

Preconceptional use of folic acid and knowledge about folic acid among low-income pregnant women in Korea

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BACKGROUND/OBJECTIVES: Folic acid supplementation before pregnancy is known to significantly reduce the risk of having a baby with neural tube defects (NTDs). Therefore, it is important for women to be aware of the effects of folic acid supplementation before pregnancy. The purpose of this study was to investigate the awareness and preconceptional use of folic acid and to assess the current knowledge about folic acid among low-income pregnant women in Korea.

SUBJECTS/METHODS: A questionnaire survey was conducted in 2012. Five hundred pregnant women were selected from the waiting list for the Nutriplus program implemented in public health centers using a multistage clustered probability sampling design. Data from 439 women were analyzed after excluding ones with incomplete answers.

RESULTS: Among women who responded to the questionnaire, 65.6% had heard of folic acid before pregnancy, and 26.4% reported on the preconceptional use of folic acid. Women with a university degree or higher education were more likely to be aware of folic acid and to take folic acid in the preconception period. In a multivariate logistic regression, when age, education level, household income, employment status, gravidity, parity, and folic acid awareness were included in the model, folic acid awareness was a strong predictor of preconceptional folic acid use. As of interview, 85.4% and 77.7% of women were aware of the NTD-preventive role of folic acid and the appropriate time to take folic acid, respectively. The main sources of information on folic acid were healthcare professionals (41.2%), friends and family members (31.2%), and the media (26.5%).

CONCLUSIONS: Our results suggest that public health strategies are needed to increase the preconceptional use of folic acid among Korean women.

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INTRODUCTION

The neural tube is an embryonic structure that develops into the brain and spinal cord. A flat sheet of cells fuses to form a closed tube by the 28th day after conception. Neural tube defects (NTDs) occur when the neural tube fails to close completely, which causes malformations in the brain and spine, with the most common associated conditions being spina bifida and anencephaly [1].

According to the International Clearinghouse for Birth Defects Surveillance and Research, the prevalence rates of NTDs, including spina bifida, anencephaly, and encephalocele, between 2007 and 2011 were 5.14 per 10,000 live births and stillbirths in Canada, 6.85 in Japan, and 7.64 in Texas in the United States [2]. The prevalence of NTDs in European countries between 2008 and 2012 according to the European Surveillance of

Congenital Anomalies was 9.69 per 10,000 births [3]. There are no official statistics available at the national level about the prevalence of NTDs in Korea, but a few investigators have reported the prevalence, with estimates ranging between 3.9 and 20.2 per 10,000 live births and stillbirths, depending on the study settings [4-6].

Folic acid supplementation before pregnancy is known to significantly reduce the risk of having a baby with NTDs [7,8]. In 1992, the United States recommended that women of childbearing age should consume 400 µg of folic acid daily [9], and the Korean Nutrition Society has made the same recommendation for women of childbearing age since 2010 [10]. The World Health Organization and many countries recommend that all women take a folic acid supplement from the moment they begin trying to conceive or from 4 to 12 weeks before pregnancy until 12 weeks of pregnancy, which is defined as

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the “periconceptual use” [11,12].

In a survey conducted in 2005-2006, 10.3% of 1,277 pregnant Korean women reported taking folic acid during the periconceptual period [13]. Another survey, conducted in 2009, found that 66.7% of 165 pregnant Korean women took folic acid in the third trimester [14]. However, it was not reported whether these women had consumed folic acid during the periconceptual period.

Studies showed that approximately 50% of pregnant women as well as women of childbearing age in Korea consumed less than the estimated average requirement for dietary folate [15-17]. Therefore, it is important for Korean women of childbearing age to be aware of folic acid supplementation before pregnancy, which is defined as the “preconceptional use”, to improve their folate nutritional status and prevent NTDs because the neural tube is closed by the 28th day after conception, when most women do not yet know they are pregnant.

Many countries have promoted campaigns to increase the awareness and use of folic acid [18]. In addition, a mandatory folic acid fortification of some foods has been implemented in more than 50 countries to reduce the rate of NTDs [19]. However, neither an official campaign to enhance the awareness of folic acid nor a fortification policy was launched in Korea, aside from providing folic acid to pregnant women who visit public health centers (PHCs).

To date, there has been no nationwide survey to examine the preconceptional use of folic acid in pregnant Korean women. To consider any folate-related policies, such as a folic acid promotional campaign or mandatory fortification of foods, baseline data on the preconceptional use of folic acid is essential. The purpose of this study was to investigate the preconceptional use of folic acid and the associated factors, as well as the level of current knowledge on folic acid among pregnant women of low-income households in Korea. Low-income pregnant women were targeted in our study because they were more likely to have low folate nutritional status and low concern for folic acid use [20,21].

SUBJECTS AND METHODS

Study design and participants

“Dietary intake survey of physiologically vulnerable population for risk assessment” was a nationwide seasonal dietary intake survey among pregnant women, lactating women, and infants conducted by the Korea Health Industry Development Institute with the support of the Korea Ministry of Food and Drug Safety [22]. The primary purpose of the survey was to assess the dietary intake of the participants. For this study, an additional questionnaire specifically focused on folic acid was used for pregnant women to investigate the awareness, use, and knowledge of folic acid. Information was collected by a well-trained interviewer with a dietician license by visiting the homes of pregnant women from June 2012 to November 2012.

Samples were drawn from the waiting list for the Nutriplus program implemented nationwide in 251 PHCs using a multistage clustered probability sampling design. The Nutriplus program is a supplemental nutrition program for low-income pregnant women, lactating women, and children implemented

in Korea; it is similar to the Special Supplemental Nutrition Program for Women, Infants, and Children in the United States. The reason for selecting the samples from the waiting list was to rule out the possibility of any impact from nutrition education provided by the Nutriplus program to the beneficiaries.

Sampling procedures were done in two steps as follows; for the first step, multistage stratified sampling method was employed using region and city/county as strata. Korea has 16 large administrative units including 7 metropolitan cities and 9 provinces. These were grouped into 4 geographical regions (north-west, central, south-west and east). Small administrative units within each region were classified into large urban area, small urban area, and county, depending on the population size. To select 50 PHCs in each season, summer (from June to August) and autumn (from September to November), one PHC was assigned first to each of 12 strata and remaining 38 PHCs were assigned proportionally based on the birth statistics in 2010 and the number of women on the waiting list in each PHC. For the second step, 5 pregnant women were selected from the waiting list in each sample PHC by systematic sampling after lining up based on the weeks of pregnancy. A sample PHC without enough number of pregnant women on the waiting list was replaced by a PHC within each stratum.

Of 500 women selected as samples in 2 seasons, 468 women agreed to participate in the study, signed the informed consent form, and completed the questionnaire. Data from 439 women were analyzed after excluding ones with incomplete answers. This study was approved by the institutional review board of the Chungbuk National University Hospital (CBNU-IRB-2012-BQ01).

Questionnaire

The questionnaire focused on folic acid was developed with reference to previous studies [23-29]. There were seven close-ended questions and one open-ended question. The questions were whether and when they had heard about folic acid, whether and when they took folic acid, whether they knew the appropriate time to take folic acid, and how they obtained information on folic acid. The question pertaining to the knowledge about the roles of folic acid required the respondents to choose as many answers as deemed correct from six options, including three correct ones, two incorrect ones, and one “do not know”. In case they took folic acid, an additional open-ended question on the exact time to start taking folic acid was asked. The following demographic information was also obtained: age, education level, monthly household income, employment status, pregnancy stage, gravidity, and parity.

Statistical analysis

All analyses were performed using the SAS software (version 9.4, SAS Institute Inc., Cary, NC, USA). Sociodemographic characteristics and the awareness, use, and knowledge of folic acid were presented as frequencies and percentages, and a chi-square test was performed to test the differences in the proportion of categorical variables. Both univariate and multivariate logistic regression analyses were used to identify variables related to the preconceptional use of folic acid. The variables included age, education level, household income, employment status, gravidity, parity, and awareness, which were reported as the

factors related to the preconceptional use of folic acid in previous studies [23-29]. In the multivariate analysis, all the variables were added to the model simultaneously. The results of these analyses are presented as odds ratios (ORs) and 95% confidence intervals (95% CIs). $P < 0.05$ was considered statistically significant.

RESULTS

Characteristics of the study participants

The sociodemographic characteristics of the study participants are shown in Table 1. Among 439 pregnant women, 52.2% were in their early 30s (31-34 years), 38.3% had a high school diploma or lower education degree, and 35.1% were from a household with a monthly income of less than 2,000,000 won. The minimum cost of living in 2012 was 1,500,000 won for a four-person family [30]. Majority of the women (85.7%) were unemployed, 53.3% were in their third trimester, 77.2% had been pregnant previously, and 71.8% had children.

Awareness and use of folic acid

Table 2 shows the awareness and use of folic acid among the respondents. Most of the women (97.9%) reported that they had heard of folic acid, and 65.6% had heard of it before pregnancy. However, only 24.6% had taken folic acid in the preconception period.

Table 1. Sociodemographic characteristics of the study participants

	n	(%)
Age (yrs)		
< 30	131	(29.8)
31-34	229	(52.2)
≥ 35	79	(18.0)
Education (yrs)		
≤ 12 (High school or lower)	168	(38.3)
13-15	148	(33.7)
≥ 16 (University or higher)	123	(28.0)
Monthly household income (10,000 won)		
< 200	154	(35.1)
200-280	163	(37.1)
≥ 280	122	(27.8)
Employment status		
No	376	(85.7)
Yes	63	(14.3)
Stage of pregnancy		
First trimester	38	(8.7)
Second trimester	167	(38.0)
Third trimester	234	(53.3)
Gravidity		
Primigravida	100	(22.8)
Multigravida	339	(77.2)
Parity		
Nulliparas	124	(28.2)
Multiparas	315	(71.8)
Total	439	(100.0)

Factors associated with awareness and preconceptional use of folic acid

Table 3 represents the distribution of women, depending on sociodemographic characteristics, who were aware of folic acid before pregnancy ($n = 288$) and those who used folic acid in the preconception period ($n = 108$). Education level was the only significant factor associated with the awareness and use of folic acid. Among women who had a high school diploma or lower level of education, 55.4% were aware of folic acid before pregnancy, and 19.0% used folic acid in the preconception

Table 2. Awareness and use of folic acid

	n	(%)
Heard of folic acid		
Yes	430	(97.9)
Before pregnancy	288	(65.6)
During pregnancy	142	(32.3)
No	9	(2.1)
Time started taking folic acid supplement		
Before pregnancy	108	(24.6)
During pregnancy	282	(64.2)
Never consumed	49	(11.2)
Total	439	(100.0)

Table 3. Awareness¹⁾ and preconceptional use of folic acid by sociodemographic characteristics

	n	Awareness		Preconceptional use	
		n	(%)	n	(%)
Age (yrs)					
< 30	131	79	(60.3)	28	(21.4)
31-34	229	159	(69.4)	59	(25.8)
≥ 35	79	50	(63.3)	21	(26.6)
Education level (yrs)					
≤ 12 (High school or lower)	168	93	(55.4)	32	(19.0)
13-15	148	102	(68.9)	35	(23.7)
≥ 16 (University or higher)	123	93	(75.6)***	41	(33.3)***
Monthly household income (10,000 won)					
< 200	154	96	(62.3)	40	(26.0)
200-280	163	110	(67.5)	31	(19.0)
≥ 280	122	82	(67.2)	37	(30.3)
Employment status					
No	376	244	(64.9)	92	(24.5)
Yes	63	44	(69.8)	16	(25.4)
Stage of pregnancy					
First trimester	38	26	(68.4)	10	(26.3)
Second trimester	167	117	(70.1)	45	(27.0)
Third trimester	234	145	(62.0)	53	(22.7)
Gravidity					
Primigravidas	100	71	(71.0)	27	(27.0)
Multigravidas	339	217	(64.0)	81	(23.9)
Parity					
Nullipara	124	83	(66.9)	30	(24.2)
Multipara	315	205	(65.1)	78	(24.8)
Total	439	288	(65.6)	108	(24.6)

*** $P < 0.001$ by chi-square test

¹⁾ Heard of folic acid before pregnancy

Table 4. Factors associated with preconceptional use of folic acid using logistic regression

	Univariate analysis OR (95% CI)	Multivariate analysis ¹⁾ Adjusted OR (95% CI)
Age (yrs)		
< 30	1.00	1.00
31-34	1.28 (0.77-2.13)	1.19 (0.69-2.06)
≥ 35	1.33 (0.70-2.55)	1.33 (0.66-2.67)
Education level (yrs)		
≤ 12 (High school or lower)	1.00	1.00
13-15	1.32 (0.77-2.26)	1.11 (0.63-1.95)
≥ 16 (University or higher)	2.13 (1.24-3.64)	1.65 (0.93-2.93)
Monthly household income (10,000 won)		
< 200	1.00	1.00
200 - 280	0.67 (0.39-1.14)	0.59 (0.34-1.04)
≥ 280	1.24 (0.73-2.10)	1.21 (0.67-2.19)
Employment status		
No	1.00	1.00
Yes	1.05 (0.57-1.94)	0.88 (0.44-1.78)
Gravidity		
Primigravidas	1.00	1.00
Multigravidas	0.85 (0.51-1.41)	0.60 (0.18-2.04)
Parity		
Nullipara	1.00	1.00
Multipara	1.03 (0.64-1.67)	1.81 (0.56-5.86)
Awareness ²⁾		
No	1.00	1.00
Yes	5.79 (3.06-10.97)	5.59 (2.91-10.72)

OR, odds ratio; CI, confidence interval.

¹⁾ Variables included in the multivariate analysis: age, education level, household income, employment status, gravidity, parity, and awareness

²⁾ Heard of folic acid before pregnancy

Table 5. Current knowledge about folic acid (n = 439)

	n	(%)
Knew the roles of folic acid ¹⁾		
Prevents NTDs	375	(85.4)
Prevents anemia	52	(11.8)
Helps the growth of fetus	158	(36.0)
Knew the appropriate time to take folic acid		
Yes	341	(77.7)
No	98	(22.3)
Source of information about folic acid ²⁾		
Health professionals (doctors, pharmacists)	177	(41.2)
Friends / family members	134	(31.2)
Media (TV, book, journal)	114	(26.5)
Other	16	(3.7)

NTDs: neural tube defects

¹⁾ Multiple responses

²⁾ Multiple responses, among those who had heard of folic acid (n = 430)

period. Among women who had a university degree or higher level of education, 75.6% were aware of folic acid before pregnancy, and 33.3% used folic acid in the preconception period.

Table 4 shows ORs and 95% CIs for the preconceptional use of folic acid derived from logistic regression. Univariate regression analyses showed that women with a university degree or higher

level of education were more likely to use folic acid in the preconception period than those with a high school diploma or lower level of education (OR 2.13, 95% CI 1.24-3.64). In addition, women who had heard of folic acid before pregnancy were more likely to use folic acid in the preconception period (OR 5.79, 95% CI 3.06-10.97). Multivariate analysis, when age, education level, household income, employment status, gravidity, parity, and awareness were included in the model, showed that the awareness of folic acid before pregnancy was the only factor associated with the preconceptional use of folic acid (OR 5.59, 95% CI 2.91-10.72).

Current knowledge about folic acid

Table 5 represents the current knowledge about folic acid among the respondents. Although 85.4% knew that folic acid could prevent NTDs, the percentages of those who knew that folic acid could prevent anemia or help the growth of the fetus were only 11.8% and 36.0%, respectively. In total, 77.7% women knew that the appropriate time to take folic acid is at least 1 month before conception. Seventy-two percent of women knew about both the NTD-preventive role of folic acid and the appropriate time to take it. The main sources of information regarding folic acid included healthcare professionals (41.2%), friends and family members (31.2%), and the media (26.5%).

DISCUSSION

Our study demonstrated that majority of the pregnant women (97.9%) who answered our questionnaire had heard of folic acid, and 65.6% acquired this knowledge before pregnancy. However, only 26.4% used folic acid in the preconception period. Women with a higher level of education were more likely to be aware of and take folic acid, which is consistent with the results of other studies [23-27]. More than 70% of pregnant women knew that folic acid could prevent NTDs, as well as the appropriate time to take folic acid.

The proportion of pregnant women who had heard of and had knowledge of folic acid in our study was higher than that reported in other Asian countries. A study from a region in northern China with a high prevalence of NTDs in 2002-2004 showed that 36% of pregnant women had heard of folic acid, 29.6% knew that folic acid could prevent NTDs, and 23.0% knew the appropriate time to take folic acid [26]. A survey conducted in Thailand in 2005 found that 89% of pregnant women had heard of folic acid, 24.4% knew that folic acid could prevent NTDs, and 16% knew that there was a need to take folic acid during the periconceptional period [27]. A survey conducted in Taiwan in 2008 also showed that 89% of pregnant women had heard of folic acid [28].

One reason for the higher awareness rate among Korean pregnant women was that our survey was conducted in 2012, much later than the published studies from other countries, although no educational campaign was implemented in Korea. Similar results were reported in a postpartum survey conducted in New Zealand in 2012 [29]. The survey showed that among women with planned pregnancies, 98.0% had heard of folic acid, 63.6% knew that folic acid could prevent birth defects, and 77.4% knew the appropriate time to take folic acid; however,

these rates were lower among women with unplanned pregnancies.

When 34 studies about the preconceptional folic acid use between 1990 and 2003 were reviewed, the rate ranged from 0.9% to 49% and tended to increase over time [31]. In addition, the rates of periconceptional folic acid use in 49 studies ranged from 0.5% to 52% [31]. In a study conducted in Korea in 2005 [13], only 10.3% of pregnant women took folic acid during the periconceptional period (no report on preconceptional use), even though their socioeconomic status was much higher than that of the general population in Korea. Therefore, our findings that 24.6% and 64.2% of women took folic acid starting from preconception period and during pregnancy, respectively, indicate a great increase in periconceptional folic acid use during the last several years in Korea.

This increase may be explained by a prenatal program that provides folic acid to pregnant women at PHCs supported by the Ministry of Health and Welfare since 2011 [32]. This program provides folic acid to registered pregnant women until 12 weeks of pregnancy. Although it is a program for a rather short period, it might have been effective in informing pregnant women of the importance of folic acid use, particularly to low-income women who often visit PHCs. However, in this program, folic acid is given only during pregnancy; therefore, many pregnant women in our study took folic acid from 8 weeks of pregnancy, when pregnancy was confirmed, to 12 weeks of pregnancy.

The multivariate analyses showed that folic acid awareness was a strong predictor of the preconceptional use of folic acid. Women who had heard of folic acid before pregnancy were more likely to take folic acid in the preconception period. Other studies showed that the awareness of folic acid was a factor associated with its use during the appropriate period among pregnant Chinese [26] and Mediterranean women [33], after adjusting for potential confounding factors. In a recent study, knowledge about the preventive role of folic acid was reported to be the only factor contributing to an increase in folic acid use by pregnant Japanese women [34].

Many studies have shown that nutrient intake by Korean women of childbearing age is inadequate, particularly in terms of calories, calcium, iron, and folate, which are critical nutrients for healthy mothers and babies [13-15, 35-37]. In addition, 33% of pregnant Korean women in the first trimester had a serum folate concentration lower than 7 ng/mL [38], which is the concentration required for the prevention of NTDs [39]. Therefore, it is necessary to educate women of childbearing age on the importance of the preconceptional use of folic acid in Korea.

Many countries have conducted campaigns to educate women of childbearing age regarding the importance of folic acid supplementation [40]. After a national campaign in Israel, the awareness of folic acid among pregnant and postpartum women increased from 54.6% in 2000 to 90.3% in 2005, the proportion of women with the knowledge of folic acid increased from 17.6% to 80.8%, and the preconceptional use of folic acid also increased from 5.2% to 34.0% during the same period [41]. In the Netherlands, the folic acid campaign from 1995 to 2004 increased the proportion of pregnant women who were aware of the NTD-preventive role of folic acid, from 27% in 1994 to 73% in 2005. In addition, folic acid use during the recommended

period also increased from 0.4% to 51% [42]. The awareness, knowledge, and use of folic acid were all improved by national campaigns [40]. Therefore, a folic acid promotional campaign to increase the preconceptional use of folic acid should be considered in Korea.

The strength of our study is that low-income women were recruited by nationwide sampling in Korea. This is the first report to investigate the preconceptional use of folic acid among nationwide samples of pregnant women in Korea. However, the participants were selected from the waiting list for the Nutriplus program in PHCs. They might be more familiar with the nutrition program implemented in PHCs, including the program to provide iron and folic acid supplements; thus, they may not represent all low-income pregnant women as well as all pregnant women in Korea.

In conclusion, the percentages of pregnant women who were aware of and knowledgeable about folic acid were higher than those reported in other countries, even though they were from low-income households in Korea. However, the rate of the preconceptional use of folic acid was as low as that observed in other countries. We confirmed that folic acid awareness was a strong predictor of preconceptional folic acid use. Therefore, a folic acid promotional campaign toward women of childbearing age to increase the preconceptional use of folic acid is encouraged. In addition, the prevalence of NTDs should be systematically monitored along with the folate nutritional status and folic acid use in Korean women.

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