

# Folic acid awareness and intake among women in areas with high prevalence of neural tube defects in China: a cross-sectional study

Ziqian Zeng<sup>1,2</sup>, Ping Yuan<sup>1</sup>, Yanping Wang<sup>2</sup>, Xi Ma<sup>3</sup> and Jun Zhu<sup>2,\*</sup>

<sup>1</sup>Department of Epidemiology, West China School of Public Health, Sichuan University, Chengdu, People's Republic of China; <sup>2</sup>National Center for Birth Defects Monitoring of China, West China Women's and Children's Hospital, Sichuan University, no. 17, Section 3, South Ren Min Road, Chengdu 610041, People's Republic of China; <sup>3</sup>Shanxi Provincial Maternal and Child Hospital, People's Republic of China

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## Abstract

**Objective:** To measure folic acid awareness and intake rates among women of childbearing age in certain areas of China with a high prevalence of neural tube defects (NTD).

**Design:** A cross-sectional survey was carried out utilising a nineteen-item questionnaire enquiring into individual women's knowledge of, attitude towards and practice of folic acid supplementation.

**Setting:** A total of 293 low-income counties in six provinces of China.

**Subjects:** Women aged 19–44 years from six provinces with a high prevalence of NTD recruited from June to August 2008.

**Results:** Among 33 025 participants, 57% had heard of folic acid but only 15% knew all of the core information. The intake rate was 12%; only 8% took the recommended dose and only 4% of non-pregnant women took folic acid. Some women did not take folic acid because they did not know that they should take it (49%) or they had misconceptions about it (24%). According to logistic regression analysis, rural residence was a risk factor for folic acid awareness. Ethnicity, educational level, average annual income per person and pregnancy were the influencing factors of folic acid awareness and folic acid intake.

**Conclusions:** Although more than half of the respondents had heard of folic acid, the intake rate was still very low in areas with a high prevalence of NTD. Thus, more efforts are needed to increase folic acid awareness and intake among women of reproductive age in these areas.

**Keywords**  
Folic acid  
Neural tube defects  
Awareness  
Intake

Neural tube defects (NTD), one of the most serious birth defects in the world, can lead to stillbirth, infant death and disability. Some studies confirmed that folic acid (400 µg/d) lowers the risk of NTD if women use it before and during early pregnancy<sup>(1,2)</sup>. Folic acid reduces the risk of NTD by 50–70% and prevents other major birth defects<sup>(3)</sup>. Since the 1990s, many developed countries have widely promoted folic acid supplementation for childbearing women as a public health measure against NTD<sup>(4–6)</sup>. Moreover, some developed countries started promoting food fortification<sup>(7,8)</sup>, particularly in 2006, when WHO released a guide on folate fortification to promote folic acid supplement use in all countries<sup>(9)</sup>.

Folic acid awareness and intake rates are important factors to be considered when evaluating the preventive effects of folic acid supplementation on NTD. In the past 10 years, many studies have reported folic acid awareness and intake rates in different counties, regions

or populations<sup>(10–12)</sup>. For example, the March of Dimes Foundation's surveys in the USA have provided annual trends in folic acid awareness and behaviour<sup>(13)</sup>. Relevant studies were conducted in 2002 and 2007 in Japan to determine the awareness rate among laywomen<sup>(14)</sup>. Although most studies focused on women's folic acid awareness or intake rates, they did not deeply analyse differences in intake rates between women with partial knowledge and those with complete knowledge. Furthermore, the reasons for women not taking folic acid have not been sufficiently identified.

Previous studies identified that the prevalence of NTD in the northern areas of China is among the highest in the world<sup>(16,17)</sup> – about 6 per 1000 live births involved NTD in northern rural areas in 1997<sup>(15)</sup>. Since 2008, although the prevalence of NTD had decreased because of some interventions, monitoring of national birth defects showed that the average prevalence of NTD in

\*Corresponding author: Email zhujun028@163.com

northern rural areas of China was about 3 per 1000 births. The surveillance is hospital based and covers pregnancies of  $\geq 28$ -week gestation.

A study in Shan Xi Province of northern China showed that about 10.2% of women had ever used folic acid and only 3.3% used it periconceptionally<sup>(18)</sup>. However, the study was conducted only in four counties from one province in northern China in 2005, hence necessitating further research to obtain more evidence before intervention. The objective of the present study was to obtain data regarding folic acid awareness and intake rates through different characteristics and knowledge points in northern China. Meanwhile, the reasons some women did not take folic acid have also been further analysed. Scientific evidence should be obtained to aid in the formulation of more effective intervention measures among public health decision makers working in areas with high occurrence of NTD.

## Methods

The present study was conducted in 293 low-income counties of six provinces in northern China. The six provinces are Shann Xi, Shan Xi, Qing Hai, Xin Jiang, Gan Su and Inner Mongolia; a very high occurrence of NTD has been recorded in these provinces.

Women who went to local maternal and children's hospitals for prenatal examinations or pre-pregnancy care from June to August 2008 were selected as subjects. In the present study, a woman was considered eligible if she was 19–44 years old, had resided locally for  $>1$  year and had no history of NTD-affected pregnancy.

The self-administered questionnaires were constructed on the basis of relevant literature and recommendations from experts. After conducting pilot tests and revisions of the initial questionnaire, the final questionnaire included a total of nineteen questions. Of these, six questions were with regard to demographic characteristics, eight questions were related to knowledge about folic acid, three questions assessed attitudes towards folic acid intake, one question assessed folic acid intake behaviour and a final question addressed the reasons for not taking folic acid. Among those eight questions on knowledge, four points were defined as core knowledge: the preventive role of folic acid, intake time, intake method and intake dose. In each county, one or two maternal and child health-care workers received training as investigators responsible for participant recruitment and data collection. The formal investigation was conducted after obtaining the participants' consent.

The  $\chi^2$  analysis was performed to test for the difference in the proportions of various characteristics between two or more groups. Logistic regression analysis was used for quantifying an association while adjusting for possible confounding factors.

## Results

A total of 34 626 women were recruited into the present survey. From the questionnaires obtained from the women, 1601 were excluded because of logical errors or incomplete content. Finally, 33 025 questionnaires were used in the present study. The response rate was 95.4%.

Of the 33 025 women, 42% were within 25–30 years of age and 72% were from urban areas. In terms of ethnicity, 72% were Han Chinese. In terms of educational level, 64% had attained educational levels below senior high school. In addition, 81% had an average annual income of  $<6000$  RMB (equal to \$US 860) per person. Of all the respondents, a total of 18 648 women had heard of folic acid, indicating that the awareness rate was only 57%. In all, 12% took folic acid daily but only 8% took the recommended amount. Among the women with  $>12$  weeks of gestation, 8% took folic acid 3 months before pregnancy and 3 months after conception. Furthermore, only 4% of non-pregnant women took folic acid (Table 1).

Folic acid awareness and intake behaviour were analysed in relation to different characteristics. The univariate analysis results from the  $\chi^2$  test showed that all demographic characteristics seemed to influence folic acid awareness and intake behaviour; all *P* values were  $<0.001$  (Table 1). We used the logistic regression analysis to quantify the association of demographic characteristics on awareness and intake behaviour while adjusting for possible confounding factors. Urban residence was positively associated with women's folic acid awareness (OR = 1.41), and women's pregnant status was a significant factor for awareness (OR = 1.51). The increase in educational level was associated with an increase in awareness rate; however, annual income had a weak impact on awareness (Table 2).

With regard to intake behaviour, the dominant factor was women's pregnant status (OR = 4.878), and the rate increased with an increase in educational level (Table 2). No significant differences in intake behaviour were found between women from urban and rural areas (*P* = 0.091).

Knowledge about folic acid was further analysed according to the following indicators: 44% of participants knew that folic acid was a type of vitamin and 27% were aware of the recommended daily folic acid dose, which was relatively low. In all, 15% of women were familiar with all core knowledge of folic acid, which had the lowest rate among all indicators.

The intake rates among women who had partial knowledge of folic acid were lower than among those who had core knowledge. The intake rates in the two groups were 16% and 42%, respectively. In addition, the difference between the intake rates of the two groups was significant (*P*  $< 0.001$ ).

The main source of folic acid knowledge for the participants (57%) was doctors (Table 3). About 34% of women received knowledge from mass media sources

**Table 1** Association of folic acid awareness and intake behaviour with different demographic characteristics in six provinces of China, 2008

Characteristic	Survey sample		Heard of folic acid			Folic acid intake		
	<i>n</i>	%	<i>n</i>	Rate (%)	<i>P</i> value*	<i>n</i>	Rate (%)	<i>P</i> value
Residence								
Urban	9322	28.2	6804	73.0	<0.01	976	10.5	<0.01
Rural	23703	71.8	11844	50.0		1801	7.6	
Ethnic groups								
Han	23873	72.3	15215	63.7	<0.01	2276	9.5	<0.01
Others	9152	27.7	3433	37.5		501	5.5	
Educational level								
Illiterate	1686	5.1	459	27.2	<0.01	46	2.7	<0.01
Primary school	5552	16.8	2027	36.5		255	4.6	
Junior high school	13828	41.9	7108	51.4		1101	8.0	
Senior high school	7077	21.4	5059	71.5		776	11.0	
Junior college	3834	11.6	3157	82.3		465	12.1	
University degree and above	1048	3.2	838	80.0		134	12.8	
Average annual income per person (RMB)								
<1500	11240	34.0	5449	48.5	<0.01	732	6.5	<0.01
1500–2999	9380	28.4	5233	55.8		839	8.9	
3000–5999	6282	19.0	3779	60.2		571	9.1	
6000–10 000	3533	10.7	2376	67.3		340	9.6	
>10 000	2590	7.8	1811	69.9		295	11.4	
Pregnancy								
Non-pregnancy	22345	67.7	12115	54.2	<0.01	956	4.3	<0.01
Pregnancy	10680	32.3	6533	61.2		1821	17.1	

\*Calculated from the  $\chi^2$  test.

**Table 2** Adjusted association of folic acid awareness and intake behaviour with different demographic characteristics in six provinces of China, 2008\*

Characteristic	Heard of folic acid		Folic acid intake	
	OR	95% CI	OR	95% CI
Urban residence	1.41	1.33, 1.50	1.09	0.99, 1.20
Han ethnicity	2.65	2.51, 2.79	1.67	1.51, 1.85
Educational level				
Illiterate		Reference		Reference
Primary school	1.29	1.14, 1.47	1.50	1.09, 2.07
Junior high school	2.20	1.96, 2.47	2.60	1.92, 3.52
Senior high school	4.70	4.15, 5.33	3.76	2.76, 5.13
Junior college	8.07	6.97, 9.35	4.28	3.10, 5.91
University degree and above	7.07	5.80, 8.61	4.41	3.07, 6.34
Average annual income per person (RMB)				
<1500		Reference		Reference
1500–2999	1.08	1.02, 1.15	1.21	1.08, 1.34
3000–5999	1.08	1.01, 1.16	1.07	0.95, 1.20
6000–10 000	1.08	0.99, 1.18	1.06	0.92, 1.23
>10 000	1.06	0.96, 1.18	1.19	1.02, 1.39
Being pregnant	1.51	1.44, 1.59	4.88	4.49, 5.30

\*Calculated from the logistic regression analysis.

such as television, radio, newspapers, magazines and books. Moreover, we found that the group of women who obtained knowledge from family planning staff had the highest daily intake rate (33%).

Among women who did not take folic acid, 49% were not familiar with folic acid and were not aware of the importance of taking it (Table 4). Some participants did not take folic acid because of misconceptions about it. For example, 13% believed that folic acid was a drug and should not be taken by a healthy woman; 11% thought that they had eaten enough green leafy vegetables and

had no need to take additional folic acid and 6% did not take folic acid because of economic limitations.

## Discussion

Measuring folic acid awareness and intake rates among women of childbearing age is essential for understanding the effect of folic acid intervention on NTD. This understanding is important while planning folic acid intervention programmes. The results from the China-US Collaborative

**Table 3** Sources of knowledge related to folic acid in six provinces of China, 2008

Sources	<i>n</i>	Daily intake rate (%)
Doctor	10 691	26.1
Relatives/friends	4367	23.2
Television/radio/newspaper/ magazine/books	6284	21.8
Staff of family planning	3628	33.2
Others	627	22.0

**Table 4** Reasons for not taking folic acid in six provinces of China, 2008

Reasons	<i>n</i>	Rate (%)
Does not know she should take folic acid/have not heard of folic acid	12 932	48.9
Thinks folic acid is a drug	3451	13.0
Eats enough green leafy vegetables and does not need to take additional folic acid	2819	10.7
Does not know the benefits of folic acid	2491	9.4
Folic acid is too expensive	1667	6.3
Folic acid is not recommended by the doctor	1639	6.2
Forgets to take folic acid	1631	6.2
Others	3418	3.8

Project for Neural Tube Defect Prevention showed the effectiveness of daily supplementation of 400 µg of folic acid among women preparing for pregnancy in the Chinese population. Since then, the folic acid supplementation measures had been promoted through some local agencies, such as a family planning department and a civil affairs department. However, in 2008 the government of China began to provide folic acid free of charge to women of reproductive age in 293 low-income counties of six provinces with a high prevalence of NTD. The present survey was the baseline investigation before intervention programmes began. One year later, the Chinese government expanded the intervention from 293 counties of six provinces to all rural areas of China on the basis of the results of the present study.

Many studies on folic acid awareness and intake rates have been conducted in different counties, areas and populations. Some of these studies have measured folic acid awareness rates, such as the rate of exposure to information about folic acid or that folic acid prevents NTD, or the rate of folic acid supplementation before pregnancy. Such rates appear high in many of the countries studied. About 95% of respondents in Canada in 2003 were aware of folic acid<sup>(19)</sup>, nearly 77% of women in Australia had heard of folic acid<sup>(20)</sup> and about 84% of women in the USA knew about folic acid<sup>(21)</sup>. However, knowledge about the preventive role of folic acid and folic acid supplementation methods was found to be much lower than general awareness about folic acid. For example, a study conducted in South Australia in 2007 indicated that only 39% of subjects were aware that they should take folic acid before pregnancy<sup>(20)</sup>. In another

study conducted in 2008, only 39% of surveyed women in the USA<sup>(21)</sup> and 25% of those surveyed in Canada<sup>(19)</sup> were aware that folic acid can prevent NTD.

From the results of the logistic analysis, we found that the awareness rate among women was related to residence, ethnicity, educational level and pregnancy status. The intake behaviour was associated with ethnicity, educational level and pregnancy status. The average increase of annual income per person did not necessarily influence women's awareness and intake behaviours. It indicated that women's educational level was an important factor for awareness and intake behaviour; hence, more programmes should be designed for women with low educational levels, as well as for non-pregnant and minority women. Meanwhile, considering the residence factor, more folic acid information channels should be found for women living in remote areas.

Moreover, we also found that the intake rate correlated with whether women had core knowledge of folic acid. Only 15% of women in our study were familiar with all of the core information about folic acid, which was remarkably lower than the rate of those who had only certain knowledge points about folic acid. By contrast, this group had a significantly higher intake rate than other groups who had only partial knowledge about folic acid, indicating that women who had core knowledge are more easily persuaded to take folic acid compared with others. Therefore, although most women had heard of folic acid, only few were aware of the core points of knowledge for folic acid supplementation. Normally, it is rational to assume that the higher the awareness rate, the higher the intake rate. However, the ideal situation was not seen in many reports. For example, in the USA, the rate of those who had heard of folic acid was nearly 80% but the intake rate was about 40%, and our study showed similar results. We speculated that just hearing of folic acid was not enough for women to change their behaviour. Therefore, we suggested that the awareness promotion should emphasise on the core knowledge of folic acid supplementation. In addition, the core knowledge should be considered as the awareness indicator. It possibly contributes to improvement in health education.

Many studies have reported intake rates and trends in many counties. In the UK, 44.6% of surveyed pregnant women took folic acid in 1998<sup>(22)</sup>; of the women surveyed in the USA, 28% were reported to take folic acid in 1995, which increased to 33% in 2005<sup>(12)</sup> and to 40% in 2007<sup>(21)</sup>. In a study conducted in Japan in 2002, only 9.1% of surveyed pregnant women took folic acid, which increased to 43.1% in 2007<sup>(14)</sup>. A survey of small samples in the northern areas of China with a high prevalence of NTD showed that the folic acid intake rate was 10.2% in 2005<sup>(17)</sup>, whereas the intake rate among pregnant women was 15% in 2004<sup>(23)</sup>. In the present survey, the intake rate was 12% in the northern areas of China with a high prevalence of NTD in 2008. Although there were different samples for

both studies, the findings suggested no remarkable changes during these years. Moreover, still fewer participants took folic acid before pregnancy. The intake rate in China as of 2008 was similar to that of most developed countries in 2000. We identified a significant gap in folic acid intake for women in poor Chinese areas with a high prevalence of NTD compared with those in developed countries. Thus, this gap became a priority intervention field for folic acid supplementation. More efficient interventions are required to encourage women to take folic acid.

Because many women were not taking folic acid, understanding the reasons behind their decision was indispensable. Previous studies rarely analysed why women did not take folic acid, except for the reports from March of Dimes. Our study also focused on some details of cause analysis. The results showed that 49% of participants had never heard of folic acid, which is the first main cause. Various misconceptions on folic acid supplementation became the succeeding reasons why women did not take folic acid. These findings indicated that educational materials should list not only the benefits of folic acid but also women's misconceptions about supplementation. Among those who did not take folic acid, 6% said that the reason was purely economical. Therefore, the economic factor is not a major reason behind the decision not to take folic acid.

Our results showed that doctors' recommendations affected women's decisions to take folic acid, which supports the results of other studies. For example, a study conducted in Chile found that about 54% of surveyed individuals obtained information on folic acid through midwives and doctors<sup>(24)</sup>. Some special training should aim at enhancing health practitioners' knowledge about folic acid and promote their counselling skills.

## Conclusion

In general, there was a large gap in folic acid supplementation awareness and intake rates between China and developed countries in 2008. Meanwhile, the present study found that core knowledge about folic acid supplementation is essential for improving the folic acid intake rate. More knowledge points should be provided for women as the next step in our folic acid promotion programme. Our results suggest that future policies must focus on women with low educational levels living in remote areas who hold misconceptions about folic acid supplementation. Meanwhile, doctors and health practitioners should also play an influential role in changing women's attitudes towards folic acid and its intake.

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