The final version of this paper is published in *ANZJOG* 2016; 56: 154-161

Dietary vitamin, mineral and herbal supplement use: a cross-sectional survey of before and during pregnancy use in Sydney, Australia.

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Running title: dietary supplement use in pregnancy

Word count: abstract 243

Word count: main text 2491

References 29

Key words: vitamins, dietary supplements, pregnancy, multivitamins

ABSTRACT

AIM: To describe use of dietary vitamin, mineral and herbal supplements before and during pregnancy.

METHODS: Pregnant women attending antenatal care at two tertiary Sydney hospitals between January and March 2014 completed an anonymous survey. Information on general maternal and pregnancy characteristics and the use of dietary and herbal supplements, including type, duration, and sources of information was collected. Frequency and contingency tabulations were performed.

RESULTS: 612 women agreed to participate (91% response rate). 23 were excluded due to incomplete data. Of 589 women included in the analysis, the mean gestational age at the time of survey was 28.5 weeks (SD 8.3), 55% had no children, and 67% were tertiary educated. Overall 62.9% of women reported taking a multivitamin (MV) and/or folic acid (FA) supplement in the 3 months pre-pregnancy. At the time of the survey 93.8% of women were taking at least one supplement (median 2, range 1-13). During pregnancy 79.1% of women were taking MVs, including 59.2% taking MV only and 19.9% taking MV and FA. The 5 most common supplements outside of a MV were FA (31%), iron (30%), vitamin D (23%), calcium (13%) and fish oil (12%).

CONCLUSION: Use of folic acid and MVs and other supplements during and pre-pregnancy is relatively high, although pre-pregnancy FA supplementation rates could still be improved. Further research on the actual dosages and dietary intakes consumed are needed to examine whether pregnant women have adequate intake of nutrients, regardless of supplement use.

INTRODUCTION

Dietary supplement use is increasing worldwide, including among pregnant women.[1, 2] It is well-known that a woman's nutritional status before and during pregnancy influences the well-being of both mother and fetus.[3] Pregnant women aiming to optimise their own or their baby's health may use dietary supplements.[4]

Folic acid (FA) / folate supplement use is recommended pre and in early pregnancy to reduce the risk of fetal neural tube defects (NTD).[5] In pregnant women without malnutrition, the necessity or benefit of other nutrients supplied via dietary supplements is unclear.[3] A variety of dietary supplements are commercially available; some contain FA alone, while others contain single or multiple vitamins, minerals or herbal ingredients. Some studies have pointed out that the safety, or evidence base of dietary supplements containing herbal ingredients, is not conclusive for pregnancy.[6-9]

There is limited information on dietary supplement use before and during pregnancy among women of all gestational ages. A survey of 588 women near term in Melbourne in 2004, found that 36% of women took at least one herbal supplement, the most common being raspberry leaf (14%), ginger (12%) and chamomile (11%).[10] With increased availability and marketing, dietary supplement use in pregnant women is expected to increase in Australia. Therefore, the aim of this study was to examine the current status of dietary supplement use before and during pregnancy, and characteristics of pregnant women taking these.

MATERIALS AND METHODS

A cross-sectional survey of pregnant women attending antenatal care between January and March 2014 was conducted at two tertiary teaching hospitals in Sydney, New South Wales: Royal North Shore Hospital and the Royal Hospital for Women. Eligibility criteria included the ability to complete the questionnaire in English. Women may have been attending medical and/or midwifery models of care, or shared-care with their general practitioner. Women were given verbal and written information about the study and consent was ascertained via the woman returning the completed survey to the recruiter or a covered marked box.

The aim of the survey was to collect information about vitamin, mineral and herbal supplement use 3 months before pregnancy and during the current pregnancy. The survey was self-administered and anonymous, and took approximately 10 minutes to complete. No pregnancy outcomes were determined. The survey was developed based on a review of literature, existing surveys, and discussion with researchers and midwives. After piloting the survey, minor modifications were made in the sequence, but not to the content of questions. The survey consisted of 22 items organised into three sections. Section 1 collected information on general maternal and pregnancy characteristics such as age, education level, parity, gestational age, height and weight, intake of red meat and food allergies, restrictions and intolerances. Section 2 collected information on previous pregnancy factors regarded as potential determinants of current iron status and/or iron supplement use. These factors and other survey data related to iron have been reported elsewhere (Chatterjee, unpublished). Section 3 collected data on type(s) of supplements consumed in the 3 months prior to the current pregnancy and during the current pregnancy. Response options for type(s) of supplements 3 months prior to pregnancy included: none, multivitamin (MV), FA, iron and

Vitamins D, B and A, and 'other'. Current MV supplement use was categorised as either yes or no, and the response options for the combination of vitamins, herbs or dietary supplements that women were currently taking, that were not in the form of a MV, comprised a list of 18 items including: none, iron, FA, vitamin A, vitamin D, calcium, nettle leaf and ginseng. Women were asked to tick more than one response option, if applicable. Women were also asked about the average amount of money spent per month and main sources of information for dietary supplement use in pregnancy.

Maternal age was categorised into <25, 25-34, and >35 years. Gestational age was categorised into ≤20, 21-26 and ≥27 weeks to correspond with gestational age distribution of responses and then dichotomised to <20 and ≥20 weeks taking into account that many women do not book for antenatal care until closer to 20 weeks gestation. Body mass index (BMI; kg/m^2) was calculated using patient reported pregnancy booking weight and height, and categorised using international standards.[11] Ethics approval was obtained for both sites (HREC# LNR/13/HAWKE/340).

Statistical analysis

Cross-tabulations were used to examine use of MVs and FA 3 months before pregnancy and during the current pregnancy, by gestational age at time of survey (<20 or ≥20 weeks) and by maternal and pregnancy characteristics. Descriptive statistics of the prevalence of dietary supplement use 3 months prior to, and during the current pregnancy, and pregnancy characteristics of respondents were estimated for MV and any type of dietary supplement. Current intake of individual dietary vitamin, mineral, and herbal supplements (outside MV supplement) was examined from highest to lowest prevalence and compared by mean (SD)

gestational week at the time of survey using the Satterthwaite statistic to test for statistically significance differences. The most common individual dietary vitamin, mineral, and herbal supplements (FA, vitamin D, calcium, and fish oil) were compared by maternal and pregnancy characteristics. Descriptive statistics involved percentage tabulation and contingency tables. Statistical testing was performed using Chi-squared (X^2) test, or in the case of small cell sizes, the Fisher's exact test for categorical variables and the Wilcoxon signed rank test for continuous variables. All analyses were performed using SAS version 9.3 (SAS Institute Inc) and P-values <0.05 were considered statistically significant.

RESULTS

Of 674 women invited to participate, 612 agreed to participate (91% response rate). After excluding 23 women with incomplete data, 589 women were included in the final analysis. Two thirds of women (64%) were over 26 weeks' gestation (mean gestation (weeks) ± SD: 28.5±8.3), 55% had no children, 28% were overweight or obese, and 67% were tertiary educated (Table 1).

In the three months before pregnancy, 66.5% of women reported taking any dietary supplement. Overall, 62.9% of women stated that they took either a MV and/or FA three months pre-pregnancy: of these 25.7% of women took a MV only, 19.9% took FA only and 17.3% of women took both FA and a MV (Figure 1). Apart from MV and FA supplement use, the prevalence of specific supplement use before pregnancy was 10.1% for iron, 6.7% for iodine, 13.2% for vitamin D, 5.5% for B vitamins, 2.1% for vitamin A, and 15.2% 'other.' The 'other' category included a range of responses; however, the most frequently reported were calcium and fish oil.

At the time of survey, 93.8% of women reported taking at least one supplement. The majority of women (90.2%) were taking MV and/or folic acid (Figure 1). Overall 79.2% of pregnant women reported currently taking a MV supplement (Table 1): 59.2% of women a MV only and 19.9% both MV and FA, while another 10.1% of women were taking FA supplement only. There were no significant differences in maternal or pregnancy characteristics in women currently using or not using MV supplements, except women taking a MV were more likely to report having gestational diabetes mellitus ($P<0.004$). Compared to women not currently taking a MV, current MV users were more likely to have taken any type of supplement three months prior to pregnancy (i.e. MV and/or other dietary supplement) (53.3% vs. 70.0%, $P=0.006$) or a MV supplement (15.8% vs. 50.6%, $P<0.001$) but not a FA only supplement (42.5% vs. 35.5%, $P=0.16$). There was no association between women's gestational age at the time of survey (<20 and ≥20 weeks gestation) and reported supplement use for MV only (58.4% vs. 59.2%), FA only (13.6% vs. 9.0%), both (20.0% vs. 20.1%) or neither (8.0% vs. 11.7%), respectively ($P=0.35$).

A list of individual dietary vitamin, mineral, and herbal supplements taken by women at the time of survey is reported from highest to lowest prevalence and by mean (SD) gestational week at time of survey in Table 2. The 5 most common individual supplements used in the current pregnancy were FA (31%), iron (30%), vitamin D (23%), calcium (13%) and fish oil (12%). The average number of supplements taken alone or in addition to a MV was 2 and ranged from 1-13.

Maternal characteristics for the four most common supplements taken in pregnancy, apart

from iron are presented in Table 3. Women who were taking vitamin D in the current pregnancy were less likely to be ≤ 20 weeks gestation ($P<0.01$) or underweight ($P<0.04$), and more likely to have gestational diabetes ($P<0.001$). Women taking calcium or fish oil were more likely to state that they had a food allergy, intolerance or dietary restriction ($P<0.005$), and calcium users were more likely to have high blood pressure ($P<0.003$). All other examined characteristics showed no statistically significant differences.

Women reported spending a median amount of $30 (interquartile range: $22- $50) per month on vitamin and mineral supplements. The six most commonly reported sources of information on vitamins and supplements were a doctor (69.1%), midwife/nurse (35.8%), internet (30.2%), family/friend (19.4%) pharmacist (15.5%) and naturopath (9%).

DISCUSSION

We found high rates of FA and/or MV use, with two out of three women taking FA or MVs pre-pregnancy, and four out five women taking MV during pregnancy. Women also reported high rates of other supplement use, both pre and during pregnancy.

Just over a third of women (37.3%) took pre-pregnancy FA, which is higher than that reported in other Australian studies, which have reported rates of 30% in South Australia[12], 23% in Sydney[13], 29% in Melbourne[14], and 27% in Wollongong.[15] Rates of MV use in our study (43% pre- and 79.1% during pregnancy) were also generally higher than those reported in other Australian studies: 11% MV pre-pregnancy and 35% MV during pregnancy in Melbourne[14], 32% MV in the first trimester in the Gold Coast[16], and 82% of women taking supplements during pregnancy in Wollongong.[15] Our findings are encouraging given the well known positive benefits of FA supplementation pre and in early pregnancy in reducing the risk of fetal NTD. Pre-pregnancy FA supplementation has also been associated with decreased risk of spontaneous miscarriage[17], and a reduction in small for gestational age infants.[18] These findings suggest some adherence with recommendations by The Royal Australian and New Zealand College of Obstetricians and Gynaecologists (RANZCOG)[5] and the Australian National Clinical Practice Guideline for Antenatal Care.[19] However, findings also revealed one third (37.1%) of women were not taking FA nor a MV pre-pregnancy, and it is not known whether all women who were taking pre-pregnancy MV were taking a MV containing FA. To help overcome inadequate intake of FA, food fortification with FA was introduced into Australia in 2009 to reduce the potential burden of NTD. Further research to identify the barriers to pre-pregnancy FA supplementation, and ongoing education of reproductive aged women about the importance of pre-pregnancy FA is still required.

Differences in maternal characteristics of the study populations may partly explain these differences in rates of supplement use compared to other studies, with women in this study predominately tertiary educated, older, and attending hospitals in geographical areas of higher income.[20] This is consistent with a study from Denmark which found that in women planning pregnancy, (62% of who were taking FA and or MVs), those who were older, non-smokers, non–drinkers, physically active and had higher education and income, were more likely to take FA or MVs pre-pregnancy.[21]

Of those taking FA, our findings highlight that women continued to take this beyond the first trimester. A meta-analysis has found no association with FA supplementation during pregnancy and a reduction in a range of pregnancy outcomes including preterm birth and stillbirth/ neonatal deaths; although there was some improvement in mean infant birthweight.[22] The benefit of ongoing folic supplementation beyond the first trimester remains uncertain and further trials are currently underway evaluating continued FA supplementation throughout pregnancy.[23]

Commonly reported supplements used outside of a MV were vitamin D, calcium, iron and fish oil. Although the RANZCOG recommends vitamin D supplements in women with proven vitamin D deficiency and encourages considering testing those women with risk factors for vitamin D deficiency,[5] and an association between maternal vitamin D status and offspring birth weight and bone mass has been reported, there is limited evidence that routine vitamin D supplementation in pregnancy improves outcomes for either mother or infant.[24] However, calcium supplementation ($\geq$ 1 gram/day) in pregnancy has been found in a meta-analysis to be

associated with a significant reduction in the risk of pre-eclampsia, particularly for women with low calcium diets, as well as reducing preterm birth and the occurrence of the composite outcome 'maternal death or serious morbidity'.[25] Women taking calcium in this study were more likely to report having high blood pressure, and hence may be more likely to benefit from calcium supplementation. However, the benefit of omega-3/ fish oil supplements is weak with a recent systematic review reporting no association between omega 3 dietary supplements in pregnancy and preterm delivery, decreased maternal depressive symptoms or infant neurodevelopmental outcomes.[26]

This study found that women taking calcium and fish oil were more likely to have a food intolerance or restriction, and were presumably aiming to achieve the recommended daily intake for nutrients by supplementation. However, the dose of calcium in many commonly used pregnancy MVs is small (range 0-140mg), as it makes the tablets large. Therefore women taking MV may be falsely reassured they are taking a "complete supplement" when their intake may be still below the recommended daily intake. Women in our study reported doctors and midwives as their primary sources of information, however many women and their care providers may not be aware of the actual ingredients of specific MVs, nor the recommended daily intakes of vitamins and minerals in pregnancy.[27]

In terms of herbal supplement use, women in this study reported relatively low rates compared to other studies.[7, 28, 29] The reasons for this difference are not known, but may reflect the study population characteristics or women's sources of information. Previous studies have found women from English-speaking backgrounds were more likely to take herbal supplements[7] or

use complementary alternative medicine.[28]

The main strengths of the study include the high response rate in two different hospitals. However, this study may be limited by recall bias with women self-reporting their pre-pregnancy supplement use at a mean gestation of 28 weeks. In addition, the actual doses of individual vitamin/ minerals from supplements and/or from diet, or in the case of Vitamin D, from sunlight, are not known. Another limitation was the lack of pregnancy outcome data. The study may also have limited generalisability because the women were predominantly tertiary educated, older, and completed the survey in English. Nevertheless, this study provides important and current information about dietary vitamin, mineral and herbal supplement use prior and during pregnancy.

In conclusion, reported rates of pre-pregnancy FA and/or MV use are encouraging; however pre and early pregnancy FA supplementation could still be improved. Further studies are required to determine the role of dietary supplementation in pregnancy, evaluating pregnancy outcomes, measuring other important factors such as costs, nutrient intakes and diet.

Acknowledgements

Thank you to the women who participated and to the staff of the antenatal clinics.

Funding for this study and Amina Khambalia was from an Australian NHMRC Centre for Research Excellence (APP1001066) and Natasha Nassar a NHMRC Career Development Fellowship (#APP1067066). Rahul Chatterjee was funded by the University of Sydney Summer Student Scholarship scheme.

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Table 1. Maternal and pregnancy characteristics by multivitamin supplement use in the current pregnancy.

	Entire Sample	**Multivitamin use in the current pregnancy^**		
		Yes	**No**	
	N=589	**N=457 (79.2%)**	**N=120 (20.8%)**	
Maternal and pregnancy characteristics	***n (%)***	***n (%)***	***n (%)***	**P-value**
Maternal age, years				
<25	29 (4.9)	22 (4.8)	7 (5.8)	0.90
25-34	345 (58.6)	269 (58.9)	70 (58.3)	
≥35	215 (36.5)	166 (36.3)	43 (35.8)	
Singleton pregnancy	557 (94.9)	432 (95.0)	115 (95.8)	0.69
Gestational age at time of survey, weeks				
≤ 20	128 (22.0)	98 (21.8)	27 (22.7)	0.96
21-26	80 (13.8)	64 (14.2)	16 (13.5)	
≥ 27	373 (64.2)	288 (64.0)	76 (63.9)	
No previous children	323 (54.9)	202 (44.3)	59 (49.2)	0.34
BMI categories				
Underweight	58 (10.7)	44 (10.5)	14 (12.4)	0.77
Normal weight	335 (61.6)	262 (62.4)	66 (58.4)	
Overweight	94 (17.3)	73 (17.4)	19 (16.8)	
Obese	57 (10.5)	41 (9.8)	14 (12.4)	
Smoker	8 (1.4)	*	*	
Educational attainment				
Less than up to year 12	47 (8.1)	31 (6.9)	13 (10.8)	0.17
Trade/apprenticeship/diploma	144 (24.9)	107 (23.9)	34 (28.3)	
University undergraduate or higher	388 (67.0)	309 (69.1)	73 (60.8)	
Vegetarian (no lamb, pork, beef or chicken)	5 (0.9)	*	*	
Any food allergy, intolerance or dietary restriction†	85 (14.5)	72 (15.9)	12 (10.0)	0.11
Gestational diabetes	83 (14.1)	73 (16.0)	7 (5.8)	0.004
High blood pressure	24 (4.1)	18 (4.0)	6 (5.0)	0.61
Thyroid problem	50 (8.5)	41 (9.0)	9 (7.5)	0.60

^ n=12 multivitamin use not reported. †Milk, egg, soy, wheat, shellfish/fish, lamb, beef, pork, chicken, gluten or other. *numbers too low to report.

Table 2
Prevalence of individual dietary vitamin, mineral, and herbal supplement use in the current pregnancy (separate from multivitamin supplement use) from highest to lowest and by mean (±standard deviation) gestational week at the time of survey.

Individual supplement	**N=589** ***n (%)***	**Gestational age at time of survey Mean (±SD) (weeks)**
Folic acid	180 (30.6)	27.3 (8.6)
Iron	179 (30.4)	31.4 (7.6)
Vitamin D	135 (22.9)	29.6 (7.9)
Calcium	76 (12.9)	29.3 (8.3)
Fish oil	71 (12.1)	30.3 (8.1)
Vitamin C	48 (8.2)	29.1 (8.2)
B Vitamins	38 (6.5)	29.8 (7.8)
Iodine	37 (6.3)	28.3 (8.6)
Zinc	33 (5.6)	28.4 (8.8)
Raspberry leaf	26 (4.4)	35.8 (4.3)
Vitamin A	14 (2.3)	26.9 (9.5)
Spirulina	9 (1.5)	27.8 (9.0)
Evening Primrose	9 (1.5)	36.8 (4.6)
Other†	3 (0.5)	31.3 (10.7)

†Other includes: nettle leaf (n=2), St. John Wort (n=1), fenugreek (n=1) and ginseng (n=1). None of the women reporting using valerian.

Table 3
Maternal and pregnancy characteristics for selected dietary vitamin, mineral and herbal supplement use in the current pregnancy.

Maternal and pregnancy characteristics	Folic acid		Vitamin D		Calcium		Fish oil	
	Yes N=180 (30.6%)	**No N=409 (69.4%)**	**Yes N=135 (22.9%)**	**No N=454 (77.1%)**	**Yes N=76 (12.9%)**	**No N=513 (87.1%)**	**Yes N=71 (12.1%)**	**No N=518 (88.0%)**
	n (%)	**n (%)**	**n (%)**	**n (%)**	**n (%)**	**n (%)**	**n (%)**	**n (%)**
Maternal age, years								
<25	6 (3.3)	23 (5.6)	4 (3.0)	25 (5.5)	2 (2.6)	27 (5.3)	4 (5.6)	25 (4.8)
25-34	106 (58.9)	239 (58.4)	85 (63.0)	260 (57.3)	46 (60.5)	299 (58.3)	38 (53.5)	307 (59.3)
≥35	68 (37.8)	147 (35.9)	46 (34.1)	169 (37.2)	28 (36.8)	187 (36.5)	29 (40.9)	186 (35.9)
Singleton pregnancy	170 (94.4)	387 (95.1)	126 (94.0)	431 (95.1)	72 (94.7)	485 (94.9)	69 (97.2)	488 (94.6)
Gestational age at survey, weeks								
≤ 20	44 (24.7)	84 (20.8)	17 (12.8)	**111 (24.8)***	12 (15.8)	116 (23.0)	10 (14.3)	118 (23.1)
21-26	25 (14.0)	55 (13.7)	22 (16.5)	58 (13.0)	10 (13.2)	70 (13.9)	9 (12.9)	71 (13.9)
≥ 27	109 (61.2)	264 (65.5)	94 (70.7)	279 (62.3)	54 (71.1)	319 (63.2)	51 (72.9)	322 (63.0)
No previous children	74 (41.1)	191 (46.8)	54 (40.0)	211 (46.6)	34 (44.7)	231 (45.1)	29 (40.9)	236 (45.7)
BMI categories								
Underweight	18 (10.7)	40 (10.7)	10 (7.9)	**48 (11.5)***	4 (5.5)	54 (11.5)	3 (4.5)	55 (11.5)
Normal weight	95 (56.2)	240 (64.0)	71 (55.9)	264 (63.3)	41 (56.2)	294 (62.4)	44 (65.7)	291 (61.0)
Overweight	34 (20.1)	60 (16.0)	25 (19.7)	69 (16.6)	20 (27.4)	74 (15.7)	14 (20.9)	80 (16.8)
Obese	22 (13.0)	35 (9.3)	21 (16.5)	36 (8.6)	8 (11.0)	49 (10.4)	6 (9.0)	51 (10.7)
Smoker	3 (1.7)	5 (1.2)	2 (1.5)	6 (1.3)	1 (1.3)	7 (1.4)	0 (0.0)	8 (1.6)
Educational attainment								
Less than up to year 12	15 (8.5)	32 (7.9)	11 (8.2)	36 (8.1)	6 (8.0)	41 (8.1)	5 (7.0)	42 (8.3)
Trade/apprenticeship/diploma	52 (29.6)	92 (22.8)	29 (21.6)	115 (25.8)	19 (25.3)	125 (24.8)	11 (15.5)	133 (26.2)
≥University undergraduate	109 (61.9)	279 (69.2)	94 (70.2)	294 (66.1)	50 (66.7)	338 (67.1)	55 (77.5)	333 (65.6)
Vegetarian†	2 (1.1)	3 (0.7)	0 (0.0)	5 (1.1)	0 (0.0)	5 (1.0)	1 (1.4)	4 (0.8)
Any food allergy, intolerance or dietary restriction‡	28 (15.6)	57 (14.0)	22 (16.3)	63 (14.0)	19 (25.0)	**66 (12.9)***	20 (28.2)	**65 (12.6)***
Gestational diabetes	22 (12.3)	61 (15.0)	35 (25.9)	**48 (10.6)***	11 (14.5)	72 (14.1)	8 (11.4)	75 (14.5)

High blood pressure	7 (3.9)	17 (4.2)	5 (3.7)	19 (4.2)	9 (11.8)	**15 (2.9)***	0 (0.0)	24 (4.6)
Thyroid problem	15 (8.4)	35 (8.6)	8 (5.9)	42 (9.3)	5 (6.6)	45 (8.8)	5 (7.1)	45 (8.7)

†Vegetarian includes women who reported not eating lamb, pork, beef or chicken.

‡Milk, egg, soy, wheat, shellfish/fish, lamb, beef, pork, chicken, gluten or other.

***** P-value<0.05

Figure legend

Prevalence of multivitamin and/or folic acid supplement use three months before pregnancy and during current pregnancy

Figure 1
Prevalence of multivitamin and/or folic acid supplement use three months before and during current pregnancy