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# Knowledge and use of folic acid for birth defect prevention among women of childbearing age in Shanghai, China: A prospective cross-sectional study

## Authors' Contribution:

- A** Study Design
- B** Data Collection
- C** Statistical Analysis
- D** Data Interpretation
- E** Manuscript Preparation
- F** Literature Search
- G** Funds Collection

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## Summary

### Background:

This study aimed to assess the knowledge, attitude, and practice of folic acid intake for prevention of birth defects in Chinese women of child-bearing age.

### Material/Methods:

In this prospective cross-sectional study, a total of 1,338 women aged 20–45 years were randomly selected for interview. Data on folic acid knowledge and information on folic acid intake in the subjects were collected. Age, education, contraception, and status of family planning were used as the independent variables in multivariate logistic regression.

### Results:

55.6% of the subjects took contraception at all times, and 33.9% had pregnancy planning in the next six months. 49.7% of the interviewed women knew the benefits of folic acid and 34.6% realized the correct time of folic acid intake; and 14.9% of these women actually took folic acid daily. Planning to be pregnant in the next six months was associated with knowledge of folic acid benefits, correct time of folic acid intake and actual intake. A higher education level was correlated with the knowledge of folic acid benefits and correct time of folic acid intake, but was not linked to actual intake of folic acid.

### Conclusions:

The knowledge and use of folic acid were at low to moderate levels in women at childbearing age in Shanghai, China, and general knowledge of folic acid benefits and correct time of folic acid intake should be conveyed to these women.

### key words:

**folic acid • neural tube defect • knowledge • pregnancy**

### Abbreviations:

**CI** – confidence interval; **NTD** – neural tube defect; **OR** – odds ratio

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## BACKGROUND

Neural tube defects (NTDs), a group of congenital central nervous system anomalies affecting 0.5–2/1,000 pregnancies worldwide, are the second most common type of birth defect after congenital heart defects [1]. NTDs occur when the neural tube, the embryonic precursor of the brain and spinal cord, fails to close during days 21–28 postconception. In humans, anencephaly (a total or partial absence of the cranial vault and cerebral hemisphere responsible for about 30% of NTDs) and myelomeningocele (open spina bifida, a midline defect in the lumbosacral region in which the spinal cord is dysplastic and the overlying spinal column is absent) are the most common NTDs [2]. Anencephaly is lethal and spina bifida often causes paraplegia with paralysis of the lower extremities and impaired bladder and bowel function. More than 4,000 infants with NTDs are born per year in the United States, and this figure is estimated to be 80,000 to 100,000 in China [3]. Although the causes of NTDs are poorly understood, NTDs are considered to arise from a combination of genetic predisposition, environmental risk factors and maternal conditions. Previous clinical studies have observed folic acid deficiency in women who gave birth to infants with NTDs [1]. Large-scale epidemiological studies have demonstrated that periconceptional use of folic acid before and during the early weeks of pregnancy significantly decreased the risk of NTDs by

50–70% in British women who had previously had NTD-affected pregnancies or Hungarian women with pregnancy planning [4,5]. The US Public Health Service (USPHS) recommends that reproductive-aged women who are capable of becoming pregnant should consume 400 µg of folic acid daily from enriched foods and supplements since 1998 [6,7]. A population-based study in the US has demonstrated that folic acid fortification reduced the prevalence of NTDs by 19% and also decreased the risk of transposition of the great arteries, obstructive urinary tract abnormalities, limb defect, facial cleft, and congenital hypertrophic pyloric stenosis [8]. However, a survey in 1998 has revealed that only 29% of women in the US followed this recommendation [9]. A worldwide campaign has been carried out to raise awareness, in particular among the general public and women at childbearing age, about the importance of folic acid intake for preventing birth defects [10–14].

The prevalence of NTDs in China is about 2.7 or higher per 1,000 pregnancies, which is significantly higher than that of about 1 per 1,000 in American Caucasians [14,15]. However, only 3–5% Chinese women at childbearing age take folic acid, although 20–30% of them know the importance of folic acid in NTD prevention [16–18]. In China, a premarital health examination at local maternal and child healthcare centers was mandatory for both men and women before 2003, and after the examination healthcare providers

**Table 1.** Number of women at childbearing age who knew the benefits of folic acid intake and proper time of intake and who took folic acid daily by selected sociodemographic characteristics in Shanghai, China.

Parameter	No. (%)	No. of women who had knowledge of folic acid benefits (%)	No. of women who knew the correct time period of folic acid intake (%)	No. of women who took folic acid daily (%)
All respondents	1,338	652 (49.7)	463 (34.6)	200 (14.9)
Age (year)				
20–24	148 (11.1)	49 (33.1)	37 (25.0)	16 (10.8)
25–29	812 (60.7)	403 (49.6)	284 (35.0)	112 (13.8)
30–34	294 (22.0)	162 (55.1)	115 (39.1)	56 (19.0)
35–39	62 (4.6)	32 (51.6)	23 (37.1)	14 (22.6)
40–45	22 (1.6)	6 (27.3)	4 (18.2)	2 (9.1)
Education				
High school or less	284 (21.2)	90 (31.7)	58 (20.4)	38 (13.4)
College or university	1054 (78.8)	562 (53.3)	405 (38.4)	162 (15.4)
Contraception				
At all time	744 (55.6)	356 (47.8)	263 (35.3)	72 (9.7)
Sometimes	107 (8.0)	53 (49.5)	37 (34.6)	17 (15.9)
Never	476 (35.6)	238 (50.0)	158 (33.2)	107 (22.5)
Planning to be pregnant in the next six months				
No	885 (66.1)	363 (41.0)	268 (30.3)	66 (7.5)
Yes	453 (33.9)	289 (63.8)	195 (43.0)	134 (29.6)

**Table 2.** Multivariate logistic regression analysis of the relationships of knowledge of folic acid benefits, correct time of folic acid intake, actual folic acid intake and selected sociodemographic characteristics.

Parameter	Knowledge of folic acid benefits		Correct time of folic acid intake		Actual folic acid intake	
	OR (95% CI)	<i>p</i>	OR (95% CI)	<i>p</i>	OR (95% CI)	<i>p</i>
Age (year)						
20–24	1.00	–	1.00	–	1.00	–
25–29	1.64 (1.11–2.41)	<0.05	1.05 (0.67–1.65)	NS	0.98 (0.53–1.81)	NS
30–34	2.13 (1.38–3.27)	<0.01	1.21 (0.74–1.99)	NS	1.41 (0.73–2.71)	NS
35–39	2.00 (1.06–3.78)	<0.05	1.25 (0.61–2.56)	NS	1.73 (0.72–4.11)	NS
40–45	0.86 (0.31–2.41)	NS	0.69 (0.19–2.51)	NS	1.05 (0.21–5.31)	NS
Education						
High school or less	1.00	–	1.00	–	1.00	–
College/university	2.42 (1.80–3.25)	<0.01	1.79 (1.25–2.56)	<0.01	0.90 (0.58–1.39)	NS
Contraception						
At all time	1.00	–	1.00	–	1.00	–
Sometimes	0.90 (0.59–1.38)	NS	0.89 (0.55–1.44)	NS	1.43(0.77–2.66)	NS
Never	0.69 (0.52–0.91)	NS	0.75 (0.55–1.03)	NS	1.61(1.10–2.38)	<0.01
Planning to be pregnant						
No	1.00	–	1.00	–	1.00	–
Yes	3.11 (2.36–4.10)	<0.01	1.37 (1.01–1.85)	<0.05	3.54 (2.43–5.14)	<0.01
Knowledge of folic acid benefit						
No	–	–	1.00	–	1.00	–
Yes	–	–	7.23 (5.49–9.53)	<0.01	2.81 (1.88–4.20)	<0.01
Knowing correct time of folic acid intake information						
No	–	–	–	–	1.00	–
Yes	–	–	–	–	2.14 (1.50–3.05)	<0.01

NS – Not significant.

would educate young couples about the benefits of folic acid. Regardless of the cancelling of compulsory premarital health examination in 2003, strategies for improving periconceptional health have been incorporated into various programs by National Committee of Population and Family Planning of China in 2006. The aim of this study was to assess the knowledge, attitude and practice of folic acid intake for prevention of birth defects in women at childbearing age in Shanghai, China.

## MATERIAL AND METHODS

### Subjects

From July 1<sup>st</sup> to November 30<sup>th</sup> 2008, this population-based cross-sectional study enrolled 1,338 women aged at 20–45 years in Jing'an District in Shanghai (population: 330,000). The subjects were included in the study when: 1) who were 20–45 year old; 2) who were the permanent residence of Jing'an

District and registered in the Committee of Population and Family Planning of Jing'an District Government; 3) who had no child and were allowed to have a child by China government; and 4) who planned to be pregnant. This study was approved by the Institutional Ethics Committee, Obstetrics & Gynecology Hospital, Fudan University, Shanghai, China. All participants signed a written consent.

### Questionnaire

Trained staff specialized in family planning and women healthcare interviewed the residence in person and fulfilled a structured questionnaire which has been previously used for investigating nutrition status in child-bearing women in China. The questionnaire mainly covered two parts: the first part was sociodemographic status (maternal age and educational level), contraception (at all times, sometimes or never) and planning to be pregnant in next six months (yes/no). The term “planning to be pregnant” refers to a

**Table 3.** Association of knowledge of correct time of folic acid intake and selected sociodemographic characteristics.

Parameter	Univariate analysis		Multivariate analysis	
	OR (95% CI)	<i>p</i> value	OR (95% CI)	<i>p</i> value
Age (year)				
20–24	1			1
25–29	1.61 (1.08–2.40)	<0.05	1.05 (0.67–1.65)	NS
30–34	1.93 (1.24–2.99)	<0.01	1.21 (0.74–1.99)	NS
35–39	1.77 (0.94–3.34)	NS	1.25 (0.61–2.56)	NS
40–45	0.67 (0.21–2.10)	NS	0.69 (0.19–2.51)	NS
Education				
High school or less	1			1
College or university	2.43 (1.78–3.33)	<0.01	1.79 (1.25–2.56)	<0.01
Contraception				
At all time	1			1
Sometimes	0.97 (0.63–1.48)	NS	0.89 (0.55–1.44)	NS
Never	0.91 (0.71–1.16)	NS	0.75 (0.55–1.03)	NS
Planning to be pregnant in next six months				
No	1			1
Yes	1.74 (1.38–2.20)	<0.01	1.37 (1.01–1.85)	<0.05
Knowledge of folic acid benefits				
Unknown	1			1
Known	8.21 (6.29–10.73)	<0.01	7.23 (5.49–9.53)	<0.01

CI – Confidence interval; NS – Not significant; OR – Odds ratio.

plan of women to cease contraception for being pregnant. The second part included questions about knowledge about folic acid supplement (yes/no), and whether knowing appropriate time period of folic acid intake and folic acid intake status (daily, sometimes or never). The knowledge about folic acid was defined as knowing its beneficial effect on preventing NTDs; “knowing the proper time period of folic acid intake” was defined as folic acid intake for folic acid intake 4 weeks before pregnancy and during first 12 weeks of pregnancy once a day, while “improper” as intake only during pregnancy.

#### Statistical analysis

Statistical analysis was performed using SPSS10 (SPSS Inc., Chicago, IL). Levels or percentages of the subjects who had proper knowledge on the beneficial effect of folic acid and when to take it were determined for demographic and family planning variables for descriptive purposes. Multivariate logistic regression was used to identify predictors of knowledge on the effect of folic acid and proper time period of intake. Age, education level, contraception and status of family planning were used as the main independent variables. The results were presented as the odds ratio (OR) and 95% confidence interval (CI). A two-tailed *p* value of <0.05 was considered statistically significant.

#### RESULTS

Among 1,362 women at childbearing age in Shanghai who were invited to participate in our study, 1,338 have completed the interview with a response rate of 98.2%. The sociodemographic characteristics of the subjects who completed the study are summarized in Table 1. Among the 1,338 women of childbearing age, 55.6% used contraceptives at all times, 8% used sometimes and 35.6% never used any contraception. 33.9% of the women planned to be pregnant in the next six months. Overall, 49.7% of them knew the benefits of folic acid intake for preventing NTDs. After analysis by multivariate logistic regression, knowledge of folic acid benefits was significantly associated with older age, higher education level and planning to be pregnant, but not with contraception status (Table 2).

In addition, 34.6% of the women answered that folic acid ought to be taken before pregnancy, 16.1% knew that folic acid ought to be taken after pregnancy and the other 49.3% did not know that folic acid should be taken before pregnancy. After multivariate logistic regression analysis, it was demonstrated that the knowledge of correct time of folic acid intake was significantly associated with higher education level, planning to be pregnant and knowing the benefits of folic acid intake (Table 3).

**Table 4.** Univariate and multivariate logistic regression of the association of the actual folic acid intake daily and selected sociodemographic characteristics.

Parameter	Univariate analysis		Multivariate analysis	
	OR (95% CI)	p value	OR (95% CI)	p value
Age (year)				
20–24	1		1	
25–29	1.32 (0.76–2.30)	NS	0.98 (0.53–1.81)	NS
30–34	1.94 (1.07–3.52)	<0.01	1.41 (0.73–2.71)	NS
35–39	2.41 (1.09–5.30)	<0.01	1.73 (0.72–4.11)	NS
40–45	0.83 (0.18–3.86)	NS	1.05 (0.21–5.31)	NS
Education				
High school or less	1		1	
College or university	1.18 (0.80–1.72)	NS	0.90 (0.58–1.39)	NS
Contraception				
At all time	1		1	
Sometimes	1.76 (0.99–3.13)	NS	1.43(0.77–2.66)	NS
Never	2.71 (1.96–3.74)	<0.01	1.61(1.10–2.38)	<0.01
Planning to be pregnant in next six months				
No	1		1	
Yes	5.21 (3.78–7.19)	<0.01	3.54 (2.43–5.14)	<0.01
Knowledge of folic acid benefits				
Unknown	1		1	
Known	4.59 (3.22–6.54)	<0.01	2.81 (1.88–4.20)	<0.01
Time information of FA				
Unknown	1		1	
Known	3.31 (2.43–4.50)	<0.01	2.14 (1.50–3.05)	<0.01

CI – Confidence interval; NS – Not significant; OR – Odds ratio.

Moreover, the study demonstrated that 14.9% of the subjects took folic acid at least once per day, 11.8% took sometimes and 74.3% had never taken it. The multivariate logistic regression analysis revealed that folic acid intake was significantly associated with higher education level, without using contraception, planning to be pregnant, knowing the benefits of folic acid and realizing the correct time of folic acid intake (Table 4).

## DISCUSSION

Firstly, this study has revealed that only 14.9% women at childbearing age in Shanghai, China, regularly take folic acid, similar to that in women living in Croatia (14.4%) [19] and Lebanon (14.0%) [20] and lesser than that in women of Israel (34.0%) after a five-year campaign for promoting the use of folic acid [21]. In addition, 49.7% of women at childbearing age were aware of the benefits of folic acid intake compared with 20–52% in the US [19,21,22]. Moreover, 34.6% of women of childbearing age in Shanghai appreciated the correct time of folic acid intake compared with 30–75% in the US [21–23].

Secondly, our study has showed that women who knew the folic acid benefits were 2.8 times more likely to take preconceptional folic acid than women who did not know, which was in agreement with reports from others that the knowledge of folic acid was strongly linked to actual folic acid intake [10,20,24–26]. In addition, the women who knew the correct time of folic acid intake was 2.1 times more likely to regularly take folic acid than those who did not know this after considering other factors with multivariate regression analysis. Therefore, it is necessary to deliver proper folic acid knowledge that can influence the attitude and behavior of women at childbearing age through health education and promotion. Such knowledge should cover the benefits of folic acid on prevention of birth defects and the correct time of folic acid intake.

Thirdly, there was only a small proportion of women at childbearing age in Shanghai, China (14.9%), actually took folic acid before pregnancy despite knowing the benefits and correct time of folic acid intake [20,27–30] after healthcare campaign [21], which may be the consequence of high incidence

of unintended pregnancy [31]. The periconceptional period is the critical window for primary prevention of birth defects [32]. As previously reported, planning to be pregnant affected the number of women who had the knowledge of periconceptional folic acid intake and who took it [33–36], partly because women planning to be pregnant would pay much more attention on their own health care. In this study, 34% of women planning to be pregnant in the next six months also had the knowledge of folic acid benefits, correct time of folic acid intake, and how to take it. Meanwhile, women who did not plan to be pregnant in the next 6 months and took conception all times were less interested in periconceptional health-care knowledge including the benefits of folic acid intake.

## CONCLUSIONS

In conclusion, knowledge and use of folic acid was relatively poor in women at childbearing age Shanghai, China. Based on the theory that knowledge is a precursor to behavior and does not guarantee an automatic positive behavior modification, health education for reproductive-aged women who plan to be pregnant will play an important role in increasing their folic acid intake. Hence, more health-promoting campaigns are needed to provide specific knowledge on folic acid benefits to all women at childbearing age in Shanghai, China.

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