube defects (NTD) (including elective terminations of pregnancies) varies from 0.84/1000 in British Columbia to 1.41/1000 in Quebec and 3.9/1000 in Newfoundland.¹⁻³ Survivors deal with severe handicaps such as mental retardation, lower limb paralysis or poor bladder control throughout their entire life.⁴ Observational and experimental studies have shown that women who took a daily vitamin supplement containing at least 400 µg of folic acid during the periconception period had a reduced risk of NTDs.⁵ In the early 1990s, Health Canada and various groups of experts recommended that every woman of childbearing age or planning a pregnancy should take a daily supplement of 400 µg of folic acid to prevent possible NTDs.⁶⁻⁸ Despite the mandatory fortification of cereal products that has been in effect in Canada since 1998, it is estimated that between 68 and 87% of women of childbearing age take less folic acid than recommended.⁹

Pregnancy planning is an ideal time to adopt behaviours that could improve the health of both mother and foetus.¹⁰ However, pregnancy planning is a complex, multidimensional concept. Consequently, our team conducted a systematic analysis of the "pregnancy planning" concept,¹¹ based on the theoretical model proposed by Miller.¹² Miller developed a sequence starting with desire, followed by intention which leads to procreation (sexual behaviour enhancing the chances of becoming pregnant; opposite of contraception).¹² In our analysis, pregnancy planning is inserted directly after intention and includes three main components: attitude towards pregnancy, timing and procreation. Based on these components, we developed and validated a tool to measure planning intensity.¹³

The objectives of this study were: to evaluate women's knowledge and beliefs with regard to folic acid; to estimate the frequency of vitamin supplement consumption; and to identify its determinants during the periconception period. More specifically, we were interested in the association between pregnancy planning and certain behaviours that could affect the health of the foetus. The results will enable us to evaluate the impact of current nationwide campaigns promoting the use of vitamin supplements. In a broader

sense, the results will provide valuable information concerning women's actual degree of knowledge regarding folic acid in the prevention of NTDs as well as the pregnancy planning status of different groups of women (e.g., women with a lower socioeconomic profile), enabling health promoters to develop focused educational messages.

METHOD

Sample

A random sample of 10 public hospitals that do obstetric ultrasounds was drawn from 31 institutions located on the south shore of the Saint Lawrence River in Quebec where about 50% of the population lives. To make the sample more representative, the hospitals were stratified according to their location (metropolitan/non-metropolitan) and vocation (university/non-university). A minimum sample of 1,000 women was needed to obtain an estimate of vitamin supplement consumption with an accuracy of $\pm 3\%$. A quota of participants was established for each hospital based on its annual volume of obstetric ultrasounds. The inclusion criteria were having a routine obstetric ultrasound and sufficient knowledge of French. Women under 18 years of age and those whose pregnancy was over 35 weeks were excluded. Between March 1999 and May 2000, the women who came to the hospitals were invited by the radiology department staff to complete the questionnaire in the waiting room before their examination. The protocol was approved by the Research Ethics Committee of the Sherbrooke University Hospital and accepted by the directors of each participating hospital.

Instruments and data collection

The questionnaire comprised 40 multiple-choice statements. Vitamin supplement consumption was classified according to when it started, consumption frequency and the type of supplements. The statements measuring pregnancy planning intensity were based on the questions validated in a previous study.¹³ The statements relating to a belief in the importance of taking supplements at the beginning of pregnancy (yes/no), knowledge of food sources and the role of folic acid in pre-

TABLE I

Knowledge* of the Participants About the Role of Folic Acid in the Prevention of NTDs

Question	Possible Responses	Points Assigned	Distribution of the Results (%)
Vitamin or mineral supplements particularly important for all women who might get pregnant	Iron	1	64.4
	Calcium	1	57.0
	Vitamin C	0	31.1
	Folic acid	2	57.1
	Vitamin B12	0	20.8
Role of folic acid during pregnancy	Don't know	0	11.4
	Prevention of low birthweight babies	0	2.9
	Prevention of prematurity	0	2.0
	Prevention of congenital defects	1	70.3
	Prevention of cerebral palsy	0	9.6
Way(s) to increase folic acid intake at the beginning of pregnancy	Don't know	0	15.2
	Drink more milk	0	3.3
	Eat more green vegetables	1	29.2
	Eat more meat	1	4.5
	Take a folic acid supplement	2	75.3
The main food source of folic acid	Eat more breakfast cereals	1	6.0
	Don't know	0	66.4
	Green vegetables	2	40.3
	Orange juice	1	4.1
	Fruits	1	6.4
Food(s) fortified with folic acid	Meat	1	3.8
	Breakfast cereals	1	3.0
	Milk products	0	1.7
	Don't know	0	40.7
	Bread	1	6.7
	Breakfast cereals	1	17.9
	Fruit juices	0	10.1
	Milk products	0	4.2
	Pasta	1	6.4
	Don't know	0	11.6

* Maximum score = 15

bold = correct responses

TABLE II

Sociodemographic Characteristics of the Participants and Comparison with the Sample of Pregnant Women in the 1998 Santé-Québec Study

Sociodemographic Characteristics	Study Sample	Santé-Québec Sample
Age (years)		
Average age	27.8 $\pm$ 5.1	29.3
Parity (%)		
Nulliparous	34.9	N/A
Multiparous	65.1	N/A
Time since last pregnancy (%)		
< 2 years	46.4	N/A
2 - 4 years	33.8	N/A
> 4 years	19.8	N/A
Family income after tax (%)		
< \$30,000	35.7	37.7
\$30,000 - \$59,999	35.4	36.8
> \$60,000	28.8	25.5
Schooling (%)		
Elementary or high school	28.8	18.2
College	41.6	55.5
University	29.7	26.3
Marital status (%)		
Living in a couple	93.0	90.5
Living alone	7.0	9.5

venting NTDs were based on the work of Pender¹⁴ and existing questionnaires.¹⁵⁻¹⁷ The consumption of breakfast cereals (frequency and type of cereals) and health behaviours (relaxation, eating habits, exercise, etc.) adopted before and after confirmation of the pregnancy were also mea-

sured. Data were also collected on the following sociodemographic variables: age, marital status, family income, schooling, parity and the year of the last pregnancy. The questionnaire is available from the authors.

TABLE III

Distribution of Vitamin Supplement Consumption Among the Participants

Supplement consumption began ...	N	%
... more than 6 months before the start of pregnancy	232	37.4
... between 3 and 6 months before the start of pregnancy	71	11.5
... during the 3 months preceding the start of pregnancy	89	14.4
... during the first 12 weeks of this pregnancy	188	30.3
... during the 13th week of pregnancy	40	6.5

TABLE IV

Factors Associated with Consumption of Multivitamin Supplements Prior to Conception Among Women of Childbearing Age (n=1,069)

Variable	Odds Ratio (OR)	CI 95% of OR
Planning intensity (score)	1.06	1.02 – 1.11
Knowledge (score)	1.11	1.07 – 1.16
Beliefs		
Does not think supplements are important	Reference	
Thinks supplements are important	1.56	1.02 – 2.39
Age (years)	1.02	0.99 – 1.05
Family income		
< \$30,000	Reference	
\$30,000 - \$59,999	1.48	1.06 – 2.07
> \$60,000	1.50	1.05 – 2.15
School		
High school	Reference	
College	0.98	0.72 – 1.35
University	1.25	0.84 – 1.84
Parity		
First pregnancy	Reference	
> 1 pregnancy	1.07	0.81 – 1.42

TABLE V

Percentage of Women Who Modified Their Behaviours Before and After Confirmation of the Pregnancy

Behaviour	Before Confirmation of the Pregnancy (%)	After Confirmation of the Pregnancy (%)
Exercise	63	74
Relaxation	90	61
Reduce alcohol consumption	49	75
Reduce tobacco consumption	47	80
Eat more fruits and vegetables	65	97
Eat more dairy products	65	96
Read about pregnancy	49	89

DATA PROCESSING AND ANALYSIS

A pregnancy planning intensity score was calculated by adding the responses to the questions related to the three components of the concept. Scores ranged from 0 to 12 where 12 represents the most intense planning. Bivariate analyses showed pregnancy planning intensity was highly associated with vitamin intake determinants except schooling and parity (chi square = 0.2 and 0.89 respectively). The knowledge score, from 0 to 15, was obtained by adding the points for each question, as indicated in Table I. The determinants of taking vitamin supplements in the periconception period (prior to pregnancy or during the first 12 weeks of pregnancy) were identified by a logistic regression model using pregnancy planning intensity as the independent variable and controlling for beliefs, knowledge and sociodemographic variables.

Despite the two-stage sampling technique (stratification of hospitals and quota of participants in each hospital), the analysis of the intraclass correlation coefficients for the “pregnancy planning intensity” ($r=0.002$) and “consumption of multivitamin supplements” ($r=0.066$) variables indicated that the design effect was minimal.¹⁸ Therefore, the data were treated as if they came from a simple random sample using version 8.0 of the SPSS software.

RESULTS

A total of 1,240 women waiting for an obstetric ultrasound participated in the study. The average length of the participants' pregnancies was 19.8 weeks (range: 10-35 weeks). Their sociodemographic characteristics are presented in Table II. Compared to a sample of pregnant women in the Santé-Québec study (Institut de la

statistique du Québec, personal communication), there was a great similarity in the distribution of family income and the percentages of university-educated and married women.

At the time of the study, 620 women reported taking supplements. They are classified in Table III according to the time they started taking supplements. Two thirds of this group ($n=392$) reported taking vitamin supplements prior to conception and 85% of them took supplements more than four times a week. Since the majority of multivitamin pills sold in pharmacies contain the recommended 400 µg of folic acid, it was determined that $24.8 \pm 2.4\%$ of the embryos were exposed to optimal doses of folic acid before the neural tube closed.

More than half of the participating women had read or heard about folic acid. Of these, 64% knew about it before the beginning of their pregnancy. The percentages of women who answered the questions about knowledge are reported in Table I. The level of knowledge was only very slightly related to the intensity of pregnancy planning (Spearman correlation coefficient = 0.151). The main sources of information about health during pregnancy were the media (53%), health professionals (39%), and family and friends (8%). The average pregnancy planning intensity score was 8.19 ± 3.25 . Eighty-eight percent of the participants believed that it is important to take a vitamin supplement during pregnancy.

Table IV shows the factors associated with the consumption of supplements prior to conception. In addition to beliefs, knowledge and family income, pregnancy planning intensity was a significant determinant of early consumption of vitamin supplements. The probability of taking supplements before conception increased 6% for every additional point on the planning intensity score. When this score was divided into quartiles, we saw an increase in the probability of early consumption in relation to planning intensity (score < 6: reference; score 7-11:OR [CI 95%] 1.15 [0.78-1.70]; score 12-14: 1.58 [1.07-2.33]; score >15: 1.64 [1.11-2.40]).

During the three months preceding the start of the pregnancy, 38.2% of the women had modified at least one health behaviour and nearly 60% did the same

once their pregnancy was confirmed. The behaviour most likely to be modified before the start of pregnancy was the time set aside for relaxation (Table V). Once the pregnancy was confirmed, dietary changes varied the most.

Seventy-six percent of the respondents ate breakfast cereals. Of these, 18% ate it every day and the majority ate it three or four times a week.

DISCUSSION

Our results showed that pregnancy planning was positively associated with the consumption of vitamin supplements during the periconception period. However, despite a high proportion of women being aware of folic acid and a high belief in the usefulness of supplements, only 25% of the foetuses were exposed to the recommended doses of folic acid during the critical embryonic development period. Health behaviour modifications occurred mainly after the pregnancy was confirmed.

In Quebec, the vast majority of pregnant women undergo routine ultrasound examination.^{7,8} There were only minor differences in the sociodemographic variables between our sample and the sample interviewed in the Quebec Social and Health Survey (Table II). However, it must be pointed out that a small percentage of women might not have attended the ultrasound examination, or were not willing or not able to complete the questionnaire. Since educated women tend to plan their pregnancies more, our results might overestimate the proportion of planners and folic acid users.^{19,20} Also, our sample was drawn from a population of French-speaking Canadian women and there may be important cultural differences between the provinces, which could affect the impact of promotional campaigns.

The planning measure used was a valid, reliable instrument developed from a systematic conceptual analysis.^{11,13} The planning intensity score was 8.19 out of a maximum of 12, which indicated a high degree of planning in this population. In a previous study, the average score of women attending fertility clinics was 9.21 compared to 1.99 for women attending family planning clinics.¹³

The knowledge score was very low among participants (median = 4/15) and

only 49% had taken supplements before conception. A high degree of knowledge is essential, but is not the only condition to bring about a behaviour modification during the planning period.¹⁶ For that matter, the PRECEED-PROCEED model²¹ is often used as a theoretical model for the elaboration of health promotion programs. It considers knowledge and beliefs as *pre-disposing factors* and adds *reinforcing factors* such as the partner's or the physician's influence and *facilitating factors* such as resources and attitudes in order to enable behaviour modification. In other words, messages disseminated through the mass media enhance knowledge whereas meetings between clinicians and clients are more effective in inducing behaviour modifications.²²

Finally, Canadian regulations regarding the fortification of breakfast cereals could be modified to permit the addition of up to 400 µg of folic acid per portion, which would give women the choice between having a bowl of cereal or a vitamin supplement to reach the recommended doses of folic acid. Since the majority of women ate breakfast cereal three or four times a week, this strategy would improve compliance with the recommendations made by Health Canada and groups of experts.¹⁴

In conclusion, the data taken from this study should provide the rationale for targeting pregnancy planning as a convenient timeframe to modify health behaviours that would ultimately lead to better pregnancy outcomes.

RÉSUMÉ

Objectifs : La consommation journalière de suppléments contenant 400µg d'acide folique en période périconceptionnelle peut diminuer jusqu'à 70 % le risque d'anomalies de fermeture du tube neural (AFTN). Malgré des recommandations explicites, le niveau de consommation chez les femmes susceptibles de devenir enceintes demeure faible. Les objectifs de cette étude étaient d'évaluer les connaissances et les croyances des femmes en regard de l'acide folique ainsi que d'estimer leur fréquence de consommation de suppléments vitaminiques puis d'identifier les déterminants de cette consommation durant la période périconceptionnelle.

Méthode : En 1999-2000, lors d'une enquête, nous avons interrogé 1 240 femmes enceintes dans 10 hôpitaux du Québec.

Résultats : Soixante-dix pourcent des participantes connaissaient le rôle préventif de l'acide folique, mais seulement 25 % avaient pris des suppléments, à la dose recommandée, durant la période périconceptionnelle. La consommation de suppléments est associée au score d'intensité de la planification de la grossesse (OR : 1,06; 95 % IC : 1,02 à 1,11), au score de connaissances (OR : 1,11; 95 % IC : 1,07 à 1,16) et à la croyance en l'utilité des suppléments (OR : 1,56 ; 95% IC : 1,02 à 2,39).

Conclusion : Ces résultats indiquent que des efforts sont encore nécessaires pour informer la population et promouvoir l'utilisation optimale des suppléments d'acide folique.

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