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Limited knowledge about folic acid and iodine nutrition in pregnant women reflected in supplementation practices

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Abstract

Aim In order to reduce the risk of neural tube defects (NTDs) and iodine deficiency in pregnancy, the National Health and Medical Research Council recommends that pregnant women supplement their diet with folic acid and iodine. This study aimed to identify the knowledge, attitudes and practices of pregnant women regarding intake of these nutrients in order to assess whether women are adequately exposed to this health message. Methods One hundred and fifty-two conveniently sampled pregnant women residing in a regional area of New South Wales, Australia, completed a pretested questionnaire on knowledge and practices regarding nutritional supplement use during pregnancy and dietary sources of folic acid and iodine. Results Eighty-two per cent of women reported using supplements during their pregnancy, with the majority (67.7%) taking supplement brands containing both folic acid and iodine. Supplement use was significantly higher among women in the highest household income category (30.8 vs 69.2%; P = 0.001). Seventy-six per cent of the participants correctly identified NTDs to be associated with inadequate intake of folic acid, whereas only 40% correctly identified health problems associated with inadequate iodine intake. Women's knowledge of dietary sources of folic acid and iodine was limited. Conclusions A third of the pregnant women surveyed were not adhering to clinical recommendations for supplement use during pregnancy, and many had knowledge deficits with regard to the need for an adequate dietary intake of folic acid and iodine from both food and supplements during pregnancy.

Keywords

Folic acid, iodine, knowledge, pregnancy, supplementation

Disciplines

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Limited knowledge about folic acid and iodine nutrition in pregnant women reflected in supplementation practices

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ABSTRACT

Aim: In order to reduce the risk of Neural Tube Defects (NTDs) and iodine deficiency in pregnancy,the National Health and Medical Research Council recommends that pregnant women supplement their diet with folic acid and iodine. This study aimed to identify the knowledge, attitudes and practices of pregnant women regarding intake of these nutrients in order to assess whether women are adequately exposed to this health message.

Methods: 152 conveniently sampled pregnant women residing in a regional area of New South Wales, Australia completed a pre-tested questionnaire on knowledge and practices regarding nutritional supplement use during pregnancy and dietary sources of folic acid and iodine

Results: Eighty-two percent of women reported using supplements during their pregnancy; with the majority (67.7%) taking supplement brands containing both folic acid and iodine. Supplement use was significantly higher among women in the highest household income category (30.8% vs. 69.2%; p=0.001). Seventy-six percent of the participants correctly identified NTDs to be associated with inadequate intake of folic acid, whereas only 40% correctly identified health problems associated with inadequate iodine intake. Women's knowledge of dietary sources of folic acid and iodine was limited.

Conclusion: A third of the pregnant women surveyed were not adhering to clinical recommendations for supplement use during pregnancy, and many had knowledge deficits with regard to the need for an adequate dietary intake of folic acid and iodine from both food and supplements during pregnancy

Keywords: iodine, folic acid, supplementation, knowledge, pregnancy

Introduction

The role of folic acid in the prevention of neural tube defects (NTDs) is undisputed. [1] Similarly, the importance of an adequate intake of iodine during pregnancy to prevent a range of adverse outcomes, including miscarriages, still births, cretinism, and other major impairments of the foetus is well understood. [2] Public health strategies in Australia have included mandatory fortification of bread with folic acid and iodine since October 2009,[3] as well as recommendations for both folic acid and iodine supplementation during pregnancy. [4-6]

Pregnant women generally have limited knowledge and understanding about the role of folic acid for healthy foetal development and their practices reflect this knowledge deficit.[7] In the United States, women of childbearing age from low socioeconomic backgrounds knew little about the importance of the recommended daily intake of folic acid and only a quarter of the 250 women surveyed reported consuming folic acid supplements daily.[8] Similarly, in Australia, only about a third of women consume folic acid supplements preconceptionally. [9-11] Emmett et al. reported that the recommended daily level of folic acid intake (400 microgram/day from supplementation and food fortification) was achieved by only 37% of Australian women of child bearing age.[12] One study found that low serum folate levels were almost twice as common in Australian women who were not consuming supplements (9.3 %), compared to supplement-users (4.7 %). [13]

Pre-fortification(ie, prior to September 2009), data from various states including New South Wales, Victoria, and Tasmania showed that median urinary iodine concentrations (MUIC) among pregnant women were below 150 µg/L, which is indicative of mild to moderate iodine deficiency.[14-16] As with folic acid requirements during pregnancy, knowledge and practices related to iodine nutrition have been identified to be inadequate among Australian pregnant women.[17] A pre-post fortification study reported an improvement in iodine status since 2009 in pregnant women, but only those taking supplements containing iodine had a MUIC indicative of sufficiency.[18] Other studies have reported similar findings and a small study in lactating women (n=60) identified this group to be at risk of inadequate intakes, even in the presence of the fortification programme.[19, 20]

It is evident that further strategies additional to fortification are required in Australia to ensure that pregnant women consume adequate amounts of folic acid and iodine for optimal pregnancy outcomes. This may require advocacy and lobbying of health service providers to encourage greater uptake of pregnancy supplement formulations, as recommended by health agencies in the country.[5, 6] Additionally, health education programs, using tailored plain language oral and verbal communication strategies may

be needed to increase awareness in women of childbearing age, especially among women with poor health literacy skills.[21, 22] Other practical approaches which could be incorporated into the health education programs include the use of simple illustrations and education materials suitable for women with poor health literacy skills.[23] Moreover, women could potentially benefit from carrying their own case notes during pregnancy,[24] as well as from receiving prompts in their e-health records.[25] The current study was undertaken to identify knowledge and practices of pregnant women regarding folic acid and iodine supplementation in order to inform such public health interventions.

Methods:

A cross sectional survey of pregnant women residing in in the Illawarra region of New South Wales was undertaken between October, 2012, and February, 2013. A pre-tested self-administered questionnaire developed from a number of sources [17, 26] included both closed and open-ended questions relating to pregnant women's knowledge of: (1) folic acid and iodine; (2) dietary sources of these nutrients; (3) health problems associated with insufficient intake of these nutrients prior to and during pregnancy; and (4) the mandatory Australian folic acid and iodine fortification programs. Information was obtained about dietary practices during pregnancy, sources of information that are accessed about nutrition-related issues, consumption of nutritional supplements prior to and during pregnancy, and use of iodised salt. (5) Sociodemographic information included participants' age, annual household income, and education level. The average cost of pregnancy-related supplements for the relevant brands identified by women in the study was obtained from online information available at the time of the survey, including Australian-based online pharmacies such as Pharmacy Direct, epharmacy, Pharmacy Online, Chemist Australia, and Chemist Direct.

Sample size was determined using estimated births in the region. According to Australian Bureau of Statistics,[27] the total number of babies born in the Illawarra region during 2010 was 4863, with 49.1 % of these births occurring in Wollongong (n = 2388). Thus, the expected number of births in the [removed for blinding] area over a three month period would be 597. Assuming that 50 % of women take nutritional supplements during pregnancy, with a confidence level of 95 %, a sample size of 134 participants was required to obtain an estimate of nutritional supplementation.[28] This study aimed to recruit a sample size of 200 pregnant women, (i.e. approximately one third of the estimated births at the major public health antenatal clinic in the region that corresponded with the 3-month data collection time frame) by using a convenience sampling recruitment technique in the following locations:

- Private obstetrician practices: Of the 10 obstetricians whose contact details were available online, [29]five agreed to display promotional materials for this study in their practice rooms.

- Miscellaneous venues frequented by pregnant women in the region, including maternity and baby shops, three physiotherapy practices, and two antenatal classes agreed to display promotional materials for this study. Women who agreed to participate were provided with the option of completing a hard copy of the questionnaire, or an online version using a dedicated Survey Monkey site.

Ethics approval for the study was obtained from the [removed for blinding] (Ethics number: HE 12/297).

The *Statistical Package for the Social Sciences* (SPSS) (version 21.0, IBM,Grad Pack) was used to analyze the data. Descriptive statistical tests were conducted for frequencies (%) using Chi square tests with 95% confidence intervals. Chi square analysis was used to investigate the association between various socio-demographic factors and the proportion of pregnant women who were taking recommended daily doses of folic acid and iodine supplements. In addition, the association between folic acid/iodine knowledge of pregnant women and socio-demographic factors were tested using Chi square analysis. All p values <0.05 were considered statistically significant.

Analysis was also conducted according to bivariate groupings of various characteristics, namely awareness of health problems associated with inadequate intake of folic acid (Yes/No); awareness of health problems associated with inadequate intake of iodine (Yes/No); low compared with high family incomes (cut-off=$70,000); high level of education compared with low educational attainment (cut-off=TAFE or apprenticeship); and suburban area of classified according to the classification of the Socio-Economic Indexes For Area (SEIFA) (cut off=5). [30]

Results:

Demographic characteristics of participants are shown in Table 1**,** which highlights that most participants were aged 25 - 34 years, were in their 2nd or 3rd trimester of pregnancy and were well educated. Family income was similar to 2011 census data for the Illawarra statistical local area,[31] which reported a median weekly family income for residents aged 15 years and over of $1,413 (annual $73,476), compared to $1,477 (annual $76,804) for New South Wales and $1,481 for Australia (annual $76,960) . Fifty five percent of women had a university degree compared to 45% of high school and TAFE or Apprenticeship degree, which is higher than the national average for Australia (23.2 %).[32]

Most women (81.6%) indicated that they used supplements during their pregnancy, and many (63.4%) indicated that they had started consuming supplements during the current pregnancy, rather than preconceptually (Figure 1).

Two-thirds (67.7%) of women reported that they took supplement brands which contained both folic acid and iodine. Only 4.6% were taking supplements containing only folic acid, and a further 9.2% consumed other nutritional supplements, containing vitamin D, fish oil, vitamin C, calcium and iron (See Table 2). Fifty-six percent of women reported that they took supplements once daily, with an estimated monthly cost ranging from $7.47 to $16.78. Supplement use was significantly higher among women who were in the highest household income category, as compared to those in the lowest category (69.2% vs 30.8% p=0.001).

Open-ended responses from participants who were not taking supplements (n=28, 18.4%), suggested that they had not been advised to do so by their doctor (26.7%); they could not tolerate them because of nausea from morning sickness (20%); they could not afford to purchase the supplements (20%); they did not feel that they needed supplements because they were in good health (20%); or that they perceived that they could obtain adequate nutrients from their diet (13.3%).

Approximately half (52.7%) of the women correctly reported that folic acid supplements are required during pregnancy, in addition to folate provided from the diet, but 29.3% were unable to answer this question. Most women perceived that they had received enough dietary information to make informed decisions regarding folate (85.5%), iron (74.4%), healthy eating (90.7%), calcium (75.5%), listeriosis (78.1%), and iodine (61.1%) intake during their pregnancy**.** Of the 130 pregnant women who answered the open-ended survey question about dietary changes made since becoming pregnant, 40.1% reported that they were eating more “healthy food”, and 25.7% reported that they avoided foods that could potentially cause listeriosis.

Most women reported that they had received information about folic acid and iodine supplements from their general practitioners, the internet, and obstetricians or from written information sources (Figure 2). Dietitians and pharmacists were less commonly accessed. It was also found that most health professionals, including general practitioners, were more likely to discuss folic acid supplementation rather than iodine supplementation with pregnant women.

Almost all (98%) participants had heard of the need for folic acid during pregnancy and most (84%) could correctly identify the recommended timing for commencement of folic acid supplementation (i.e. prenatally). Most women (75.6 %) identified that neural tube defects are the main health problem associated with an inadequate intake of folic acid, while 11.8% reported that they did not know the consequences of folic acid deficiency during pregnancy (See Table 3). Notably, knowledge about the consequences of folic acid deficiency was higher among participants with higher educational levels compared to those with lower education levels (54.9% vs 45.1% p=0.031).

Knowledge about dietary sources of folic acid was limited. Even though most (81.8%) women knew that green leafy vegetables were a rich source of folic acid, approximately half correctly identified fruit (48%), breakfast cereals (55.2 %), and bread (44.1 %) as sources of folic acid. Similarly, only 56 % identified supplementation as an additional source of folic acid and 25.5% correctly identified that bread has to be fortified with folic acid, by law. With regard to responses about their daily consumption of bread, 56% reported that they consumed two slices of bread in an average day, with 14.7% reporting one slice of bread per day and 10.7% reporting that they generally consumed less than one slice of bread per day.

Knowledge related to iodine was more limited than that for folic acid. Regarding health problems associated with inadequate iodine intake during pregnancy, only 39.5% could identify all the correct answers (goitre, mental retardation, malformations in pregnancy, impaired physical development) and more than half (53.6%) could not identify any of the associated health problems (See Table 3). Once again, knowledge about the adverse health outcomes associated with low iodine intake during pregnancy was higher among participants from higher educational (26.7 vs. 73.3 p=0.001) and household income backgrounds (23.2% vs. 76.8% p=0.013).

Knowledge about dietary sources of iodine was poor among the participants. Approximately half correctly identified salt (56.5%) and fish/seafood (46.9%) as good sources, 26.5 % recognized eggs to be a good source of iodine, but only 17% identified bread. Many of the participants (14.1% - 29.8%) incorrectly identified meat, fruit and vegetables as rich dietary sources of iodine. Only 11.5% correctly identified that bread is required by law to be fortified with iodine in Australia, while 73 % could not name a food vehicle. Less than half of participants (45.6%) reported that they used iodized salt, when they did use salt, in cooking or at the table.

Discussion:

According to national clinical guidelines about folic acid supplementation, the optimal time to consume folic acid supplements for women considering pregnancy is prior to conception.[4, 33] Findings from this study indicate that two-thirds of women from a regional area of [removed for blind review] did not adequately supplement with folic acid prior to becoming pregnant . These findings are consistent with data reported from the USA which found that only 50% of pregnant women took folic acid supplements before conception.[34] It is evident that further strategies are needed to ensure adequate periconceptional folic acid intake.[35] According to NHMRC guidelines, both folic acid and iodine supplementation is recommended for pregnant women.[4-6] Our study found that two-thirds of pregnant women were consuming iodine supplements, but in varying dosages ranging from 150 to 250 micrograms per day, as reported according to the specific product within the brand of supplements being used. The same brand may offer differing doseages per day, for example the ***Cenovis™*** Pregnancy & Breastfeeding Formula Cap provides 450 ug/day of folic acid and 150 ug/day iodine, compared to 500ug/day and 200ug/day, respectively for their Once Daily Pregnancy & Breastfeeding Cap (data not shown). This uptake is an improvement as compared to previous surveys [11, 17], from 23% in 2006 11 to 36% for prenatal folic acid and from 35% in 2008 17 to 68 % for iodine supplementation during pregnancy.

Not surprisingly, folic acid and iodine supplement use was higher among pregnant women who had higher household incomes. This finding suggests that cost may be a barrier to supplementation in women from lower socio-economic household income brackets, which included 20% of women in the present sample. The cost of supplements ranged widely at the time of our study, from $5.95 - $65.95. These findings are confirmed by another Australian study,[36] as well as studies from other countries (USA, Denmark, China, Canada),[7, 35-37] and similar findings have been reported where education level is lower. [17]

Other reasons for not taking folic acid and iodine supplements, as reported by pregnant women in this study, included: poor knowledge and understanding about the importance of taking supplements; not receiving enough information from their health professional about the need to take these supplements; and/or feeling nauseous when taking these supplements. Similarly, a British study reported that the main barriers associated with not taking folic acid supplements before becoming pregnant were: previous healthy pregnancy outcome(s); nausea and morning sickness; and not receiving folic acid information from their General Practitioner.[38] In addition, Gallego et al. also indicated that not only was the monthly cost of iodine supplements a possible deterrent, but so too was the lack of advice about the importance of iodine supplementation during pregnancy.[39]

Increased knowledge and understanding among pregnant women about the need to take both folic acid and iodine supplements could help to improve the use of these supplements during pregnancy.[10, 40]
We found that although most women understood the importance of folic acid supplementation before pregnancy, most did not appear to understand that supplements, and in particular folic acid supplements, needed to be taken prior to conception. Women's knowledge regarding folic acid supplementation and NTDs was improved after the introduction of a folic acid promotion program (targeted at providing information to women and health professionals about the importance of folic acid supplements to reduce risk of NTDs) and a voluntary folic acid fortification program in both Western and South Australia.[9, 41] Importantly however, these interventions did not improve women's understanding about the need for preconceptional folic acid.

A low level of knowledge of pregnant women regarding the importance of iodine intake has been reported in other surveys, conducted both pre- and post fortification.[18] Recent data from the UK and Tasmania has confirmed that even mild iodine deficiency during pregnancy can affect the later cognitive development and educational attainment of the young child.[42, 43] For these reasons, and given that our results confirm poor understanding about iodine requirements during pregnancy, it could be argued that prenatal supplements containing iodine should be prescribed to pregnant and lactating women.[44]

Pregnant women in this study had limited knowledge about dietary sources of folic acid and iodine, as reported by other studies in New Zealand and Australia.[18, 19, 26] There was also a low level of awareness regarding the mandatory fortification programs that require bread to be fortified with both folic acid and iodine. Similar findings have been reported from New Zealand, where iodine fortification was introduced simultaneously to Australia and which later adopted folic acid fortification of bread flour in 2012.[45] In addition, bread consumption patterns among women in our study indicates a lower consumption than estimates used by Food Standards Australia New Zealand (FSANZ) in the dietary modelling to determine levels of fortificants to be added to wheat flour (folic acid) and salt used in bread (iodine) (ie. three slices of bread per day).[3, 46] This food standard may need to be revised by FSANZ following monitoring of the fortification programme. Women expressed concerns regarding avoidance of foods that could potentially cause listeriosis. Although specific foods were not identified in this survey, our previous work has identified that fish and seafood, the richest sources of iodine, are not commonly consumed by pregnant women. The majority of dietary iodine is provided by dairy foods, with only 3-7% provided by fish and seafood.[18,47] A need for greater public awareness of the mandatory iodine fortification program is confirmed by a qualitative study which explored the opinions of women of child bearing age about the topic of nutrient fortification of the food supply.[48]

Many of the pregnant women in the current study seemed to have received limited information about the need for folic acid and, in particular, iodine supplementation during their pregnancy. In most cases, their main source of information about these micronutrient supplements was from their GP, with very little information being made available to them from either community pharmacists and/or midwives, as has been reported previously in Australia and New Zealand.[17, 49] A recent study has identified that General Practitioners that participate in the antenatal shared care programme have poor knowledge about the importance and roles of iodine during pregnancy and only a quarter of GPs surveyed reported that they discussed iodine supplementation with their pregnant patients. Most healthcare providers (74%) expressed interest in receiving ongoing professional education about iodine in pregnancy.[50]It could be recommended therefore, that all health professionals involved in antenatal care, especially GP's, pharmacists and midwives, be encouraged, through continuing professional development activities, to discuss the need for both folic acid and iodine supplementation with their pregnant clients or young women considering becoming pregnant. Furthermore, all health professionals need to be cognisant of the impact that health literacy skills can have on the client's ability to make informed decisions based on the information that they have been provided.[51] For example, client's with poor health literacy skills, which is a pervasive problem in Australia affecting over 59% of the adults aged 15-74 years,[52] cannot read or understand written health information and find it difficult to comply with health recommendations.[53-55] In view of the extent of poor health literacy skills among Australians, it is important for all health professionals to ensure that they communicate effectively with their clients and when appropriate avail them with information resources which are simple and easy-to-understand, recommend suitable websites and suggest useful patient aids.[56]

Generalizability of the findings is limited by the non-representative nature of the convenience sample obtained from only one geographical area in regional [removed for blind review]. Women were recruited from the clinics of private obstetricians and through a variety of venues frequented by pregnant women such as baby stores, physiotherapy practices and antenatal classes. Due to logistics, women were not recruited from General Practices, nor from family planning clinics and we acknowledge this may have resulted in a sample not truly representative of the broader community. Likewise, exclusion of non English speaking women is a further limitation, as women from culturally diverse backgrounds are likely to be under-represented. However, family income was similar to census data for the Illawarra region as a whole but we were unable to calculate median income from the categorical question included in our survey instrument. A higher proportion of women in the survey had a university degree qualification, compared to national averages, which suggests that their health-related knowledge and hence use of

supplements may be better than for the general population. The lack of a comprehensive dietary assessment prevents consideration of the contribution of supplements to overall iodine and folic acid intake. A strength of the study is the use of a standard set of questions related to knowledge and practices of women that allows comparability with other published studies.[17, 18, 26, 57]

Conclusion

The use of folic acid and iodine supplements by pregnant women in the [removed for blinding] region is suboptimal, irrespective of the mandatory fortification programs that have been implemented for both folic acid and iodine in Australia. Targeted education campaigns are indicated to ensure that women recognize good dietary sources of folic acid and iodine, and to increase awareness of the importance of additional folic acid and iodine supplements prior to and during pregnancy, particularly in women from low socio-economic backgrounds. Health care practitioners involved in antenatal care may require further education and training regarding nutrient supplementation in pregnancy, while pharmacists at the point-of-sale may be best placed to advise women about managing symptoms of nausea and supplement use, as well as identifying the most affordable options.

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Conflicts of interest

None of the authors declare a conflict of interest.

F**unding source**

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Authorship statements:

Souad El-mani: Conceptualisation of study design, data collection and analysis, writing of first draft of manuscript.

Karen Charlton: Conceptualisation of study design, interpretation of data analysis, editing of manuscript.

Victoria Flood: Conceptualisation of study design, interpretation of data analysis, editing of manuscript.

Judy Mullan: Interpretation of data analysis, editing of manuscript.

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Table 1 Demographic characteristics of the participants

Characteristics N=152	**Percentage of sample**	**Comparison with indicators from Illawarra region[31] and Australian women[32]**
Age		
16-24	12.2%	
25-34	70.2%	
>35	17.6%	
Trimester		
1(0-12 weeks)	8.6%	
2(13-28 weeks)	46.7%	
3(>28 weeks)	44.7%	
Highest level of education		
Some high school	6.8%	
Complete high school	14.9%	
TAFE or Apprenticeship[a]	23.6%	25.9%
University degree(bachelor level)	23.6%	19.0 %
University degree(postgraduate level)	31.1%	4.2 %
Annual family income[b]		
<$40,000-<$70,000	34.5%	
$70,000-<$120,000	34.5%	Median for Illawarra =
$120,000->$150,000	22.7%	$73,476

(a) Includes diploma, advanced diploma, certificate III/IV
(b) n = 12 women did not report their annual household income
TAFE, Tertiary and Further Education.

Table 2 Brand names of supplements consumed by pregnant women in the Illawarra

Brand name of supplements	**Frequency n=124**	**%**	**Folic acid content (µg/day)**	**Iodine content (µg/day)**	**Average cost of supplements per month** §
Blackmores[a]	47	30.9	500	250	$14.11
Elevit	46	30.3	800	250	$16.78
FefolMultipregnancy[b]	7	4.6	500	200	$10.46
Nature's Own[c]	4	2.6	500	250	$12.95
Ethical Nutrients[d]	2	1.3	500	299	$10.97
Cenovis[e]	2	1.3	500	200	$7.47
Fabfol Plus	2	1.3	500	150	$13.34
Others[f]	14	9.2	-	-	-

§based on average cost of pregnancy-related supplements for the relevant brand, obtained from online information at the time of the survey. Cheapest formulation for relevant brand not shown for folic acid and iodine content.

[a]Blackmores™ Gold Pregnancy and Breastfeeding Cap

[b]**Fefol™** Multi-Preg Liquid Cap

[c]***Nature's Own™*** Pregnancy & Lactation Platinum Multivitamin Cap

[d]***Ethical Nutrients™*** Pregnancy Support Tab

[e]***Cenovis™*** Once Daily Pregnancy & Breastfeeding Cap

[f]Unable to calculate

Table 3 Health problems identified by participants as associated with inadequate intake of folic acid and iodine

Health problems ‡	Frequency §	Percentage
1-Health problems associated with inadequate intake of folic acid:-		
Neural Tube Defects	115	75.6
Malformations in pregnancy (birth defects)	57	37.4
Weak bone and teeth	10	6.6
Mental retardation	2	1.3
Do not know	18	11.8
2-Health problems associated with inadequate intake of iodine:-		
Goitre	41	27.2
Mental retardation	25	16.6
Malformation in pregnancy (birth defects)	23	15.3
Impaired physical development during childhood	7	4.6
NTDs	5	3.3
Weak bone and teeth	4	2.6
Blindness	4	2.6
Do not know	81	53.6

§ **P**articipants could select more than one option from a defined list
‡**B**old typeface indicates correct answers

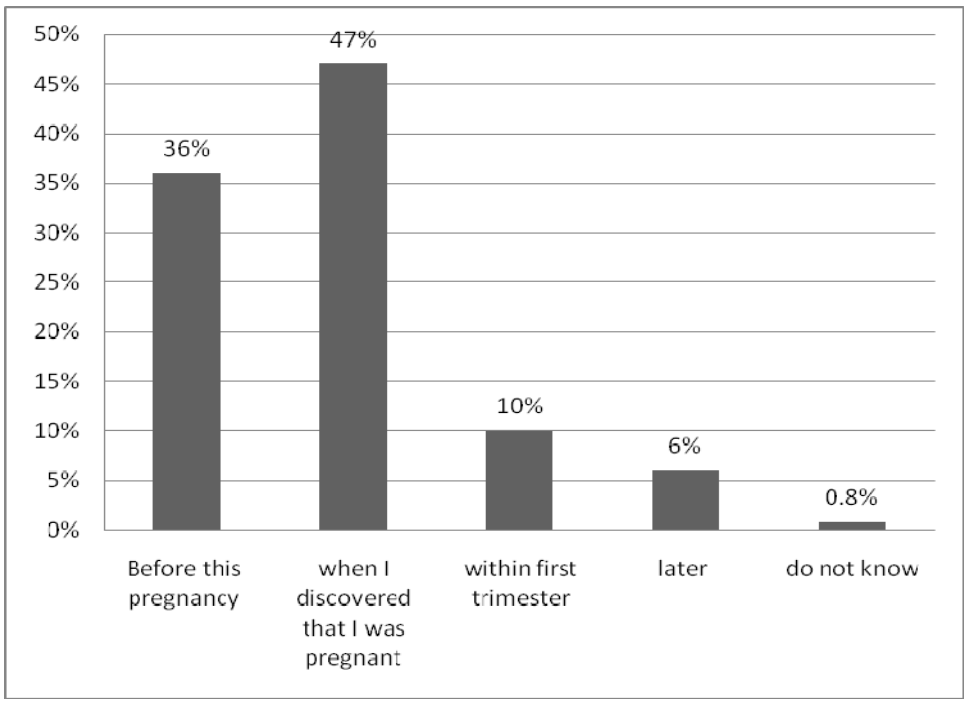

Figure 1: Timing of supplement commencement

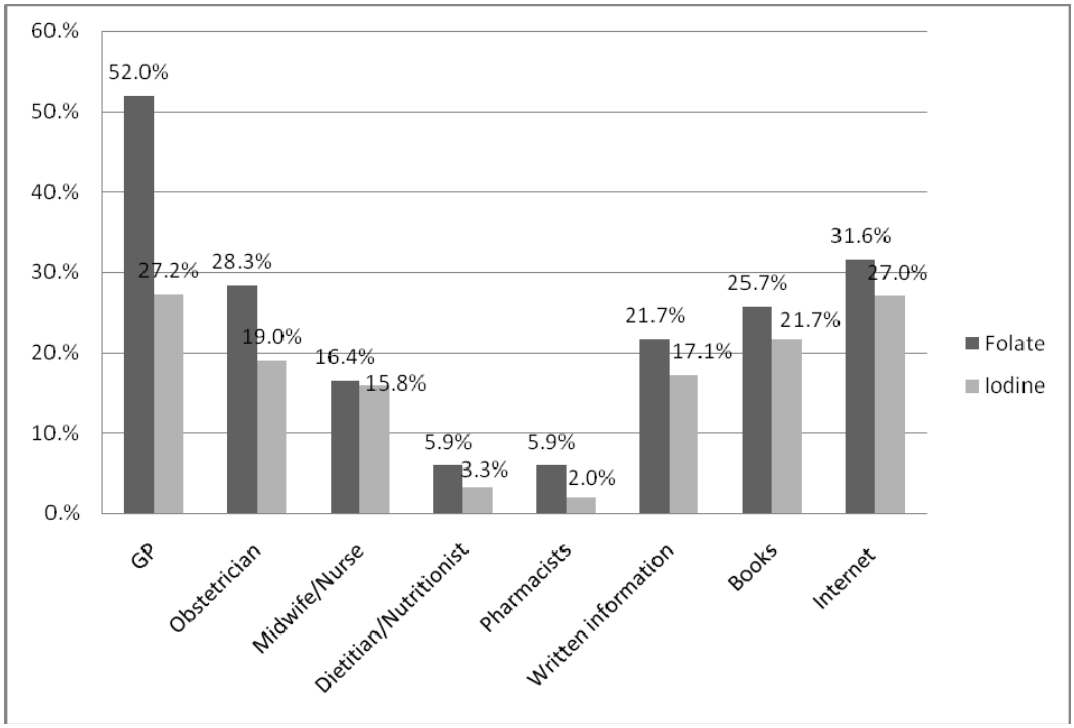

Figure 2 Sources of information received by pregnant women about folic acid and iodine