

ORIGINAL ARTICLE

Consumption of dietary supplements by Chinese women during pregnancy and postpartum: A prospective cohort study

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Abstract

The objectives of this study were to investigate usage patterns and factors associated with maternal dietary supplementation by Chinese women. A prospective cohort study of 695 mothers, who gave birth to a singleton baby, was conducted in Jiangyou, Sichuan Province of China. Information on dietary supplement use was collected from participants by personal interview at hospital discharge and followed up by telephone at 1, 3, and 6 months postpartum. Logistic regression analysis and generalised linear-mixed modelling were performed to determine factors affecting dietary supplementation during pregnancy and the first 6 months postpartum, respectively. A total of 81.8 and 32.1% of women consumed dietary supplements during pregnancy and postpartum, respectively. Calcium was the most popular supplement (pregnancy 63.9%; postpartum 28.1%), whereas folic acid was only taken during pregnancy (62.3%) with an average usage duration of 2.5 (standard deviation 1.3) months among users. High school and above education, adjusted odds ratio (OR) = 2.67, 95% confidence interval (CI) [1.63, 4.38], and attendance at prenatal classes (adjusted OR = 1.99, 95% CI [1.05, 3.76]) were associated with dietary supplementation during pregnancy. Mothers with a higher level of education (adjusted OR = 3.10, 95% CI [1.81, 5.30]) were also more likely to use dietary supplements in the postpartum period. Although dietary supplementation appeared to be common among Chinese mothers, maternal intake of folic acid was well below the guidelines. There is a need for further nutrition education on maternal use of micronutrient supplements, especially targeting mothers who are less educated.

KEYWORDS

China, dietary supplements, folic acid, nutrition, postpartum, pregnancy

1 | INTRODUCTION

The nutritional status of a woman during pregnancy and the postpartum period has a significant impact, not only on her own health but also on foetal and infant growth and development (Chen et al., 2012; Vause, Martz, Richard, & Gramlich, 2006), which may continue to influence the health of her infant at a later age (Barker, 2004; Berti et al., 2010). It is vital that pregnant and lactating mothers eat a variety of healthy foods to meet the increased nutrient demands caused by maternal physiological changes (Picciano, 2003). However, the daily intakes of several micronutrients through food sources alone, such as iron and folate, may be below the recommended levels even among pregnant and childbearing age

women in developed countries (Bailey et al., 2010; Watson & McDonald, 2009).

Apart from interventions to improve the diet quality, provision of dietary supplements is a common approach to increase maternal intake of specific micronutrients. Examples include the international recommendation for oral folic acid supplementation in the periconceptional period (American Academy of Pediatrics Committee on Genetics, 1999; National Health and Medical Research Council & New Zealand Ministry of Health, 2006) and the routine iron supplementation for all pregnant women (WHO, 2012a, 2012b). There is convincing evidence that daily consumption of 0.4 mg of folic acid before and during early weeks of pregnancy can reduce the risk of neural tube defects (Czeizel & Dudas, 1992; De-Regil, Fernandez-

Gaxiola, Dowswell, & Pena-Rosas, 2010). Similarly, regular intake of iron supplements during pregnancy is effective in preventing maternal anemia, iron deficiency, and low birth weight (Haider et al., 2013; Pena-Rosas, De-Regil, Dowswell, & Viteri, 2012). Nevertheless, caution should be exercised with certain supplements such as vitamin A as its excessive intake may lead to increased risk of birth defects (Oakley & Erickson, 1995).

To date, studies on maternal dietary supplementation were mainly conducted in Western countries. A national survey undertaken in the USA from 1999 to 2006 reported that 78% of pregnant women used dietary supplements in the previous 30 days (Branum, Bailey, & Singer, 2013), whereas over 73% of lactating mothers consumed at least one vitamin or mineral supplement in a medical centre in Pennsylvania (Stultz, Stokes, Shaffer, Paul, & Berlin, 2007). A birth cohort study in Finland found that prevalence of dietary supplementation was about 85% during pregnancy (Arkkola et al., 2006). Another survey from South Korea suggested usage rates of 88% for pregnant women and 60% for lactating mothers (Kim et al., 2013). Being older and more educated has been identified to increase the prevalence of dietary supplementation (Arkkola et al., 2006; Kim et al., 2013; Picciano & McGuire, 2009).

In China, the national guidelines recommend that pregnant women use folic acid supplements, and women suffering from anaemia or iron deficiency should take a low dose of iron supplement under doctors' guidance (Chinese Nutrition Society, 2010). A cross-sectional study conducted in eight provinces in 2009 revealed that 50 and 16% of the 726 pregnant women surveyed had used folic acid and iron supplements, respectively, but the prevalence varied significantly between urban and rural areas (Wang et al., 2010). In general, the usage patterns have not been documented, and information is lacking on Chinese mothers regarding their supplementation in the postpartum period.

Along with a rapid economic growth, many types of dietary supplements are now marketed and available in China, including single ingredient products and combinations of vitamins, minerals, and other constituents. This study aimed to determine the prevalence and type of dietary supplements used by Chinese women during pregnancy and the first 6 months postpartum and to ascertain the factors associated with their use. The focus was on tablet, capsule, and powder forms of dietary supplements, excluding traditional Chinese medicines, herbals, and botanicals.

2 | PARTICIPANTS AND METHODS

2.1 | Study design and setting

A prospective cohort study was undertaken during 2010–2011 in Jiangyou, Sichuan Province, China. Sichuan is a large province in Western China with a population of 80 million people. According to its provincial Health and Family Planning Commission in 2011, approximately 95% of the pregnant women had hospital delivery. Jiangyou, a typical county level town with a population of 880,000, is located 160 km north of the provincial capital city Chengdu. In 2010, the annual per capita income of urban and rural residents in Jiangyou was 15,400 yuan and 6,500 yuan, respectively. The birth and death rates were 7.7 and 5.3 per 1,000 population. Between March and November 2010, mothers aged greater than or equal to 18 years, who gave a singleton birth at one of the seven hospitals in Jiangyou, were invited to participate in this study before discharge. Exclusion criteria were unable to answer the questions due to limited understanding, illness, or deemed unsuitable as advised by the health professionals. A minimum sample size of 530 mothers at 6 months postpartum was required, assuming an estimated prevalence of dietary supplementation between 28 and 36% in the first 6 months after delivery and at 5% level of significance.

2.2 | Procedure

At discharge, a total of 695 eligible women consented to participate (response rate 96%) and were interviewed face-to-face by the first author or a trained nurse using a structured questionnaire. Information on the frequency and duration of usage was recorded for nine categories of common dietary supplements, namely, folic acid, iron, calcium, multivitamins and minerals, vitamin C, vitamin E, zinc, protein powders, and miscellaneous (such as fish oil, vitamin D, vitamin A, docosahexaenoic acid, and α -Linolenic acid). Folic acid, iron, calcium, vitamin C, vitamin E, and zinc were individual dietary supplements. In addition, the sources of recommendation regarding dietary supplementation were documented among users.

The baseline survey also collected information on sociodemographic (age, educational level, occupation, and household income), health-related (parity, attendance at prenatal classes), and lifestyle (smoking status, alcohol drinking, and tea drinking) characteristics.

Key messages

- More than 80% of Chinese women consumed dietary supplements during pregnancy and almost one-third of them continued to use supplements after childbirth.
- Calcium was the most popular maternal dietary supplement in our study.
- Maternal intake of folic acid and iron supplements was well below the guidelines.
- The majority of our participants cited hospital staff as their source of recommendation for dietary supplements.
- Nutrition education on maternal use of micronutrient supplements should be provided to childbearing age women, especially those who are less educated.

To determine prenatal smoking status, we classify participants who reported smoking any cigarette during pregnancy as smokers and the rest as nonsmokers. Both alcohol drinking and tea drinking were defined in a similar manner.

The cohort was then followed up by the first author who telephoned the participants at 1, 3, and 6 months postpartum to obtain detailed information on the consumption of dietary supplements and other characteristics after childbirth. The questions used in the surveys had been validated for the Chinese population in previous studies (Liang, Lee, & Binns, 2009; Qiu, Binns, Zhao, Lee, & Xie, 2010). A flow-chart of participant recruitment and follow-up is presented in Figure S1.

2.3 | Statistical analysis

Dietary supplement users during pregnancy were defined as women who had consumed at least one dietary supplement between the estimated conception date and the date of childbirth. Likewise, users in the postpartum period were mothers who had taken at least one dietary supplement within the first 6 months postpartum. Descriptive statistics were first applied to summarise the sample characteristics. The associations between use of dietary supplement and characteristics of the participants were examined using chi-square test. The prevalence of dietary supplementation was next tabulated, along with the frequency and duration of usage for each supplement category among users. Standard and mixed binary logistic regression models were then fitted to ascertain factors associated with dietary supplementation during pregnancy and the postpartum period, respectively. The latter incorporated both subject- and hospital-specific random effects to account specifically for the correlation of the repeated measures. All statistical analyses were undertaken using the SPSS package version 22 (IBM, Armonk, NY, USA).

2.4 | Ethical considerations

The project protocol was approved by the local hospitals, health authority, and the Human Research Ethics Committee of Curtin University (approval number HR 169/2009). An information letter explaining the study was given and read to each mother. Informed written consent was obtained before commencement of each interview. All participants were assured of anonymity and confidentiality of information provide, and that they could withdraw freely from the study at any time.

3 | RESULTS

3.1 | Characteristics of participants

By 6 months postpartum, 599 mothers (86.2%) remained in the cohort. Among the dropouts, 55 women (57.3%) could no longer be contacted by telephone, 39 (40.6%) decided to withdraw, and 2 women (2.1%) declined because their infants were severely ill. Compared to women remaining in the cohort, those who were lost to follow up tended to have a higher household income ($p = .012$), but no significant differences were evident in parity ($p = .466$), maternal education

($p = .171$), employment ($p = .233$), or age at delivery ($p = .679$) between the two groups.

The average age of participants was 25.2 (standard deviation [SD] = 4.9) years. More than half attained middle school or below (54.7%), were employed (68.8%), and came from families with a monthly income less than 3,000 yuan (53.3%). Approximately, 80% of the participants gave birth to their first baby, and 98.4% had a gestation over 37 weeks. In terms of lifestyle habits, more than 97% of mothers had never smoked or drunk alcohol whilst pregnant, and about 90% of them continued to abstain from smoking and consuming alcoholic beverages after giving birth. Similarly, less than 30% of women drank tea during the study period.

Table 1 compares the characteristics of dietary supplement users and nonusers during pregnancy and the postpartum period. Pregnant women users appeared to be older and primiparous, have attended prenatal classes, and have a higher education level with greater household income than nonusers. After childbirth, dietary supplements were more likely to be consumed by mothers who have completed high school or above than those with middle school education or below.

3.2 | Prevalence, frequency, and duration of usage

Overall, 557 women (81.8%) had taken dietary supplements whilst pregnant and the prevalence decreased to 32.1% during the postpartum period. The users often consumed more than one type of product. Table 2 presents the prevalence of the nine dietary supplement categories. The most commonly consumed supplements among pregnant women were calcium (63.9%) and folic acid (62.3%), followed by iron (11.3%). For new mothers, calcium (28.1%) remained popular, but other supplements were rarely consumed after giving birth. Table 3 shows the frequency and duration of intake for the three most popular supplements. Although they were often taken daily by users, the average usage duration varied from 1 to 3 months during pregnancy but from 2 to 5 months in the postpartum period.

3.3 | Referral sources

As summarised in Table 4, 60 (10.8%) pregnant women reported that they made the decision of dietary supplementation themselves, whereas 418 (75.0%) and 100 (18.0%) pregnant women were recommended by hospital staff and family members, respectively. Regarding the referral sources after delivery, nearly 60% of mothers were advised by hospital staff, 13.3% cited friends, and 34.8% made the decision based on their own knowledge and information.

3.4 | Factors associated with usage

Table 5 shows the results of standard binary logistic regression and mixed binary logistic regression modelling with subject-specific random effects of the association between potential factors and use of dietary supplements during pregnancy and the first 6 months postpartum, respectively. Maternal education level of high school or above, adjusted odds ratio (OR) = 2.67, 95% confidence interval (CI) [1.63, 4.38], and attendance at prenatal classes (adjusted OR = 1.99, 95% CI [1.05, 3.76] were significantly associated with dietary

TABLE 1 Characteristics of mothers by dietary supplementation status during pregnancy and the first 6 months postpartum

Characteristic	Pregnancy ^a			Postpartum ^a (0 ~ 6 months)		<i>p</i> ^c
	Nonuser (n = 124)	User ^b (n = 557)	<i>p</i> ^c	Nonuser (n = 444)	User ^d (n = 210)	
Age at childbirth			<.001			.500
<30 years	85 (68.5%)	476 (85.5%)		371 (83.6%)	171 (81.4%)	
≥30 years	39 (31.5%)	81 (14.5%)		73 (16.4%)	39 (18.6%)	
Educational level			<.001			<.001
Middle school or below	93 (75.0%)	280 (50.3%)		271 (61.0%)	87 (41.4%)	
High school or above	31 (25.0%)	277 (49.7%)		173 (39.0%)	123 (58.6%)	
Occupation before pregnancy			.343			.209
Not employed	34 (27.4%)	177 (31.8%)		142 (32.0%)	57 (27.1%)	
Employed	90 (72.6%)	380 (68.2%)		302 (68.0%)	153 (72.9%)	
Monthly household income			.019			.076
≤3,000 yuan	72 (63.2%)	263 (51.1%)		228 (56.2%)	96 (48.5%)	
>3,000 yuan	42 (36.8%)	252 (48.9%)		178 (43.8%)	102 (51.5%)	
Parity			<.001			.221
Primiparous	81 (65.3%)	461 (82.8%)		352 (79.3%)	175 (83.3%)	
Multiparous	43 (34.7%)	96 (17.2%)		92 (20.7%)	35 (16.7%)	
Attendance at prenatal classes			.020			.267
No	110 (88.7%)	444 (79.7%)		367 (82.7%)	166 (79.0%)	
Yes	14 (11.3%)	113 (20.3%)		77 (17.3%)	44 (21.0%)	
Smoking status			.695			.192
Nonsmoker	121 (97.6%)	549 (98.6%)		443 (99.8%)	207 (98.6%)	
Smoker	3 (2.4%)	8 (1.4%)		1 (0.2%)	3 (1.4%)	
Alcohol drinking			.934			.662
No	121 (97.6%)	540 (96.9%)		399 (89.9%)	191 (91.0%)	
Yes	3 (2.4%)	17 (3.1%)		45 (10.1%)	19 (9.0%)	
Tea drinking			.274			.488
No	82 (66.1%)	396 (71.1%)		349 (78.6%)	160 (76.2%)	
Yes	42 (33.9%)	161 (28.9%)		95 (21.4%)	50 (23.8%)	

^aMissing data present.

^bParticipant who had used at least one dietary supplement between the estimated conception date and the date of childbirth.

^c*p* values from chi-square test of association between characteristic and dietary supplementation status.

^dParticipant who had used at least one dietary supplement in the first 6 months postpartum.

TABLE 2 Prevalence of dietary supplements consumed during pregnancy and the first 6 months postpartum

Category	Pregnancy (n = 681)	Postpartum (month)			
		0 ~ 1 (n = 648)	2 ~ 3 (n = 620)	4 ~ 6 (n = 599)	0 ~ 6 (n = 654)
Multivitamins and minerals	45 (6.6%)	7 (1.1%)	12 (1.9%)	12 (2.0%)	19 (2.9%)
Folic acid	424 (62.3%)	2 (0.3%)	1 (0.2%)	0 (0.0%)	3 (0.5%)
Vitamin C	45 (6.6%)	5 (0.8%)	3 (0.5%)	2 (0.3%)	7 (1.1%)
Vitamin E	32 (4.7%)	2 (0.3%)	6 (1.0%)	6 (1.0%)	10 (1.5%)
Calcium	435 (63.9%)	93 (14.4%)	127 (20.5%)	111 (18.5%)	184 (28.1%)
Iron	77 (11.3%)	16 (2.5%)	6 (1.0%)	0 (0.0%)	19 (2.9%)
Zinc	14 (2.1%)	2 (0.3%)	3 (0.5%)	3 (0.5%)	4 (0.6%)
Protein powders	24 (3.5%)	6 (0.9%)	4 (0.6%)	1 (0.2%)	6 (0.9%)
Miscellaneous ^a	10 (1.5%)	0 (0.0%)	2 (0.3%)	0 (0.0%)	2 (0.3%)
Overall	557 (81.8%)	116 (17.9%)	147 (23.7%)	122 (20.4%)	210 (32.1%)

^aData includes fish oil, vitamin D, vitamin A, docosahexaenoic acid, and α-Linolenic acid.

supplementation during pregnancy. Mothers with a higher level of education (adjusted OR = 3.10, 95% CI [1.81, 5.30]) were also more likely to use dietary supplements in the postpartum period, after

accounting for other available confounding factors. Similar results were produced after incorporating both subject- and hospital-specific random effects in the mixed binary logistic regression model.

TABLE 3 Frequency and duration of popular dietary supplements consumed by users during pregnancy and the first 6 months postpartum

Category	n (%) ^a	Prevalence of daily use (%)	Mean duration (SD) in months
Pregnancy (n = 557)			
Calcium	435 (78.1%)	93.6	3.0 (2.1)
Folic acid	424 (76.1%)	97.9	2.5 (1.3)
Iron	77 (13.8%)	97.4	1.1 (1.3)
Postpartum (n = 210)			
Calcium	184 (87.6%)	81.0	4.9 (1.1)
Iron	19 (9.0%)	89.5	2.2 (0.8)
Multivitamins and minerals	19 (9.0%)	78.9	5.1 (1.2)

Note. SD= standard deviation.

^aAmong users of dietary supplements

TABLE 4 Sources of recommendation regarding use of dietary supplements^a

Referral sources	Pregnancy (n = 557)	Postpartum (0 ~ 6 months) (n = 210)
Self-decision	60 (10.8%)	73 (34.8%)
Hospital staff	418 (75.0%)	125 (59.5%)
Private health workers	14 (2.5%)	0 (0.0%)
Pharmacy sales persons	10 (1.8%)	4 (1.9%)
Family members	100 (18.0)	11 (5.2%)
Friends	62 (11.1%)	28 (13.3%)

^aMultiple responses allowed

4 | DISCUSSION

This prospective cohort study provides the first report on dietary supplementation among pregnant and postpartum women in Sichuan Province, China. Our prevalence of 81.8% during pregnancy was consistent with the estimate for urban pregnant women in 2009 (Wang et al., 2010) and comparable with the 79.3% usage rate in metropolitan Chengdu about 1 decade ago (Zeng et al., 2004). The antenatal prevalence was also similar to those of several developed countries, including the USA (78%; Branum et al., 2013), Finland (85%; Arkkola et al., 2006), Norway (81%; Haugen, Brantsaeter, Alexander, & Meltzer, 2008), South Korea (88%; Kim et al., 2013), and Japan (75%; Sato et al., 2013), but lower than the prevalence of a cross-sectional survey in Australia, where 92% of the pregnant women took at least one vitamin supplement (Forster, Wills, Denning, & Bolger, 2009). Furthermore, our finding of 32.1% usage postpartum was considerably lower than those observed among lactating mothers in North America (>50%; Picciano & McGuire, 2009) and South Korea (60%; Kim et al., 2013).

Calcium was identified as the most popular supplement. The average dietary calcium intake by Chinese pregnant women was estimated to be 388 mg/day (Wang et al., 2010), well below the recommended intake of 800 to 1,000 mg/day during pregnancy (Chinese Nutrition Society, 2014). According to a recent Cochrane

systematic review, calcium supplementation of at least 1 g/day significantly reduced the risk of pre-eclampsia and gestational hypertension, especially for women with low-calcium diets (Hofmeyr, Lawrie, Atallah, Duley, & Torloni, 2014). It is likely that most of our participants did not obtain sufficient calcium from food sources during pregnancy and therefore would benefit from the antenatal calcium supplementation. However, there is a lack of evidence on the effects of calcium supplements on postpartum or lactating women (Kalkwarf, Specker, Bianchi, Ranz, & Ho, 1997; Wosje & Kalkwarf, 2004). Consequently, mothers should be encouraged to follow dietary guidelines to have a balanced diet with adequate intakes of calcium-rich dairy and soy products (Chinese Nutrition Society, 2010).

Although both the WHO and Chinese Nutrition Society advise all women to take folic acid supplements daily throughout pregnancy (Chinese Nutrition Society, 2010; WHO, 2012b), less than two-third of our participants followed the recommendation in their current pregnancy, and the average duration of usage was only 2.5 (SD = 1.3) months. Furthermore, folic acid and iron supplementation should be provided to women for at least 3 months after childbirth to reduce risk of illness due to anaemia (WHO, 2013), yet only three mothers had taken folic acid supplements postpartum. Fortification of food with folic acid is known to be effective in primary prevention of neural tube defects (Centers for Disease Control and Prevention, 2004; De Wals et al., 2007; Hertrampf & Cortes, 2008). Nevertheless, food fortification with folic is not mandatory in China. In view of the reported lack of knowledge and awareness about folic acid supplementation (Lian, Ma, Zhou, & Li, 2011; Zeng, Yuan, Wang, Ma, & Zhu, 2011), maternal nutrition education targeting childbearing age women appears to be an alternative to food fortification.

Our finding that hospital staff being the main source of referral on dietary supplementation was consistent with results of a previous survey (Wang et al., 2010). It is important that mothers consult a health professional before initiating usage (Frawley et al., 2014). Meanwhile, medical doctors working with childbearing age women should rely on scientifically proven information before making recommendations to their clients.

Two factors, maternal education and attendance at prenatal classes, were identified to influence the use of dietary supplements. The literature has demonstrated the link with higher education level among pregnant women (Arkkola et al., 2006; Haugen et al., 2008; Kim et al., 2013) and the general population (Kofoed, Christensen, Dragsted, Tjonneland, & Roswall, 2015; Rock, 2007). As expected, attendance at prenatal classes was related to antenatal supplement intake. Pregnant women are generally receptive to health counselling and advice (Pirainen, Isolauri, Lagstrom, & Laitinen, 2006), which would enable health professionals to promote healthy eating with adequate nutrients intake. Research of pregnant women in Western societies found that nonsmokers are more likely to use dietary supplements (Forster et al., 2009; Haugen et al., 2008). The observed lack of association in our study was probably due to the small number of smokers among the participants.

Maternal consumption of traditional Chinese medicines, herbals, and botanicals was beyond the scope of the study. However, Chinese herbal medicines have been used in China since ancient times and are

TABLE 5 Factors associated with dietary supplementation during pregnancy and the first 6 months postpartum

Factors	Pregnancy (n = 629)		Postpartum (n = 604)	
	Adjusted OR ^a (95% CI)	p	Adjusted OR ^b (95% CI)	p
Age at childbirth		.161		.053
<30 years	1.00		1.00	
≥30 years	0.64 (0.34, 1.20)		2.60 (0.99, 6.85)	
Educational level		<.001		<.001
Middle school or below	1.00		1.00	
High school or above	2.67 (1.63, 4.38)		3.10 (1.81, 5.30)	
Occupation before pregnancy		.162		.465
Not employed	1.00		1.00	
Employed	0.71 (0.44, 1.15)		1.24 (0.70, 2.19)	
Monthly household income		.222		.443
≤3,000 yuan	1.00		1.00	
>3,000 yuan	1.32 (0.85, 2.05)		1.23 (0.72, 2.09)	
Parity		.176		.100
Primiparous	1.00		1.00	
Multiparous	0.66 (1.05, 3.76)		0.45 (0.17, 1.17)	
Attendance at prenatal classes		.035		.841
No	1.00		1.00	
Yes	1.99 (1.05, 3.76)		1.07 (0.56, 2.04)	
Smoking status		.451		.801
Nonsmoker	1.00		1.00	
Smoker	0.48 (0.11, 2.18)		1.42 (0.09, 21.76)	
Alcohol drinking		.320		.517
No	1.00		1.00	
Yes	1.97 (0.52, 7.44)		0.68 (0.21, 2.18)	
Tea drinking		.388		.289
No	1.00		1.00	
Yes	0.82 (0.52, 1.29)		1.51 (0.70, 3.25)	

Note. CI = confidence interval, OR = odds ratio.

^aResults from standard binary logistic regression analysis.

^bResults from mixed binary logistic regression model with subject-specific random effects.

often regarded as natural and safe. It is likely that some participants in our study may have chosen to consume traditional herbal medicines instead of western dietary supplements.

A major strength of this study is its prospective cohort design, which minimised recall errors on dietary supplement intake especially in the postpartum period. Our participants were recruited from seven hospitals that serve the entire catchment region and thus should be representative of the target population of Sichuan Province. Nonetheless, there are several limitations. Due to logistical difficulties, detailed information on the brand names of dietary supplements was not collected so that the quantity of nutrients intake from such supplements could not be calculated. Although information on both the frequency and duration of the usage was recorded for each category of supplements, data on maternal compliance with dietary supplementation were not collected. Another limitation concerns the lack of qualitative data on the perception and belief behind dietary supplement use. Future qualitative research with in-depth interviews is recommended to further determine the reasons for maternal dietary supplementation. In addition, no data were collected regarding the preconceptional use of dietary supplements. Information on dietary supplement intake

during pregnancy was collected at hospital discharge, which may introduce recall errors. However, because the questions were asked within a short period of the event, it is unlikely that significant recall errors occurred. Finally, China is a large country with various stages of economic development in different areas. Replications of our study are required before generalising our findings to the entire population of Chinese mothers.

In conclusion, dietary supplementation appeared to be common for pregnant women in Sichuan Province of China, and almost one-third of them continued to consume supplements after giving birth. Calcium emerged as the most popular dietary supplement, whereas maternal intake of folic acid and iron supplements was well below the guidelines. There is a need for further nutrition education on maternal use of micronutrient supplements, especially targeting mothers who are less educated.

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CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

CONTRIBUTIONS

AHL and CWB designed the study, LT recruited participants and undertook data collection, LT and AHL conducted data analysis, LT drafted the manuscript, and AHL, KKWY, and YVH revised the manuscript. All authors have read and approved the manuscript.

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SUPPORTING INFORMATION

Additional Supporting Information may be found online in the supporting information tab for this article.

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