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Knowledge, behaviour and practices of pregnant women in Wollongong regarding folic acid and iodine nutrition after the introduction of a mandatory fortification program

Souad Faraj El-mani
University of Wollongong

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Knowledge, behaviour and practices
of pregnant women in Wollongong regarding
folic acid and iodine nutrition after the introduction of a mandatory
fortification program

Souad Faraj El-mani

This thesis is presented as part of the requirements for the
award of the Degree of Master of Science Research
of the
University of Wollongong
2013
ABSTRACT

To reduce risk of Neural Tube Defects (NTDs) and iodine deficiency in pregnancy, recommendations for supplementation with folic acid and iodine have been introduced to complement the mandatory fortification programs in Australia. However, many studies conducted before the introduction of the folic acid and iodine mandatory fortification programs indicated that folic acid and iodine knowledge and the need for these supplements was poor among pregnant women. Health care providers, including pharmacists, can have important roles regarding advice given to women about the importance of these nutrients in pregnancy.

Aims: The study aimed to identify the knowledge, attitudes and practices of pregnant women regarding folic acid and iodine supplementation. A second aim was to assess whether pharmacists have sufficient knowledge about these nutrients to provide appropriate advice to pregnant women about supplement use, and to identify which brands of pregnancy nutritional supplements contain the National Health Medical Research Council recommended amounts of iodine and folic acid.

Methods: A cross sectional survey of pregnant women residing in the Illawarra region of New South Wales, Australia was undertaken between October 2012 and February 2013. Information regarding folate and iodine knowledge and attitudes and supplement use among pregnant women was collected. Additionally, a sample of pharmacists from community pharmacies in the Illawarra region was surveyed to assess their knowledge regarding folic acid and iodine supplementation. Finally, an online audit of pregnancy supplements in Australia was undertaken to collect information regarding the availability of folic acid and iodine supplements.
**Results:** A total of 152 pregnant women responded to the survey. Most (81.6%) used supplements during their pregnancy; 67.7% took supplement brands which contained both folic acid and iodine in varying dosages. Also, 36% of them started taking supplements before their pregnancy. The supplement use was significantly higher among pregnant women who were in the highest household income category. Although 75.6% of pregnant women understood that NTDs is the health problem associated with inadequate intake of folic acid, only 39.5% of them knew the health problems associated with inadequate iodine intakes. Half of the pregnant women had limited awareness about good sources of folic acid and iodine. Educated women from higher socio-economic backgrounds had better knowledge about the importance of folic acid and iodine in pregnancy. A total of 41 pharmacists responded to the survey. It was found that most pharmacists have adequate knowledge and understanding about the role of folic acid in preventing NTDs in pregnant women, 73% of them knew that iodine deficiency during pregnancy could result in neurocognitive deficits in the baby and 27% knew the NHMRC recommendation for the 150 microgram daily dose of iodine during pregnancy.

**Conclusion:** Additional to poor practices regarding folic acid and iodine supplementation, prior to and during pregnancy, limited knowledge and understanding of women about the need for folic acid and iodine supplementation during pregnancy is still a major public health concern in Australia. Pharmacists had good knowledge and understanding about folic acid supplementation during pregnancy, but had deficits in iodine knowledge. This group may be valuable, yet under-utilised sources of nutrition education for pregnant women seeking advice at the point of sale.
ACKNOWLEDGEMENTS

I would like to offer my deepest gratitude to my supervisor A/Prof. Karen Charlton whose support, encouragement, patient and continuous helpful guidance to complete this thesis step by step.

I would like to thank my co-supervisors A/Prof. Vicki Flood and Dr. Judy Mullan for their support, helpful suggestions and their motivation during my research.

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Finally, I would like to give especial thanks to people who mean life to me. My husband, whose patient love and great support enabled me to complete my research. My lovely children Jana and Ahmed who are the happiest things for me in my life.
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<td>50</td>
</tr>
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</tr>
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<td>3.1.6</td>
<td>Food sources of iodine reported by participants</td>
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</tr>
<tr>
<td>3.2.1</td>
<td>Knowledge of pharmacists regarding food sources of iodine</td>
<td>58</td>
</tr>
</tbody>
</table>
1 LITERATURE REVIEW

1.1 The search strategy

A number of sources, such as databases and websites were used to search for relevant information pertaining to the knowledge, attitudes and practices of pregnant women regarding folic acid and iodine consumption. The databases accessed included Medline (with full text), Medline, the Academic search complete database, and the Cochrane database of systematic reviews. The articles were limited to those written in the English language and published between 2000 and 2012.

A wide range of key words and search terms were used to search and access the relevant literature. The search terms used included: folic acid; iodine; Neural Tube Defects; iodine deficiency disorders; pregnancy/pregnant; recommendation; supplements; knowledge/awareness; attitudes/beliefs; folic acid/iodine consumption/practices/use; folic acid/iodine fortification; voluntary fortification; mandatory fortification; knowledge of pharmacists; role of pharmacists; brand names of supplements; complementary medicine; recommended dose; time of consumption folic acid/iodine. Alternative terms, such as awareness, instead of knowledge, were used to review a range of the articles that related to the research topic.

In addition to the published literature, various Australian government websites were accessed to review fact sheets and governmental reports containing relevant information and statistics about folic acid and iodine consumption for pregnant women. These websites included: Food Standards Australia New Zealand (FSANZ); the New South Wales (NSW) Department of Health; the World Health Organization (WHO); the National Health Medical Research Council (NHMRC); the Australian Population Health Development Principal Committee of the Australian Health Ministers Advisory Committee (APHDPC); The Australian Institute of Health and Welfare (AIHW); and the Australian Department of Health and Ageing. Furthermore, a variety of other websites were used to review the information
available, which related to the brand names of folic acid and iodine supplements, such as MIMS Online Australia and the Australian Pharmacy Online.

1.2 Introduction
Publications from different countries, such as the United States and China, have indicated that the consumption of folic acid and iodine among pregnant women is inadequate (Hoyo et al. 2011; Pettigrew-Porter et al. 2011). Recommendations to enhance supplementary consumption of these micronutrients and to improve knowledge of pregnant women about the importance of an adequate intake of these micronutrients are presented in several studies (Mian et al. 2009; Gallego et al. 2010; Rahman et al. 2011; Zeng et al. 2011; Mallard & Houghton 2012). In Australia, there are few studies targeting the knowledge of pregnant women about the importance of folic acid and iodine supplements, especially with regard to when supplementation should be commenced and the dosage of supplementation required.

This literature review focuses on current knowledge, attitudes and practices of pregnant women regarding folic acid and iodine supplementation. The review commences with providing an overview of women’s knowledge with regard to the importance of folic acid supplementation to prevent Neural Tube Defects (NTDs), and discusses folic acid status among pregnant Australian women, before and after implementation of the mandatory folic acid fortification program. The review then goes on to provide an overview of the importance of iodine supplementation and discusses iodine status among Australians, before and after implementation of the mandatory iodine fortification program that was introduced in September, 2009, at the same time as the folic acid fortification program. Current evidence of the consumption of folic acid and iodine supplements among pregnant women worldwide, as well as in the Australian context, is reviewed in this chapter. In addition, the knowledge and role of pharmacists with regard to promoting and providing information about folic acid and iodine supplementation during pregnancy is discussed.
1.2.1 Importance of folate and iodine during pregnancy

1.2.1.1 Folate

There is strong epidemiological evidence that periconceptional consumption of folic acid can prevent risk of NTDs (Lumley et al. 2007). Women of childbearing age are recommended to take folic acid (the synthetic form of folate and 1 microgram dietary folate equivalent (DFE) = 0.6 μg synthetic folic acid, as used in fortified foods and supplements) one month before conception and during the first trimester to help prevent the occurrence of NTDs. The recommended dietary intake of folate is 600 microgram/day for pregnant women (NHMRC 2006) (See Table 1.2.1), which cannot generally be met from natural dietary sources alone, and therefore necessitates an additional intake of 400 microgram per day, either from a supplement or from fortified foods (NHMRC 1995; National Health and Medical Research Council & Ministry of Health 2006). Supplementation at this level of intake is included in the Australian clinical guidelines for antenatal (DOHA 2012). Despite the significance of folic acid intake before pregnancy for the development of a healthy foetus, knowledge of the importance of folic acid supplementation among pregnant women remains consistently inadequate (Zeng et al. 2011; Mallard & Houghton 2012).

1.2.1.2 Iodine

Iodine requirements dramatically increase during pregnancy to meet the higher demands caused by the increased production of thyroid hormones, dependency of the foetus for iodine supply from the mother and increased renal excretion of iodine (Yarrington & Pearce 2011). The recommended dietary iodine intake for pregnant women (220 microgram/day) is higher than the recommended iodine intake for adolescents and adults in general (150 microgram/day) (NHMRC 2006) See Table 1.2.1. If these higher dietary iodine recommendations are not met, a range of iodine deficiency disorders may result including; spontaneous abortion, stillbirths, cretinism, congenital anomalies, psychomotor effects and mental retardation (Qian et al. 2005; Zimmermann 2009; Yarrington & Pearce 2011). Meta-analyses have also
indicated that consumption of iodine supplements before and during pregnancy could prevent significant loss of intelligence quotient (IQ) points in children on a population basis, at least in areas of moderate to severe iodine deficiency (Qian et al. 2005).

### Table 1.2.1 Australian recommendations for folate and iodine intake for pregnant women (NHMRC 2006)

<table>
<thead>
<tr>
<th>Nutrients</th>
<th>#EAR μg/day</th>
<th>*RDI μg/day</th>
<th>Upper Level</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>-Folate</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adult women</td>
<td>320</td>
<td>400</td>
<td>1000</td>
</tr>
<tr>
<td>Pregnant women</td>
<td>520</td>
<td>600</td>
<td>800</td>
</tr>
<tr>
<td>14-18yrs</td>
<td>520</td>
<td>600</td>
<td>1000</td>
</tr>
<tr>
<td>19-&gt;50yrs</td>
<td>520</td>
<td>600</td>
<td>1000</td>
</tr>
<tr>
<td><strong>-Iodine</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adult women</td>
<td>100</td>
<td>150</td>
<td>1100</td>
</tr>
<tr>
<td>Pregnant women</td>
<td>160</td>
<td>220</td>
<td>900</td>
</tr>
<tr>
<td>14-18yrs</td>
<td>160</td>
<td>220</td>
<td>1100</td>
</tr>
<tr>
<td>19-&gt;50yrs</td>
<td>160</td>
<td>220</td>
<td>1100</td>
</tr>
</tbody>
</table>

#EAR= Estimated Average Requirement
*RDI=Recommended Dietary Intake

1.3 Pregnant women’s knowledge and understanding about folic acid and iodine requirements

1.3.1 Folic Acid

Although the importance of folic acid supplementation to reduce the incidence of NTDs is undisputed (Lumley et al. 2007), data from previous surveys have indicated that pregnant women have poor knowledge and understanding about the role of folic
acid for healthy foetal development and that their practices often reflect this knowledge deficit (Zeng et al. 2011). In the United States, Sharp, et al. (2009) reported that women of childbearing age who were from low socioeconomic backgrounds knew little about the importance of the recommended daily intake of folic acid and only 63 (25%) of the total number of women surveyed (N=250) reported consuming folic acid supplements daily. Similarly, a New Zealand study identified that knowledge and understanding about recommended folic acid intake among women of child bearing age was relatively poor, with only 64% of the 1000 women surveyed being aware that pregnant women needed to take recommended doses of folic acid and less than 50% of them recognizing that this intake should commence prior to the pregnancy (Kalafatelas & Fryer 2011). Another New Zealand study indicated those postpartum women who had received information about folic acid before pregnancy were older and were of higher education level, income (Mallard et al. 2012). Studies from other countries also confirm these findings (See Table 1.3.1), suggesting that many women worldwide have a poor knowledge and understanding about the daily folic acid intake recommendations, especially before and during the early stages of pregnancy to reduce the incidence of NTD.
Table 1.3.1 A summary of published studies investigating knowledge of folic acid among women

<table>
<thead>
<tr>
<th>Country where study was conducted, year of survey, number and some demographic information of sample population</th>
<th>Had heard of folic acid</th>
<th>Knew that folic acid reduces incidence of NTD</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canada n=148 (2003) age 18-48yrs women of child bearing age</td>
<td>95%</td>
<td>25%</td>
<td>(French et al. 2003)</td>
</tr>
<tr>
<td>USA n=646 (2006) age 14-45 yrs women of childbearing age</td>
<td>58.7%</td>
<td>41%</td>
<td>(Robbins et al. 2006)</td>
</tr>
<tr>
<td>Qatar and Oman n=300 (2007) pregnant women</td>
<td>94%</td>
<td>58%</td>
<td>(Hassan &amp; Al-Kharusi 2008)</td>
</tr>
<tr>
<td>Kansas, USA n=250 (2009) age 18-44 yrs women of childbearing age</td>
<td>58%</td>
<td>33.3%</td>
<td>(Sharp et al. 2009)</td>
</tr>
<tr>
<td>Location</td>
<td>n=</td>
<td>Age Range</td>
<td>Sample Description</td>
</tr>
<tr>
<td>------------------</td>
<td>-----</td>
<td>-----------</td>
<td>--------------------</td>
</tr>
<tr>
<td>Abu Dahbi Emirate</td>
<td>277</td>
<td>20-40 yrs</td>
<td>Pregnant women</td>
</tr>
<tr>
<td>China</td>
<td>33025</td>
<td>19-44 yrs</td>
<td>Non pregnant (n=22345) &amp; Pregnant (n=10680)</td>
</tr>
<tr>
<td>New Zealand</td>
<td>1000</td>
<td>16-44 yrs</td>
<td>Women of child bearing age</td>
</tr>
<tr>
<td>Iran</td>
<td>676</td>
<td>18-45 yrs</td>
<td>Pregnant women</td>
</tr>
<tr>
<td>Lebanon</td>
<td>600</td>
<td>18-45 yrs</td>
<td>Women of child bearing age</td>
</tr>
</tbody>
</table>

### 1.3.1.1 Strategies to improve knowledge and understanding about the recommended folic acid intake among women of child bearing age in Australia

In Australia, two major strategies have been used to reduce the population level risk of NTDs and to improve the folate status among women of child bearing age. The first was a health promotion campaign, targeting messages about the importance of maintaining recommended dietary folate intake to reduce the risk of NTDs, which was conducted in Australia and New Zealand in 1998 (ANZFA 2012). In addition to this national campaign, a state-wide health promotion program was conducted in
Western Australia between 1992-1995 to enhance knowledge, especially among women of child bearing age, regarding the importance of the recommended daily intake of folic acid during pregnancy (Bower et al. 1997). The second national Australian strategy involved the folic acid fortification scheme introduced in 1995 (FSANZ 2006). This scheme resulted in the voluntary fortification of some foods, including breakfast cereals, fruit juice, milk, yeast extracts (e.g. Vegemite) and other special dietary products, with folic acid (NHMRC 1994).

A South Australian study conducted between 2006-07 which investigated the outcomes of both these national strategies (i.e. folate health promotion campaign and then voluntary folate fortification program) found that: women of child bearing age who had been exposed to both strategies had improved knowledge and understanding regarding the role of folic acid (improved from 25% to 77%); had a greater awareness about the need for periconceptional folic acid intake (improved from 12% to 39%); and had improved in their consumption of folic acid fortified cereals prior to becoming pregnancy (increased from 15% to 29%) (Chan et al. 2008).

To date, even though both the folate health promotion campaign and the voluntary fortification program strategies seem to have somewhat improved knowledge and understanding about the recommended daily intake of folate prior to and during pregnancy, consistent results were not observed in different Australian states (See Table 1.3.2). It also appears that Australian women from poor socio-economic backgrounds are more likely to have poorer knowledge of recommended daily doses of folic acid, especially prior to becoming pregnant. Furthermore, these strategies seem to have had very little impact on improving behaviour with regard to women taking the recommended amounts of folate prior to becoming pregnant.
Table 1.3.2 Responses from recent national surveys of Australian women regarding knowledge of folic acid

<table>
<thead>
<tr>
<th>Australian States where studies were conducted; Sample size and year study conducted; Demographic characteristics of study population</th>
<th>Awareness of folic acid and NTDs link</th>
<th>Knowledge about recommended time to consume folic acid</th>
<th>Knowledge of food fortified with folic acid</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Victorian survey - n=1,196 (1996*) -n=1204 (1997#) -n=1227 (2000#) women of child bearing age Age= 15-44yrs</td>
<td>12.4% 17.4% 30.2%</td>
<td>8.2% 11.4% 17%</td>
<td>10.6% 22.4% 50.3%</td>
<td>(Watson et al. 2001)</td>
</tr>
<tr>
<td>Western Australia n=578 control n=36 cases of mothers (1997-2000)# age &lt;20-&gt;35</td>
<td>41% 62%</td>
<td>27.8% 28.5%</td>
<td>Not reported</td>
<td>(Bower et al. 2004)</td>
</tr>
<tr>
<td>South Australia Survey n=304 pregnant women (2005)# age:- 15-45yrs</td>
<td>73%</td>
<td>From (n=213) 82% provide correct answer</td>
<td>Not reported</td>
<td>(Conlin et al. 2006)</td>
</tr>
</tbody>
</table>
Despite the findings discussed above, that there is often limited knowledge and understanding among Australian women, especially among those from poor socio-economic backgrounds, the prevalence of NTDs in Australia has decreased since the implementation of the voluntary fortification program in 1995. For example, the prevalence of NTDs between 2006-2008 in Victoria, Western Australia, South Australia and NSW was lower than the prevalence of NTDs in these states between 1998-2005 (AIHW 2011) (Table 1.3.3), which was three years after the introduction of the fortification program. Importantly, however, introduction of the voluntary folate fortification program did not result in the targeted level of NTDs reductions, nor did it improve the mean intake of folic acid among women of childbearing age, which was 95 $\mu$g/day, rather than meeting the expected mean daily intake of folic acid 108 $\mu$g/day (Food Standards Australia New Zealand 2006). For these reasons, further interventions, such as supplementation and education programs were subsequently recommended (Wilton & Foureur 2010).

**Table 1.3.3 The overall prevalence of neural tube defects provided by states, 1998-2005, 2006-2008 (AIHW 2011)**

<table>
<thead>
<tr>
<th>States</th>
<th>Prevalence of NTDs per 10,000 total births 1998-2005</th>
<th>Prevalence of NTDs per 10,000 total births 2006-2008</th>
</tr>
</thead>
<tbody>
<tr>
<td>Victoria</td>
<td>12.7</td>
<td>11.5</td>
</tr>
<tr>
<td>Western Australia</td>
<td>14.9</td>
<td>12.4</td>
</tr>
<tr>
<td>South Australia</td>
<td>13.6</td>
<td>12.1</td>
</tr>
<tr>
<td>NSW</td>
<td>7.4</td>
<td>7.2</td>
</tr>
</tbody>
</table>

Source: Australian Institute of Health and Welfare 2011
Another intervention program which has been conducted in Australia is the mandatory fortification program. Similar to the international experience of conducting folic acid mandatory fortification programs, FSANZ developed folic acid mandatory standards, which required the addition of 2 to $\leq 3$ mg of folic acid per kilogram of flour making flour, in Australia and 0.8 to $\leq 1.8$ microgram in New Zealand (FSANZ 2006).

To reduce the incidence of NTDs, it is essential that pregnant women have an understanding of the importance of folic acid nutrition. However, there appears not to have been any public education that accompanied the fortification program except for a link on the FSANZ website to a video and as well as basic information on their website. A study conducted before the mandatory folic acid fortification program indicated that folic acid knowledge and practices were poor among pregnant women (Bower et al. 2004). Emmett et al. (2011) found that the recommended daily level of folic acid intake (400 microgram/day) from supplementation and fortification was achieved by only 36.9% of Australian women of child bearing age. In New Zealand, 35% of postpartum women were found to consume the required three slices or more of bread, which is the amount that was used for dietary modeling purposes to determine levels to be added to breads, and only 15% of the women were in support of such a program whereby folic acid is added to the bread mandatory (Mallard et al. 2012; Mallard & Houghton 2012). Based on results such as these, it was decided that the mandatory fortification program alone, even when three slices of fortified bread were consumed daily, would not provide enough folic acid prior to and during pregnancy, which is why the NHMRC and Department of Health and Ageing (DOHA) also recommended folic acid supplementation (NHMRC 2006; DOHA 2012).

1.3.2 Iodine

In 1994, the Universal Salt Iodization (USI) initiative, where all salt for human and animal consumption was recommended to be fortified with iodine, was recommended by the WHO and the United Nations Children’s Fund (UNICEF) Joint
Committee on Health Policy, in an attempt to reduce iodine deficiency globally. This recommendation was based on the premise that USI is considered a safe, cheap and sustainable strategy to ensure that iodine intake is sufficient and reaches all individuals (WHO 1994). The WHO recommended that in regions where a mandatory salt iodisation program does not exist, iodine supplementation should take place on either a daily basis or on an annual basis using a high iodized oil preparation (WHO 2007). Australia has opted not to implement universal salt iodisation, as this is seen to be contradictory to public health messages to reduce salt intake (Charlton & Skeaff 2011).

Irrespective of the importance of the WHO recommendations to prevent iodine deficiencies, the consumption of iodized salt among pregnant women worldwide continues to be inadequate, which is why Median Urinary Iodine Concentrations (MUIC) below 150 μg/L among populations of pregnant women are still evident in many countries and indicative of inadequate iodine intakes (WHO & UNICEF ICCIDD 2007) (Table 1.3.4). In these countries, further iodine supplementation and/or education programs about the importance of iodine intake may be needed to improve iodine status. Alternatively, it could also be argued that iodisation programs may need to be revisited for their effectiveness.
Table 1.3.4 Iodine status and iodized salt consumption in different countries

<table>
<thead>
<tr>
<th>Country and year of study</th>
<th>Number –type of participants</th>
<th>Reported use of iodized salt</th>
<th>Median Urinary Iodine Concentration μg/L</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Italy 2006-2007#</td>
<td>322 pregnant women (third trimester)</td>
<td>40%</td>
<td>83 μg/L (IQR 30-915.5)</td>
<td>(Mian et al. 2009)</td>
</tr>
<tr>
<td>Spain 2004-2008</td>
<td>1522 pregnant women (second trimester)</td>
<td>50.5%</td>
<td>137 μg/L (IQR 82-228)</td>
<td>(Murcia et al. 2010)</td>
</tr>
<tr>
<td>Bangladesh 2004</td>
<td>256 pregnant women</td>
<td>45%</td>
<td>133 μg/L</td>
<td>(Alam et al. 2010)</td>
</tr>
<tr>
<td>Catalonia, Spain. 2004-2006</td>
<td>600 pregnant women (third trimester)</td>
<td></td>
<td>104 μg/L (IQR 65-164)</td>
<td>(Alvarez-Pedrerol et al. 2010)</td>
</tr>
<tr>
<td>New Zealand 2005*</td>
<td>170 pregnant women (second &amp; third trimester)</td>
<td>66.5%</td>
<td>38 μg/L (IQR 24-56)</td>
<td>(Pettigrew-Porter et al. 2011)</td>
</tr>
<tr>
<td>Turkey 2008**</td>
<td>162 pregnant women (second trimester)</td>
<td>80.2%</td>
<td>80.5 μg/L (IQR 8.9-340.3)</td>
<td>(Oguz Kutlu &amp; Kara 2012)</td>
</tr>
</tbody>
</table>

# After mandatory use of fortified salt in Italy (2005)
* Before iodine mandatory fortification program
**After salt mandatory of iodization household salt in Turkey (1999)

A low consumption of iodized salt and poor iodine status during pregnancy may result from a lack of knowledge about the importance of iodine intake during pregnancy. In Ethiopia, for example, where iodine deficiency disorders are a major public health problem, according to WHO/UNICEF/ICCIDD, more than 90% of
women did not know the importance of iodized salt and the causes of iodine deficiency (Abuye & Berhane 2007).

1.3.2.1  Iodine status in Australia

In Tasmania, a pilot study was undertaken in 2001 to assess the impact of voluntary fortification of bread with iodine through iodised salt (Seal et al. 2007). The study showed an improvement in the Tasmanian population-level iodine status, but did not seem to impact on improving the iodine deficiency in pregnant women (Seal et al. 2007). These results are consistent with data from recent studies in NSW, Victoria, and Tasmania that also showed MUIC levels among pregnant women to be below 150 μg/L, which is indicative of mild to moderate iodine deficiencies (Hamrosi et al. 2005; Travers et al. 2006; Burgess et al. 2007). This data, in addition to other data available from both schoolchildren and pregnant women in Australia, has resulted in the government suggesting that iodine deficiency is a significant public health problem in Australia (NHMRC 2009) Table 1.3.5 summarises studies on the iodine status of pregnant women in Australia that were conducted before introduction of the mandatory iodine fortification program. Evidence such as this has led to the implementation of the mandatory iodine fortification of salt used in the bread-making process.
Table 1.3.5 Iodine Status of pregnant women in Australia 1998-2007

<table>
<thead>
<tr>
<th>Year</th>
<th>Location</th>
<th>Sample size</th>
<th>MUIC</th>
<th>Iodine status</th>
<th>Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>1998-1999</td>
<td>Sydney</td>
<td>81#</td>
<td>104 (IQR 89-129)</td>
<td>Inadequate</td>
<td>(Gunton et al. 1999)</td>
</tr>
<tr>
<td>1998-1999</td>
<td>Sydney</td>
<td>101#</td>
<td>88 (IQR 20-448)</td>
<td>Inadequate</td>
<td>(Li et al. 2001)</td>
</tr>
<tr>
<td>2003</td>
<td>Sydney</td>
<td>50#</td>
<td>47 (IQR 4.0-140)</td>
<td>Inadequate</td>
<td>(Chan et al. 2003)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>263</td>
<td>58 (IQR34-92)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>262</td>
<td>61 (IQR30-95)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2004</td>
<td>NSW</td>
<td>815#</td>
<td>85 (IQR 19-1510)</td>
<td>Inadequate</td>
<td>(Travers et al. 2006)</td>
</tr>
<tr>
<td>2000-2006</td>
<td>Tasmania</td>
<td>285 (pre intervention, 2000)*</td>
<td>76 (IQR43-189)</td>
<td>Inadequate</td>
<td>(Burgess et al. 2007)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>288 (post intervention 2003 6)*</td>
<td>81 (IQR63-115)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>229 (post intervention, 2006)*</td>
<td>86 (IQR57-160)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2008</td>
<td>Illawarra region, NSW</td>
<td>139 #</td>
<td>87.5 (IQR 62)</td>
<td>Inadequate</td>
<td>(Charlton et al. 2010)</td>
</tr>
</tbody>
</table>

*Intervention = voluntary fortification using iodized salt in bread.

#Before iodine mandatory fortification program
In Australia, in 2009, the mandatory iodine fortification program was introduced simultaneously with the folic acid fortification program, to tackle the re-emergence of iodine deficiency in the population. FSANZ developed iodine mandatory standards, which required the addition of 25-65 mg of iodine per kilogram of salt to all bread, except organic bread, in Australia and New Zealand (FSANZ 2008).

FSANZ also indicated that to reduce iodine deficiency it is essential that pregnant women have an understanding of the importance of iodine nutrition, especially during their pregnancy. However, an Australian study conducted before the mandatory iodine fortification program indicated that iodine knowledge and practices were poor among pregnant women (Charlton et al. 2010). In addition, FSANZ recommended that mandatory iodine fortification programs, as with folic acid fortification, should be routinely monitored (AIHW 2011). Monitoring includes measuring intake of iodine and folic acid in sectors of the population, recording adverse effects, measuring level of iodine and folic acid in the food supply and examining consumer behaviour related to folic acid and iodine intake. FSANZ reported that, based on the analysis of consumed bread among the Australian population in July, 2010, and data from the previous two national nutritional surveys (Australian National Nutritional Survey, 1995 and National Children’s Nutrition and Physical Activity Survey, 2007), the estimated dietary folic acid and iodine intake had increased among target group after mandatory fortification program. However, this dietary modelling process demonstrated that additional folic acid and iodine supplementation would be needed for pregnant women and women of child bearing age that were planning a pregnancy (FSANZ 2013).

Despite the 2009 iodine mandatory fortification program, which aimed to increase iodine intake among the population, a number of studies have indicated that iodine intake among pregnant women is still below the recommended amount for this group. In 2011, dietary intake data from The Australian Longitudinal Study of Women’s Health (ALSWH) collected in 2003 was used to estimate iodine intake among non-pregnant women (n=7324), pregnant women (n=665), women postpartum 0-6 months (n=432), and women postpartum 7-12 months (n=467). According to these comparisons, it was estimated that the mean iodine intake (before
and after the iodine fortification program) was 65.1 microgram/day versus 103 microgram/day among non-pregnant women, 78 microgram/day versus 124 microgram/day among pregnant women, 75 microgram/day versus 123 microgram/day among women 0 to 6 months postpartum and 71 microgram/day versus 117 microgram/day among women 7 to 12 months postpartum (Mackerras et al. 2011).

The low iodine intake among pregnant women also was confirmed by a cross-sectional study undertaken in Gippsland, Victoria, between 2009-2010, among (n=86) pregnant women, which indicated that the consumption of foods rich in iodine was low among pregnant women (e.g. seafood was consumed by 9% of the sample and eggs were consumed by 50% of the sample), and few pregnant women consumed bread at the level that had been modelled in the fortification program (i.e. at least 3 slices per day) (Rahman et al. 2011). Based on these findings, it could be argued that further strategies are required including supplementation and health education programs, to improve iodine status among pregnant and lactating women (Axford et al. 2011; Rahman et al. 2011).

1.4 Use of folic acid and iodine supplements

Recent studies indicate that despite an increase in folic acid and iodine intake at a population level following the introduction of both the folic acid and iodine mandatory fortification programs, significant improvements in the intake of these micronutrients among pregnant women have not been achieved (Emmett et al. 2011; Lamers 2011; Mackerras et al. 2011; Rahman et al. 2011). Although the evidence to date indicates that there has been an improvement in serum folate and MUICs, supplement consumption is still low among this target group (Murcia et al. 2010; Pettigrew-Porter et al. 2011; Gall et al. 2012). In the United Kingdom, for example, a study found that 67% of pregnant women (n=402) consumed folic acid supplements and only 12% of them had started taking folic acid before their pregnancy (Brough et al. 2009). An Italian study on the other hand, found that even fewer pregnant women
(40%) in their study were consuming iodine-containing supplements (Mian et al. 2009).

The use of folic acid supplements in Australia is similar to other countries, such as USA and Japan, in which less than half of the target group consumed folic acid before pregnancy (Table 1.4.1). The New South Wales Population Health Survey reported that 53.1% of mothers took folic acid before and during their first trimester of pregnancy, and that supplement usage patterns had not changed within the five year period between 2001-2002 and 2005-2006 (NSW Department of Health 2008). As in other countries, the consumption of folic acid supplements by the target population is still inadequate (Table 1.4.1).

**Table 1.4.1 Use of folic acid supplements in Australia and other countries**

<table>
<thead>
<tr>
<th>Place of study</th>
<th>Number of participants</th>
<th>Folic acid supplements</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Norway 2000-2003</td>
<td>22500 pregnant women Age 14-46 yrs</td>
<td>Two months before pregnancy 11.8% During three months of pregnancy 46.9%</td>
<td>(Nilsen et al. 2006)</td>
</tr>
<tr>
<td>South Australia, Australia, 2005#</td>
<td>304 pregnant women Age 15-45yrs</td>
<td>30%</td>
<td>(Conlin et al. 2006)</td>
</tr>
<tr>
<td>Qatar&amp; Oman</td>
<td>300 pregnant women Age 25-35 yrs</td>
<td>13.2% before pregnancy</td>
<td>(Hassan &amp; Al-Kharusi 2008)</td>
</tr>
<tr>
<td>New South Wales Population Health Survey,</td>
<td>Mothers of infants 0-11 months</td>
<td>53.1% took folic acid supplements one month before and during the first</td>
<td>(NSW Department of Health 2008)</td>
</tr>
<tr>
<td>Country, Region, Year</td>
<td>Sample Size</td>
<td>Age, Pregnancy Stage</td>
<td>Intake Percentage</td>
</tr>
<tr>
<td>-----------------------</td>
<td>-------------</td>
<td>----------------------</td>
<td>-------------------</td>
</tr>
<tr>
<td>Australia, 2008#</td>
<td>5280</td>
<td>age=29.2 yrs</td>
<td>14% before pregnancy</td>
</tr>
<tr>
<td>Lebanon</td>
<td>349 pregnant women Age 16-45yrs</td>
<td>31.5% before pregnancy 40.4% during pregnancy</td>
<td>(Paulik et al. 2009)</td>
</tr>
<tr>
<td>Kansas, USA</td>
<td>250 child bearing age Age 18-44yrs</td>
<td>25% daily intake</td>
<td>(Sharp et al. 2009)</td>
</tr>
<tr>
<td>Korea</td>
<td>1277 pregnant women Mean age 29.4yrs</td>
<td>10.3% before pregnancy</td>
<td>(Kim et al. 2009)</td>
</tr>
<tr>
<td>Sydney, Australia 2005-2006#</td>
<td>295 pregnant women</td>
<td>23% before pregnancy</td>
<td>(Wilton &amp; Foureur 2010)</td>
</tr>
<tr>
<td>Durham, USA</td>
<td>539 pregnant women Age &gt; 18yrs</td>
<td>51% before pregnancy and 66% during pregnancy</td>
<td>(Hoyo et al. 2011)</td>
</tr>
<tr>
<td>China</td>
<td>10680 pregnant women Age 19-44yrs</td>
<td>8% 3 months before and 3 months after pregnancy</td>
<td>(Zeng et al. 2011)</td>
</tr>
<tr>
<td>Iran</td>
<td>676 pregnant women</td>
<td>20.12% during preconception period</td>
<td>(Nosrat et al. 2012)</td>
</tr>
<tr>
<td>Country</td>
<td>Study Details</td>
<td>Details</td>
<td>Reference</td>
</tr>
<tr>
<td>---------------------------------</td>
<td>-------------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------</td>
<td>-----------</td>
</tr>
<tr>
<td>New Zealand 2011#</td>
<td>723 postpartum women; Age 27-35yrs; 33% during the periconceptional period</td>
<td></td>
<td>(Mallard et al. 2012)</td>
</tr>
<tr>
<td>Denmark</td>
<td>5383 non-pregnant women; Age 18-40 yrs; 7.7% folic acid exclusive, 34% folic acid &amp; multivitamins</td>
<td></td>
<td>(Cueto et al. 2012)</td>
</tr>
<tr>
<td>National cohort study in Australia (2004-2006)#</td>
<td>n=996 women at child bearing age; Age 26-36 yrs; 26% women taking multivitamin only, 6.2% women taking folate only, 8.7% women taking multivitamin and folate</td>
<td></td>
<td>(Gall et al. 2012)</td>
</tr>
</tbody>
</table>

# before mandatory fortification program was implemented in Australia and New Zealand

Regarding iodine supplement use, in Australia (See Table 1.4.2), two small studies previously conducted in the Illawarra region of NSW (Charlton et al. 2010; Charlton et al. 2012) reported that only 20% of pregnant women were taking iodine-containing supplements in 2009 (n = 139). This figure increased to 60 % in 2011 (n=147), as a result of changes to product formulations of pregnancy supplements, rather than improved knowledge about the need for supplementation in this group per se. Table 1.8 suggests that, similar to the folic acid scenario, women in the target group population worldwide are consuming inadequate iodine supplements.
Table 1.4.2 Use of iodine supplements in Australia and in different countries

<table>
<thead>
<tr>
<th>Place of study</th>
<th>Number of participants</th>
<th>Iodine supplements</th>
<th>Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Italy 2006-2007</td>
<td>322 pregnant women</td>
<td>40-60%</td>
<td>(Mian et al. 2009)</td>
</tr>
<tr>
<td></td>
<td>Age=15-46 yrs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spain 2004-2006</td>
<td>1522 pregnant women</td>
<td>58.5%</td>
<td>(Murcia et al. 2010)</td>
</tr>
<tr>
<td>New South Wales, Australia, 2008*</td>
<td>n=139 pregnant women</td>
<td>35%</td>
<td>(Charlton et al. 2010)</td>
</tr>
<tr>
<td></td>
<td>age 16-45yrs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>New Zealand 2005</td>
<td>n=170 pregnant women</td>
<td>23%</td>
<td>(Pettigrew-Porter et al. 2011)</td>
</tr>
<tr>
<td></td>
<td>Mean age 31yrs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>New South Wales, Australia, 2011#</td>
<td>n=147 pregnant women</td>
<td>60%</td>
<td>(Charlton et al. 2012)</td>
</tr>
<tr>
<td></td>
<td>mean age 28yrs</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* before mandatory fortification
# after mandatory fortification

The evidence suggests that there is a higher level of supplementation use of these micronutrients among pregnant women who come from higher education and income backgrounds, as well as among women who had planned their pregnancies (Zeng et al. 2011; Cueto et al. 2012; Gall et al. 2012; Mallard et al. 2012). Other factors that affect the consumption of these supplements include an increased awareness about the importance of supplementation during pregnancy and the receipt of relevant nutritional information from their health professionals (Kim et al. 2009; Mallard et al. 2012).

Barriers to the consumption of supplements among the target group in Australian women include: a lack of awareness relating to the importance of supplementation, the associated costs and a limited access to these supplements (FSANZ 2006). According to the evidence these barriers are documented for folic acid but there is very little documentation in terms of barriers to iodine supplementation. It is
important to note, therefore, that no recent consumer education programs have focused on iodine nutrition during pregnancy and most pregnant women have not received sufficient advice regarding iodine for them to be able to make informed decisions, which is why further education of health professionals has been recommended (Charlton et al. 2010).

1.5 Role of pharmacists
Health care providers, including pharmacists, should play an important role in educating women about the importance of folic acid and iodine intake and/or supplementation, both before and during pregnancy. Unfortunately to date, there is very limited evidence in the literature, regarding the health care providers’ role in educating women about the use of these nutrients, with even less information regarding the role of pharmacists. We do know from the evidence however, that obstetricians and gynaecologists have a better knowledge and understanding about the recommended daily doses of these micronutrients, as compared to other health care providers including physicians and general practitioners (Williams et al. 2006). In an American study, Williams et al (2006) found that the majority of health care providers knew about the association between folic acid intake (prior to pregnancy) and its impact on reducing the incidence of NTDs. Not surprisingly, the evidence also suggests that health care providers have a poorer knowledge and understanding with regard to recommendations for iodine supplementation, before or during pregnancy. For example, a recent United Kingdom (UK) study found that only 20% of the 60 midwives included in the study knew about the importance of an adequate iodine intake, prior to and during pregnancy, for brain development of the foetus and less than half of them could identify dietary sources of iodine (Williamson et al. 2012). Based on these studies, therefore, it could be suggested that further education programs about folic acid and iodine supplements are needed to improve the health care providers’ knowledge about these micronutrients (Dickinson et al. 2012; Williamson et al. 2012), which in turn could result in the better dissemination of such information to their patients/clients.
The Australian National Medicine Policy indicates that pharmacists have a professional obligation to provide information and advice to all patients about the quality use of all medicines, including complementary medicines (Department of Health and Ageing 1999). However, there appears to be no data from Australia that has specifically assessed the knowledge of pharmacists with regard to their knowledge of folic acid and iodine intake recommendations during pregnancy. However, one study conducted by Semple et al. (2006), which included 701 community pharmacists from three different states (South Australia, Victoria, and Queensland) may be relevant. This study reported that the most common barrier for pharmacists providing dietary supplementation advice was a lack of adequate training in this area, as well as a lack of available information resources about dietary supplements. Similarly, an American survey of 107 community pharmacists reported that approximately half of them did not perceive themselves to have sufficient knowledge about dietary supplementation and so hesitated to provide information regarding dietary and/or nutrient supplementation to any of their clients/customers (Brown et al. 2005). It could be argued, therefore, that pharmacists perceive themselves as having limited knowledge and understanding in this area, primarily because they self-educate themselves about dietary supplements whilst in practice, rather than being formerly trained in this area (Howard et al. 2001).

Perhaps the only other pharmacy-related evidence in this area, included an American study which surveyed pharmacy students (n=98) about their knowledge and understanding with regard to the function, requirements and food sources of folic acid during pregnancy (Lynch 2002). This study found that many of the pharmacy students lacked specific knowledge that would enable them to provide adequate information to pregnant women about folic acid supplementation. Notably the study did not investigate the pharmacy students’ knowledge and understanding about iodine supplementation during pregnancy.

In summary, even though all health care providers, including pharmacists, should provide information about recommended levels of folic acid and iodine intake, prior to and during pregnancy, there is very limited evidence in the literature which deals with this issue. This is surprising given that many health providers, such as
community pharmacists, are readily and freely available for advice, often for extended periods during the day.

1.6 Conclusion

In conclusion, there is evidence that most pregnant women do not consume adequate folic acid and iodine in the form of supplements, nor do they have sufficient levels of knowledge and understanding about the need to consume these supplements prior to and/or during pregnancy, for optimal birth outcomes (Mallard & Houghton 2012). In Australia, few studies have investigated the knowledge, attitudes, and practices of pregnant women after the introduction of the mandatory folic acid and/or iodine fortification programs.

In addition, the role of health care providers as educators of pregnant women about folic acid and iodine supplements has been neglected in the literature. The few available studies indicate that community pharmacists are among the health care providers with a relatively poor understanding about folic acid supplementation requirements during pregnancy and there is no evidence concerning their knowledge and understanding about iodine supplementation during pregnancy.

1.7 Aims of research

This study aims to; first, identify the knowledge, attitudes and practices of pregnant women regarding folic acid and iodine supplementation. Second, it aims to assess whether pharmacists have sufficient knowledge about these nutrients to provide appropriate advice to pregnant women about supplement use and, third, to identify which brands of nutritional supplements contain the NHMRC (2006; 2009) recommended amounts of folic acid and iodine.
1.7.1 Objectives

- To determine the knowledge of pregnant women living in the Illawarra regarding the role of folic acid and iodine supplementation during pregnancy.

- To determine pregnant women’s awareness of the recently introduced mandatory fortification programs for both folic acid and iodine supplementation.

- To investigate the use of folic acid and iodine supplements during pregnancy and identify barriers to supplementation, including cost and availability.

- To investigate the knowledge of pharmacists about requirements for folic acid and iodine supplementation during pregnancy.

- To conduct an audit of the formulation and cost of commercially available nutritional supplements targeted at pregnant women, with regard to folic acid and iodine.
2 METHODOLOGY

To achieve the three aims of this study, data were collected from three sources: pregnant women, community pharmacists and a review of available folic acid and iodine supplements from online Australian pharmacy sites.

2.1 Part1:-Pregnant women

A cross sectional survey of pregnant women residing in the Illawarra region (in the Australian state of New South Wales) was undertaken between October, 2012, and February, 2013. A self-administered questionnaire (see appendix A) included questions relating to a pregnant women’s knowledge of: (1) folic acid and iodine; (2) good dietary sources of these nutrients; (3) the health problems associated with insufficient intake of these nutrients prior to and during pregnancy; (4) the mandatory Australian folic acid and iodine fortification programs; (5) information about their dietary practices during pregnancy; (6) the sources of information they use to find out about nutrition-related issues; (7) their consumption of nutritional supplements prior to and during pregnancy; and (8) their use of iodised salt. The questionnaire was adapted from four questionnaires, as described in section 2.1.1.2 below.

2.1.1 Participants and recruitment

2.1.1.1 Sample size

According to Australian Bureau of Statistics (ABS 2010), the total number of babies born in the Illawarra region during 2010 was 4863 and the proportion of births that occurred in Wollongong was 49.1 % (2388). Thus, the expected number of births in the Wollongong area over a three month period would be 597. For the sample size calculation it was assumed that the point estimate for the proportion of women taking nutritional supplements was 50% based on reports from NSW Australia (Watson et al. 2006; Rahman et al. 2011). This is considered to be a conservative estimate. Using this prevalence figure, and confidence level of 95 % within 5%, a sample size of 234 pregnant women participants was required to assess the prevalence of
nutritional supplements use in this current study (sample size was calculated based on (National Statistical Service 2013)). This study therefore aimed to recruit a sample size of 200 pregnant women, (i.e. approximately one third of women giving birth within the 3-month data collection time frame) by using a convenience sampling recruiting technique at the following locations:

1- Private obstetrician practices: The 10 Illawarra based obstetricians whose contact details were available online (www.yellowpages.com.au2012) were invited to participate in the study via a letter (Appendix B) and a personal follow-up visit by the student researcher. This resulted in five of the 10 obstetricians’ volunteering to display and make available promotional materials (e.g. posters and flyers) in their practice rooms inviting pregnant women to take part in the study. Pregnant women who attended these obstetric practices and volunteered to be part of the study after reading the promotional materials were then provided with the option of completing a hard copy of the questionnaire, or an online version using a dedicated Survey Monkey site (See Appendix C).

2- Miscellaneous venues frequented by pregnant women in the Illawarra region e.g. a maternity shop, a baby shop, four physiotherapy practices, and three antenatal classes were visited by the student researcher seeking their participation in the research by displaying promotional materials (e.g. posters and flyers) inviting pregnant women to take part in the study. This resulted in managers of one maternity shop, one baby shop, three physiotherapy practices, and two antenatal classes agreeing to display the promotional materials for this study. Once again, pregnant women who agreed to take part in the study based on having read the promotional materials were asked to complete a hard copy of the questionnaire or online SurveyMonkey version of the questionnaire.

Figure 2.1.1 shows a schematic diagram of the recruitment strategies for pregnant women and the number of pregnant women who completed the survey questionnaire
Figure 2.1.1 Total numbers of pregnant women who participated in this study and method of recruitment
2.1.1.2 Survey questionnaire used for pregnant women

The survey questionnaire for pregnant women (Appendix A) developed for this study was based on four recent surveys conducted in Australia and New Zealand. The first survey assessed women’s knowledge of folate and folic acid in the period prior to conception, and women’s attitudes regarding the fortification of bread with folic acid. A telephone survey was used to collect this information from 1,000 New Zealand women aged 16-44, and the response rate was 49% (Kalafatelas & Fryer 2011). Second, the South Australia health monitor surveys were conducted through telephone interviews in April, 1998, and in October, 1999, to determine knowledge of folate. The response rate for these surveys was 76.1% and 79.1% respectively. In these surveys the sample for folate questionnaires was restricted to females aged 17-45 years. In addition, the Eat Well Tasmania Survey, 1998–99 contained the same folate questions as were included in the South Australia health monitor survey. This survey was conducted by telephone in 1998 with 406 women aged 17 years and over and in 1999 with 425 women aged 17-45 years (Abraham & Webb 2001). Finally, the questionnaire used by Charlton et al. (2010) surveyed a sample of 139 pregnant women across all trimesters in the Illawarra region of New South Wales to determine knowledge and understanding about the proposal of a mandatory iodine fortification program. This questionnaire asked about iodine deficiency as a public health problem in Australia, the adverse effects of iodine deficiency, sources of iodine and strategies to address iodine deficiency.

To ensure clarity of the developed questionnaire, our survey instrument was pretested with n=5 pregnant women to determine whether the questions were understood and to evaluate the questionnaire layout. A few minor changes were made to the survey in response to this pilot testing, mostly related to wording and formatting.
2.1.1.3 Statistical analysis

The *Statistical Package for the Social Sciences* (SPSS) version 21.0 was used to analyze the data. Descriptive statistical tests were conducted to make comparison including frequencies and Chi square test 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 among 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 income compared with high incomes (cut-off=$70,000); high level of education compared with low educational attainment (cut-off=TAFE or apprenticeship). For the purpose of analysis, the suburban area according to the classification of the Socio-Economic Indexes for Area (SEIFA) 2011 was classified into higher and lower qualifications and skills performed classes (cut off=5).

SEIFA is a measurement which classifies areas of Australia into advantaged and disadvantaged categories based on the socio-economic features of people living in the area. One of the indexes used in this study is the Index of Education and Occupation (IEO). This measurement provides an ordinal rank of the area according to qualifications and skills of people living in that area and ranks from most disadvantaged (rank=1) to most advantaged (rank=10) (ABS 2011).
2.2 Part 2: Community Pharmacists

2.2.1 Participants and Recruitment

All 55 community pharmacies within the Illawarra region, (For more detailed map of the Illawarra region see Appendix D) whose contact details were available online (www.yellowpages.com.au2012), were invited to participate in the study via a letter of invitation (Appendix E). The letter of invitation was addressed to the pharmacy manager/owner of each of the 55 community pharmacies and was followed up by the student researcher, personally visiting each of the community pharmacies. Six of the pharmacies whose contact details were available online had closed down. Forty three (78% initial response rate) of the 49 available community pharmacies volunteered to take part in the study. However, in some cases more than one pharmacist from the same pharmacy volunteered (n=4) to complete the survey. This resulted in 41 completed hardcopy pharmacy surveys (Figure 2.2.1), which were returned to the student researcher either at the pharmacies or posted via prepaid envelope (n=6 surveys were dropout).

2.2.2 Survey questionnaire used for community pharmacists

The survey questionnaire (Appendix F) used in the current study to investigate pharmacists’ knowledge and understanding about folic acid and iodine supplementation for pregnant women consisted of a 10-item survey instrument. The survey questions were adapted from the five item folic acid survey used by Lynch (2002) to assess pharmacy students’ knowledge about folic acid supplementation during pregnancy, as well as additional questions about iodine supplementation adapted from an iodine study conducted by Charlton et al (2010), used to assess pregnant women’s knowledge about iodine supplementation during pregnancy. The first five questions in the survey questionnaire asked questions relating to different aspects about folic acid supplementation during pregnancy (for example: the importance of supplementation; the recommended level of folic acid intake during pregnancy; the optimal time for commencing folic acid supplements; good dietary sources of folic acid; and which food is fortified with folic acid in Australia by law). The other five questions in the survey asked about iodine requirements during pregnancy (the importance of iodine supplementation, the recommended level
of iodine intake, good dietary sources, and which food is fortified with iodine in Australia by law). In addition to these questions, two open-ended questions asked about which supplements were typically recommended to pregnant women by pharmacists and the reasons for these recommendations.

2.2.3 Statistical analysis

For the statistical analysis of the pharmacists’ data, SPSS version 21.0 and Excel 2010 were used. Descriptive statistical tests were conducted to make comparisons, including basic frequencies and percentages.
Figure 2.2.1 Total number of participants in the study
2.3 Part3:- An audit of supplement products available from online pharmacies

Online searching of pharmacy websites, including the MIMS database and Australian-based online pharmacies such as Pharmacy Direct, epharmacy, Pharmacy Online, Chemist Australia, and Chemist Direct were reviewed to collect information regarding the folic acid and iodine supplements available online. These supplements were then audited for their folic acid and/or iodine content, the manufacturer’s recommended daily intake and the cost of the product (March, 2013). The search terms used in this investigation included pregnancy supplements, iodine and folic acid supplements, pregnancy vitamins and minerals.

2.3.1 Ethical considerations

Ethics approval for the study was obtained from the University of Wollongong Human Research Ethics Committee and the Illawarra Shoalhaven Local Health District (Appendix G). Each respondent received a Participant Information Sheet, or viewed it if the response was online through SurveyMonkey. Informed written consent was obtained from each participant (Appendix H, I, J and K) and all surveys were anonymous and de-identified. Electronic data (including questionnaire responses and computer data) are stored on password protected computers and hard copies of the data are securely stored at the University of Wollongong in the Higher Degree Research student office, in a locked cabinet.
3 RESULTS

This chapter presents the results of the three parts of this study which includes the survey responses of the pregnant women, the survey responses of the community pharmacists and the audit of the online folic acid and iodine supplements for pregnant women available on Australian pharmacy websites.

3.1 Part One: Results of pregnant women survey

To ensure that a sufficient number of completed questionnaires were returned, a total of 200 hard copy printed survey questionnaires were distributed at the study sites, as well as 200 flyers advertising the online survey questionnaire (which was available on https://www.surveymonkey.com/s/9F8MM9M). This resulted in a total of 152 completed questionnaires being returned (n=95 completed hard copy printed surveys and n=59 completed the online survey).

Demographic characteristics of the 152 pregnant women who participated in the first part of this study are shown in Table 3.1.1. Most of the women were either in their second (46%) or third (45.3 %) trimester of pregnancy, and more than half of them had obtained a bachelor level university degree or higher qualification. According to the 2011 SEIFA index, approximately half of the pregnant women participants (51.1%) lived in households which were from individuals with higher qualifications and skills performed classes.
Table 3.1.1 Demographic characteristics of the pregnant women participants

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>N=152</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16-24</td>
<td></td>
<td>12.2%</td>
</tr>
<tr>
<td>25-34</td>
<td></td>
<td>70.2%</td>
</tr>
<tr>
<td>&gt;35</td>
<td></td>
<td>17.6%</td>
</tr>
<tr>
<td>Trimester</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1(0-12 weeks)</td>
<td></td>
<td>8.6%</td>
</tr>
<tr>
<td>2(13-28 weeks)</td>
<td></td>
<td>46.7%</td>
</tr>
<tr>
<td>3(&gt;28 weeks)</td>
<td></td>
<td>44.7%</td>
</tr>
<tr>
<td>Highest level of education</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Some high school</td>
<td></td>
<td>6.8%</td>
</tr>
<tr>
<td>Complete high school</td>
<td></td>
<td>14.9%</td>
</tr>
<tr>
<td>TAFE or Apprenticeship</td>
<td></td>
<td>23.6%</td>
</tr>
<tr>
<td>University degree(bachelor level)</td>
<td></td>
<td>23.6%</td>
</tr>
<tr>
<td>University degree(postgraduate level)</td>
<td></td>
<td>31.1%</td>
</tr>
<tr>
<td>Annual household income#</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;$40,000-$70,000</td>
<td></td>
<td>34.5%</td>
</tr>
<tr>
<td>$70,000-$120,000</td>
<td></td>
<td>34.5%</td>
</tr>
<tr>
<td>$120,000-$150,000</td>
<td></td>
<td>22.7%</td>
</tr>
</tbody>
</table>

# n=12 women did not report their annual household income

3.1.1 Supplement use among pregnant women participants

The majority of the participants (81.6%) indicated that they used supplements during their pregnancy and most of them (63.4%) indicated they had started consuming supplements during their pregnancy, rather than prior to their pregnancy (See Figure 3.1.1).
More than half (67.7%) of the pregnant women reported that they took supplement brands which contained both folic acid and iodine in varying dosages. While only a small number of them (4.6%) were taking supplements containing only folic acid, a further 9.2% consumed other nutritional supplements, containing vitamin D, fish oil, vitamin C, calcium and iron (See Table 3.1.2). This table also highlights that more than half of the pregnant women (56.3%) reported that they took their supplements once daily, with an estimated monthly cost ranging from $7.47 to $16.78. According to the data collected, supplement use was significantly higher among pregnant women who were in the highest household income category (>=$70,000), as compared to pregnant women who were in the lowest household income category(<=$70,000 ) (30.8% vs. 69.2%; \( p=0.001 \)). There is an association between the level of education and the annual household income among the participants (\( p=0.029 \)).
Table 3.1.2  Brand names of supplements consumed by pregnant women participants

<table>
<thead>
<tr>
<th>Brand name of supplements</th>
<th>Frequency n=124</th>
<th>Percentage %</th>
<th>Average cost of supplements per month*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blackmores</td>
<td>47</td>
<td>30.9</td>
<td>$14.11</td>
</tr>
<tr>
<td>Elevit</td>
<td>46</td>
<td>30.3</td>
<td>$16.78</td>
</tr>
<tr>
<td>Nature’s Own</td>
<td>4</td>
<td>2.6</td>
<td>$12.95</td>
</tr>
<tr>
<td>Cenovis</td>
<td>2</td>
<td>1.3</td>
<td>$7.47</td>
</tr>
<tr>
<td>Ethical Nutrients</td>
<td>2</td>
<td>1.3</td>
<td>$10.97</td>
</tr>
<tr>
<td>Fefol Multipregnancy</td>
<td>7</td>
<td>4.6</td>
<td>$10.46</td>
</tr>
<tr>
<td>Fabfol Plus</td>
<td>2</td>
<td>1.3</td>
<td>$13.34</td>
</tr>
<tr>
<td>Others</td>
<td>14</td>
<td>9.2</td>
<td></td>
</tr>
</tbody>
</table>

*based on average cost of pregnancy-related supplements for the relevant brand, obtained from online information

Of the participants who were not taking supplements (n=28, 18.4%) their reported reasons in an open-ended question were: 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 they perceived that they could obtain adequate nutrients from their diet (13.3%).

3.1.2  Beliefs of pregnant women about folic acid and iodine supplements

Approximately half (52.7%) of the participants believed that pregnant women required folic acid supplements in addition to the folic acid they were receiving from dietary sources alone. While just over a quarter of the pregnant women (29.3%) had no idea about whether or not additional folic acid supplements were required during pregnancy.
Based on the survey responses, most pregnant 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 (Figure 3.1.2). 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”, 25.7% reported that they avoided foods that could potentially cause listeriosis, and 10.5% reported that they were taking nutritional supplements.

![Figure 3.1.2 Proportion of pregnant women who perceived they had received adequate dietary information about different diet and nutrient related topics](image)

Figure 3.1.3 highlights that most of the participants received information about folic acid and iodine supplements from their general practitioners, the internet, obstetricians or from written information sources. Dieticians and pharmacists, in particular, seemed to play a small role in providing this information to the pregnant women. It was also found that most health professionals, including general
practitioners, are more likely to discuss folic acid supplementation rather than iodine supplementation with pregnant women.

Figure 3.1.3 Sources of information received about folic acid and iodine

3.1.3 Knowledge and practices related to folic acid intake during pregnancy

Almost all (98%) participants had heard of the need for folic acid during pregnancy and the majority of them (84%) could correctly identify the recommended timing for commencement of the folic acid supplementation (i.e. prenatally). Most participants (75.6%) understood that neural tube defects are the main health problem associated with inadequate intake of folic acid, while 11.8% of the participants did not know the consequences of folic acid deficiency during pregnancy (See Table 3.1.3). Notably, knowledge about the consequences of folic acid deficiency was higher among participants with higher educational levels (bachelor and postgraduate level) (45.1% vs. 54.9% \( p=0.031 \)).
Table 3.1.3 Health problems identified by participants as associated with inadequate intake of folic acid*

<table>
<thead>
<tr>
<th>Health problems</th>
<th>Frequency*</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neural Tube Defects</td>
<td>115</td>
<td>75.6</td>
</tr>
<tr>
<td>Malformations in pregnancy (birth defects)</td>
<td>57</td>
<td>37.4</td>
</tr>
<tr>
<td>Mental retardation</td>
<td>2</td>
<td>1.3</td>
</tr>
<tr>
<td>Weak bone and teeth</td>
<td>10</td>
<td>6.6</td>
</tr>
<tr>
<td>Do not know</td>
<td>18</td>
<td>11.8</td>
</tr>
</tbody>
</table>

*Participants could select more than one option from a defined list

#bold typeface indicates correct answers

Knowledge of participants about good dietary sources of folic acid was limited. Even though most (81.8%) participants knew that green leafy vegetables were a rich source of folic acid, approximately half of the participants only correctly identified fruit (48%), breakfast cereals (55.2 %), and bread (44.1 %) as sources of folic acid. (See Table 3.1.4)

Table 3.1.4 Food sources of folic acid reported by participants

<table>
<thead>
<tr>
<th>Food sources#</th>
<th>Frequency N*</th>
<th>Percentage %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fruit</td>
<td>69</td>
<td>48.6</td>
</tr>
<tr>
<td>Green leafy vegetables</td>
<td>121</td>
<td>81.8</td>
</tr>
<tr>
<td>Milk</td>
<td>26</td>
<td>17.9</td>
</tr>
<tr>
<td>Fish /seafood</td>
<td>23</td>
<td>16</td>
</tr>
<tr>
<td>Meat</td>
<td>25</td>
<td>17.5</td>
</tr>
<tr>
<td>Breakfast cereals</td>
<td>80</td>
<td>55.2</td>
</tr>
<tr>
<td>Bread</td>
<td>63</td>
<td>44.1</td>
</tr>
</tbody>
</table>

#bold typeface indicates correct answers

*participants could select more than one option from a defined list
Similarly, only 56% of the participants identified supplementation as an additional source of folic acid and less than 25.5% of them correctly recognized that bread had been fortified with folic acid, after the introduction of the Australian mandatory folic acid fortification program. (See Figure 3.1.4)

![Diagram showing knowledge of participants about folic acid mandatory fortification program](chart.jpg)

**Figure 3.1.4 Knowledge of participants about folic acid mandatory fortification program**

With regard to responses about their daily consumption of bread, just over half (56%) of the participants indicated that they consumed two slices of bread in an average day, with 14.7% of them indicating that they consumed one slice of bread per day and 10.7% of them reporting that on average they consumed less than one slice of bread per day.

**3.1.4 Knowledge and practices related to iodine intake during pregnancy**

Knowledge of the participants related to iodine was more limited than that for folic acid. Regarding health problems associated with inadequate iodine intake during pregnancy, only 39.5% of the participants could identify all the correct answers (goitre, mental retardation, malformations in pregnancy, impaired physical development) and more than half of them (53.6%) could not identify any of the
associated health outcomes (See Table 3.1.5). Once again, knowledge about the poor health outcomes associated with poor iodine intake during pregnancy was higher among participants from higher educational (bachelor and postgraduate level) (26.7 vs. 73.3 \( p=0.001 \)) and household income backgrounds (>70,000) (23.2% vs. 76.8% \( p=0.013 \)).

Table 3.1.5 Health problems identified by participants as associated with inadequate intake of iodine*

<table>
<thead>
<tr>
<th>Health problems#</th>
<th>Frequency N*</th>
<th>Percentage %</th>
</tr>
</thead>
<tbody>
<tr>
<td>NTDs</td>
<td>5</td>
<td>3.3</td>
</tr>
<tr>
<td>Goitre</td>
<td>41</td>
<td>27.2</td>
</tr>
<tr>
<td>Mental retardation</td>
<td>25</td>
<td>16.6</td>
</tr>
<tr>
<td>Weak bone and teeth</td>
<td>4</td>
<td>2.6</td>
</tr>
<tr>
<td>Malformation in pregnancy (birth defects)</td>
<td>23</td>
<td>15.3</td>
</tr>
<tr>
<td>Impaired physical development during childhood</td>
<td>7</td>
<td>4.6</td>
</tr>
<tr>
<td>Blindness</td>
<td>4</td>
<td>2.6</td>
</tr>
<tr>
<td>Do not know</td>
<td>81</td>
<td>53.6</td>
</tr>
</tbody>
</table>

*participants could select more than one option from a defined list

#bold typeface indicates correct answers

Knowledge about good dietary sources of iodine was poor among the participants. Approximately half correctly identified that salt (56.5%) and fish/seafood (46.9%) was good dietary sources of iodine. Just over a quarter (26.1%) recognized that eggs were also a good source of iodine, while few (17%) identified that bread was good dietary source of iodine. In addition, many of the participants (14.1% - 29.8%) incorrectly identified meat, fruit and vegetables as dietary sources of iodine. (See Table 3.1.6)
Table 3.1.6  Food sources of iodine reported by participants

<table>
<thead>
<tr>
<th>Food sources*</th>
<th>Frequency #</th>
<th>Percentage %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fruit</td>
<td>22</td>
<td>15.6</td>
</tr>
<tr>
<td>Vegetables</td>
<td>42</td>
<td>29.8</td>
</tr>
<tr>
<td>Eggs</td>
<td>37</td>
<td>26.1</td>
</tr>
<tr>
<td>Meat</td>
<td>34</td>
<td>14.1</td>
</tr>
<tr>
<td>Salt(^a)</td>
<td>81</td>
<td>56.3</td>
</tr>
<tr>
<td>Milk</td>
<td>18</td>
<td>12.9</td>
</tr>
<tr>
<td>Bread</td>
<td>24</td>
<td>17.1</td>
</tr>
<tr>
<td>Fish/seafood</td>
<td>67</td>
<td>46.9</td>
</tr>
</tbody>
</table>

* Bold typeface indicates correct answers  \(^a\) Only if iodised

#participants could select more than one option from a defined list

With regard to the participants’ responses regarding the mandatory iodine fortification program, only 11.5% correctly identified that bread is required by law to be fortified with iodine in Australia. As many as 73% of the participants indicated that they did not know which foods had been fortified with iodine according to law. (Figure 3.1.5) Less than half of participants (45.6%) reported that they used iodized salt in cooking or at the table.
3.2 Survey of Community Pharmacists

3.2.1 Knowledge of pharmacists about folic acid supplement

Results from the 41 community pharmacists recruited to complete the survey showed that most participants had a good knowledge and understanding about the importance of folic acid supplementation during pregnancy. Notably, however, only half of the pharmacy participants could identify good food sources of folic acid and which foods, required by Australian law, have been fortified with folic acid since 2009.

All community pharmacists (N=41) surveyed in this study knew that folic acid is required to prevent the occurrence of NTDs during pregnancy. When asked to determine the optimum time for initiation of folic acid supplementation, most pharmacists (n=33; 80%) reported the correct answer (i.e. pre-conceptually), while 5 (12%) reported that supplementation should commence after a positive test of pregnancy had been confirmed. Regarding the NHMRC (2006) recommendation for folic acid daily requirements during pregnancy, 39 (95%) of the 41 pharmacists...
correctly identified 400 microgram per day as the recommended dose for pregnancy, with only two pharmacists getting this question incorrect.

Twenty (49%) of the pharmacists correctly identified that daily multivitamin supplements, green leafy vegetables and fortified cereals were good sources of folic acid, while 13 (32%) and 3 (7%) reported that only green leafy vegetables or a daily multivitamin was a good source of folic acid, respectively (See Figure 3.2.1).

![Graph showing percentages of pharmacists' knowledge about the good natural sources of folic acid.]

**Figure 3.2.1** Pharmacists' knowledge about the good natural sources of folic acid

When asked about the mandatory folic acid fortification program, less than half (46.3%) of the pharmacists correctly recognized that bread is the food that is required to be fortified by law with folic acid in Australia, while 43.9% of participants incorrectly identified breakfast cereals as the food which had been fortified with folic acid. (See Figure 3.2.2)
3.2.2 Knowledge of pharmacists about iodine

Most pharmacists (n=30; 73%) identified that an iodine deficiency during pregnancy could result in neurocognitive deficits in the baby. Over 70% did not know and/or identify the NHMRC (2010) recommendation of 150 microgram daily dose of iodine during pregnancy and almost half (49%) incorrectly thought that iodization of salt was mandatory in Australia (See Figure 3.2.3).
Sixty eight percent of the pharmacists knew that bread had been fortified with iodine by law in Australia, while (22 %) incorrectly identified milk as being fortified with iodine. Only 12.2% of the pharmacists correctly identified that fish/seafood, eggs, and dairy products were all good dietary sources of iodine, with as many as 75.5% reporting that fish /seafood alone was a good source of iodine and an additional 12.2 % not knowing any dietary sources of iodine. (See Table 3.2.1)
Table 3.2.1 Knowledge of pharmacists regarding food sources of iodine

<table>
<thead>
<tr>
<th>Food sources*#</th>
<th>Number of participants</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fish/seafood</td>
<td>26</td>
<td>63.3</td>
</tr>
<tr>
<td>Eggs</td>
<td>2</td>
<td>4.9</td>
</tr>
<tr>
<td>Dairy products</td>
<td>3</td>
<td>7.3</td>
</tr>
<tr>
<td>All of the above</td>
<td>5</td>
<td>12.2</td>
</tr>
<tr>
<td>Meat</td>
<td>2</td>
<td>2.4</td>
</tr>
<tr>
<td>Fruit &amp; vegetables</td>
<td>1</td>
<td>2.4</td>
</tr>
<tr>
<td>I do not know</td>
<td>5</td>
<td>12.2</td>
</tr>
</tbody>
</table>

*More than one option could be selected by participants

# Bold typeface indicates correct answers

3.2.3 Brand names of supplements that were recommended to pregnant women by pharmacists

Pharmacists reported that Elevit, Blackmores and Megafol were the supplement brands that they most commonly recommended to pregnant women (75.6%, 46.3%, 19.5%, respectively) (See Figure 3.2.4). When asked, in an open-ended question, about the reasons why these brands were recommended to pregnant women, approximately 40% responded that it was because they “contain the combination of all necessary vitamins & minerals” and 20% of them reported that “there is good evidence for these doses.”
3.2.4 Supplement brands recommended by pharmacists to pregnant women

3.3 Online audit of availability of folic acid and iodine supplements

Based on information available online from Australian pharmacy websites (Pharmacy Online www.pharmacyonline.com.au 24/1/2013; Chemist Australia 2013) and the MIMS Online database, 37 different vitamin and mineral products were available that specifically targeted pregnant and lactating women. The most common brands available on these websites, as of January, 2012, included Blackmores, Elevit, Nature’s Own, Everst, Fore life, Cenovis, Ethical Nutrients and Fefol Multipregnancy. Thirty five of the 37 different vitamin and mineral products contain recommended daily doses of folic acid of between 200-800μg/day, at costs ranging from $1.18 to $27.95 per month. In addition to products containing folic acid, 22 of the products also contain iodine with the recommended daily doses of between 75-250 μg/day (See Appendix M). Notably, not all of these supplements contain the NHMRC recommended daily doses of either folic acid and/or iodine.
4 DISCUSSION

This chapter presents the discussion of the main findings from the three parts of this study. The discussion will mainly focus on: supplement use among pregnant women; knowledge and understanding about folic acid and iodine requirements during pregnancy among pregnant women and community pharmacists, as well as information pertaining to folic acid and iodine supplements available from online Australian pharmacy websites.

4.1.1 Supplement use among pregnant women

According to the national folic acid recommendations and the NHMRC recommendations the optimal time to consume folic acid supplements for women considering pregnancy (CDC 1992; NHMRC 2006), is prior to the conception period. Findings from this study indicate that most women in the Illawarra region of New South Wales did not take adequate folic acid supplements prior to their pregnancies given that only 36% of them, who became pregnant, started taking folic acid before their pregnancy. The findings of this study are consistent with previous data from the USA which found that only 50% of pregnant women took folic acid supplements before conception (Hoyo et al. 2011). It is evident that further strategies are needed to ensure adequate periconceptual folic acid intake. Stockley & Lund (2008) suggested that preconception care should include health promotion programs which could increase folic acid intake among women considering becoming pregnant. In addition to the NHMRC (2006) guidelines regarding folic acid supplementation, iodine supplementation is also recommended for pregnant women(NHMRC 2010; DOHA 2012). The current study found that two-thirds of the pregnant women in the study consumed iodine supplements in varying dosages (75-250 microgram per day). Overall the current study found an improvement in the consumption of both folic acid and iodine supplements among pregnant women in the Illawarra, as compared to other survey results of pregnant women conducted prior to and after the introduction of both the folic acid and iodine fortification
programs. For instance, prenatal folic acid supplementation has improved from 23% (Wilton & Foureur 2010) to 36% and from 35% (Charlton et al. 2010) to 67.7% for iodine.

The current study also reported that folic acid and iodine supplement use was higher among pregnant women who were from higher socio-economic income brackets. This finding may suggest that only pregnant women who could afford supplements are taking them according to the national recommendations and guidelines, whereas women from low socio-economic income brackets, such as 20% of the pregnant women in this study, were less likely to take these supplements because of their cost. These findings are confirmed by another study in Australia (Forster et al. 2009), as well as studies from different countries worldwide (USA, Denmark, China, Canada); which found that inadequate preconceptual folic acid intake among pregnant women was associated with low socioeconomic status (Stockley & Lund 2008; Forster et al. 2009; Zeng et al. 2011; Cueto et al. 2012) and similar findings have been reported where education level is lower (Charlton et al. 2010). The current study indicated that there was an association between the annual household income and the level of education among the participants with regard to supplements use. Similar findings were also reported in an American study (n=34,818) which found that supplements use was lower among people with lower socioeconomic status (Vatanparast et al. 2010), who presumably had lower levels of education.

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. These findings are similar to those reported in a British study which found that the main barriers associated for 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 (Barbour et al. 2012). In addition, Gallego et al. (2010) 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.

The findings of this study indicate that some of the pregnancy supplements available online from Australian pharmacy websites (at the time of the study) did not contain the NHMRC (2006) recommended daily doses of folic acid (400 microgram per day). For example, Fefol and Fabfol Women’s Multi contain 300 microgram per day of folic acid, whereas Elevit contains twice the recommended daily amount of 800 microgram folic acid per day. Furthermore, only 6 of the 21 supplements available online (Appendix M) contained the NHMRC (2010) recommended levels of iodine (150 microgram per day), while Megafol Folic Acid and Nature’s Own Folic Acid did not contain any iodine at all. Notably also, the Elevit brands contained iodine in varying amounts, ranging from 75 microgram/day (which is below the recommended daily 150 microgram per day dose) to 250 microgram/day (which is above the recommended daily dose). It could be argued therefore, that not much has changed since Conline et al’s (2006) study, conducted before the fortification program, which found that some of the available supplements did not contain the recommended level of micronutrients, which may have resulted in pregnant women not taking enough of folic acid supplement, especially if they were unaware of the recommended daily doses. These findings, therefore, may suggest that further policy changes may be needed to ensure that all available supplements should contain at least the recommended daily doses of these necessary micronutrients.

4.1.2 Pregnant women’s knowledge and understanding about folic acid and iodine intake during pregnancy

The evidence suggests that 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 (Conlinh et al. 2006; Kim et al. 2009). This present study indicates that although most of the pregnant women understood the importance of folic acid supplementation before pregnancy, in the majority of cases they did not appear to understand that supplements, and in
particular folic acid supplements, needed to be taken prior to conception. These findings have been confirmed by other studies conducted in both Western Australia and South Australia (Bower et al. 2004; Chan et al. 2008). In those studies, knowledge of women 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 the voluntary folic acid fortification program. Importantly however, these interventions did not improve women’s understanding about the need for preconceptional folic acid.

Our results support the findings of another study, conducted in New South Wales, that assessed whether knowledge and practices of pregnant women regarding the importance of iodine intake had improved following implementation of the mandatory fortification program (Charlton et al. 2012). The findings of this study confirmed that Australian pregnant women have poor knowledge relating to iodine nutrition, with more than half of the pregnant women in the current study not knowing the health problem associated with an inadequate iodine intake. The current study indicates that little has changed in pregnant women’s knowledge about iodine since 2008, prior to the mandatory iodine fortification program. Potentially, this may be explained by the lack of any public health education campaigns that accompanied the fortification program about the need for iodine supplementation in pregnancy. This is an issue of public health importance that needs to be addressed to ensure that all pregnant women have access to sufficient intake of iodine during pregnancy, thereby ensuring the health benefits to their unborn babies. Recent data in the UK confirmed that even mild iodine deficiency during pregnancy can affect the later cognitive development of the child (Bath et al. 2013). For these reasons, and given that our results confirm that pregnant women’s understanding about the need to take in adequate iodine supplements during pregnancy is poor, it could be argued that prenatal supplements containing iodine should be prescribed to pregnant and lactating women to address this issue (Stagnaro-Green & Pearce 2013).

Perhaps unsurprisingly, the current study found that more highly educated women from higher socio-economic backgrounds had better knowledge about the importance
of adequate intake levels of folic acid and iodine in pregnancy when compared to women with lower levels of education. These findings support evidence in the literature that has shown a higher awareness of the need for folic acid in pregnancy among women with higher educational levels (Sharp et al. 2009). Stockly and Lund (2008) indicated in their systematic reviews that potentially the most effective method to ensure that the recommended intake of folic acid was being consumed (their research did not include iodine intake) among women of child bearing age from poorer socio-economic backgrounds was to ensure that these women received this advice from their health professionals and to ensure easy accessibility to these supplements.

Pregnant women in this study had limited knowledge about the adequacy of dietary intake of folic acid and iodine. Despite the NHMRC (2006) folic acid recommendation that pregnant women cannot meet the recommended folic acid requirements from diet alone, approximately half of the pregnant women in the current study believed that they could get enough folic acid from their dietary sources. Notably, half of the pregnant women also incorrectly identified foods such as meat, milk, and fish/seafood as good dietary sources of folic acid. These results are similar to those reported by Kalafatelis & Fryer (2011), who conducted a study among women of child bearing age in New Zealand. Their results suggested that more targeted education campaigns may need to be introduced to ensure that women recognize good dietary sources of folic acid and to recognize the importance of additional folic acid supplements prior to and during pregnancy.

In the current study, there also seemed to be some confusion among the pregnant women about good dietary sources of iodine. Only half of the women (47%) identified fish and seafood as good iodine sources, with regular consumption of seafood among the participants reported to be low. Similar results have also been found in other Australian study (Charlton et al. 2012). Another important finding in the current study was that even though more than half of the participants (56%) indicated that salt was a good source of iodine, less than half of them reported using iodized salt in cooking or at the table. The low use of iodized salt among pregnant
women in this study was also confirmed in another study undertaken by Rahman & et al. (2011).

Regarding the mandatory fortification programs, the current study indicates that most pregnant women are not aware that bread is now required by law to be fortified with folic acid and iodine. Similar findings were also reported in New Zealand, where iodine fortification was introduced simultaneously to Australia and which later adopted folic acid fortification of bread flour in 2012 (Mallard et al. 2012). In addition, bread consumption patterns among pregnant women in the current study was below the quantities that were used for dietary modelling purposes when recommended levels of folic acid and iodine to be added to bread (three slices of bread per day) in the mandatory fortification program were being considered (FSANZ 2006; 2008). It appears the folic acid and iodine awareness of pregnant women affect the consumption of naturally occurring sources of folic acid and iodine, as well as the fortified sources. 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 (Yeatman et al. 2010).

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. This study showed that approximately half (52%) of the pregnant women had received information about the need for folic acid supplementation from their GPs but only 28% of the participants had received information about the need for iodine supplementation. 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 their community pharmacists and/or midwives. These findings are confirmed by other studies conducted in Australia and New Zealand (Charlton et al. 2010; Mallard & Houghton 2012), where pregnant women had received limited information about the need for folic acid and iodine supplementation. Mazza & Chapman (2010) indicated that pregnant women were more likely to receive information about supplements from health care providers than from media sources. It could be recommended
therefore, that all health professionals, especially pharmacists and midwives, be reminded about the importance of discussing the need for both folic acid and iodine supplementation with their pregnant clients or young women considering becoming pregnant.

The researcher acknowledges that there have been limitations in this study. The participants in this study were not representative of all pregnant women, and the findings cannot be generalized to other regions because a non probability sample (i.e. a convenience sample) was used in one geographical area of regional NSW. However, the findings of this study are supported by other surveys conducted over longer periods of time (before and after the folic acid and iodine mandatory fortification programs were implemented in 2009) (Charlton et al. 2010; Wilton & Foureur 2010; Rahman et al. 2011; Charlton et al. 2012), which found that folic acid and iodine supplement intake during pregnancy and pregnant women’s knowledge about these supplements was poor in Australia.

Another limitation is the low response rate from the original online survey, which necessitated a wider recruitment strategy. Reasons for non-participation rates of pregnant women to complete the online survey are unclear, but may relate to the lack of access to internet access, a lack of computer expertise, lack of motivation, and time constraints. Despite prominent placement of advertisements in public places such as baby shops, physiotherapists and private antenatal rooms, in an attempt to attract women from a wide socioeconomic background, the impersonal nature of the recruitment strategy and lack of incentive may explain, in part, the low response rates.

4.1.3 Folic acid and iodine knowledge and understanding among community pharmacists

The current study indicates that the Illawarra pharmacists who returned their survey responses have adequate knowledge and understanding about the role of folic acid in preventing NTDs in pregnant women and they also know that folic acid supplementation should be commenced prior to conception and during pregnancy. Our results suggest that the pharmacists could provide information on the NHMRC
(2006)-based recommendation for women to take 400 microgram per day of folic acid at least one month before pregnancy and during the first three months of pregnancy. They should be well equipped, therefore, to provide appropriate advice to pregnant women regarding their folic acid requirements in pregnancy. Importantly however, only 6% of the pregnant women in this study had received information about folic acid supplementation from their community pharmacists. In another study 25% of pregnant women reported that they used pharmacists as a source of information about the need for folic acid supplementation (Watson et al. 2006). These findings demonstrate, therefore, that pharmacists are a valuable but underutilized resource with regard to acquiring information about folic acid supplementation.

In contrast to their sound knowledge and understanding about folic acid supplementation during pregnancy, pharmacists in the current study had limited knowledge and understanding about iodine supplementation requirements during pregnancy. Few pharmacists in the study were able to recognize that iodine deficiency could result in neurocognitive deficits in the foetus during pregnancy. Despite the recent NHMRC (2010) iodine supplementation recommendations for pregnancy in Australia, less than half of pharmacists in the current study were able to identify the recommended iodine intake during pregnancy and only 2% of pregnant women in this study had received information about the need for iodine supplementation from their pharmacists. This once again suggests that pharmacists do not seem to be a resource often used by pregnant women for information about their dietary supplementary needs during pregnancy, despite being the major outlet supplying pregnancy supplements. Furthermore, the results suggest that community pharmacists may need to be more effectively educated about the iodine intake recommendations in pregnancy.

The findings of the current study suggest that pharmacists do not seem to have a good knowledge and understanding about the dietary sources of folic acid and iodine and/or that bread has been fortified with folic acid and iodine according to new legislation. More than half of the surveyed pharmacists were aware that bread is required to be fortified by law with iodine, but few of them recognized that bread has
also been fortified with folic acid according to law. These findings are consistent with the USA study (Lynch 2002), which found that most student pharmacists, during their final year of study, knew about the importance of prenatal folic acid to reduce the risk of NTDs. However, these students had a relatively poor understanding about when folic acid supplementation needed to be commenced in pregnancy and in many cases were unaware of the appropriate dose to recommend to their customers/clients.

The current study reported that although the knowledge of pharmacists was inadequate about iodine and other concerns of folic acid, the majority of pharmacists provide advice to pregnant women to take supplements. However, not all the brands of supplements that are marketed to pregnant women contain the recommended levels of iodine. For example, some brands that were recommended by pharmacists, such as Megafol, contain only folic acid which means that an additional iodine supplement will be required. Other brands, such as Elevit, which is the most frequently recommended pregnancy supplement among the responding pharmacists, contains varying levels of iodine. These findings confirm a previous study, in which half of the pharmacists identified as providing advice to pregnant women were dissatisfied with their knowledge (Kwan et al. 2006). Further training programs are needed to inform pharmacists to provide appropriate nutritional supplementation advice to pregnant women.

This study identifies that pharmacists are often underutilised as an information resource regarding nutrient supplementation during pregnancy. The small sample size of pharmacists involved in this study however, limits the generalizability of the findings with regard to pharmacists’ knowledge about folic acid and iodine supplementation for pregnancy. Intuitively therefore, the results lend themselves to further investigation which should also include consumer-pharmacist interactions.
Concluding the discussion, the implementation of mandatory fortification programs for folic acid and iodine in Australia has not significantly improved the use of these supplements among pregnant women in the Illawarra region of NSW. Despite the mandatory programs, knowledge and understanding about the importance of these supplements during pregnancy remain limited. One significant observation is that women from higher socio-economic backgrounds are more likely to use these supplements compared to those from lower socio-economic backgrounds.

Pharmacists, who possess substantial knowledge about folic acid supplementation, are underutilized as sources of information and advice for pregnant women. Since their understanding of iodine supplementation is limited, they may benefit from additional training.

**5.1 Recommendations**

This study recommends:

1. Targeted education programs should be used to encourage increased folic acid and iodine intake among pregnant women and/or women considering becoming pregnant, especially those from poor socioeconomic backgrounds.
2. Health messages should have more targeted and adequate information to inform pregnant women to improve their behaviour with regard to folic acid and iodine supplementation.
3. Wide implementation of existing antenatal clinical guidelines related to nutritional supplementation use.
4. Investigate the feasibility of making these supplements available on the Pharmaceutical Benefits Scheme.
5- All health professionals (including pharmacists and midwives) should be encouraged to discuss folic acid and iodine supplementation with pregnant women; which may also require the availability of further education and/or appropriate educational resources about these supplements for all health professionals.

6- Further research is required to identify the knowledge and practices of other health professionals regarding nutritional supplementation for pregnant women and to identify barriers to not taking folic acid and iodine supplementation among pregnant women.
6 REFERENCES


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IRIS 2013, 'The Illawarra Region', IRIS, 6KB.


Lumley, J, Watson, L, Watson, M & Bower, C 2007, 'Periconceptional Supplementation with Folate and/or Multivitamins for Preventing Neural Tube Defects (Review)', *Cochrane Library*, no. 4.

Lumley, J, Watson, L, Watson, M & Bower, C 2007, 'Periconceptional Supplementation with Folate and/or Multivitamins for Preventing Neural Tube Defects (Review)', *The Cochrane Library*, no. 4.


NHMRC 2006, 'Nutrient Reference Values for Australia and New Zealand: Including Recommended Dietary Intakes', National Health and Medical Research Council, Canberra.


Appendix A  Survey On Knowledge, Attitudes, And Practice Of Nutritional Requirements During Pregnancy

My name is Souad Elmani and I am undertaking this research as part of my Master of Science Degree at the University of Wollongong, under the supervision of Associate Professors Karen Charlton and Vicki Flood (School of Health Sciences) and Dr Judy Mullan (Graduate School of Medicine). The aim of this survey is to identify the knowledge, attitudes, and practices of pregnant women regarding nutritional requirements during pregnancy. The questionnaire focuses firstly on folate and folic acid, and then goes on to questions about iodine. This survey should take approximately 15 minutes to complete and all information is anonymous. You are free to choose not to participate at any time while completing this survey and you can choose not to answer questions if you wish. However, by completing and returning this survey you have given us permission to use this information in our study. As this survey is anonymous, researchers will not be able to identify the information you have provided as yours and therefore you will be unable to withdraw the survey information once submitted.

1- Section
1:-How many weeks pregnant are you?

.................. Weeks
2- Are you taking any vitamins or supplements at present?

☐ Yes
☐ No (If No, go to question 4?)

If yes, please tick the brand name
☐ Blackmores
☐ Elevit
☐ Nature’s Own
☐ Everst
☐ Fore life
☐ Cenovis
☐ Ethical Nutrients and
☐ Fefol Multipregnancy
☐ Others, please name them

………………………………………………………………………………………………………………………………………………………………………………………………………………

How many times did you take them? ........................................................

And what is the daily recommended dose?

………………………………………………………………………………………………………………………………………………………………………………………………………………

If No, what are your reasons for not taking any? (Please go to Question 4 after answering.)

………………………………………………………………………………………………………………………………………………………………………………………………………………

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3- When did you start taking these supplements?

☐ Before this pregnancy
☐ When I discovered that I was pregnant
☐ Within first trimester (i.e. first 3 months of pregnancy)
☐ Later
☐ Do not know
4- Do you believe that you have received enough dietary information to make informed decisions concerning the following nutrition topics during this pregnancy? (Please tick a box for each category)

<table>
<thead>
<tr>
<th>Nutrition Topic</th>
<th>Yes</th>
<th>No</th>
<th>Do not know</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iron intake during pregnancy</td>
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<tr>
<td>Iodine intake during pregnancy</td>
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<tr>
<td>Healthy eating during pregnancy</td>
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<td>Calcium intake during pregnancy</td>
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<td>Folate intake during pregnancy</td>
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<tr>
<td>Listeria and food poisoning risks during pregnancy</td>
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If yes, what changes have you made to your diet since you became pregnant?

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5- From where have you received information, for each topic?

( Please tick a box for each person/place from which you received information )

<table>
<thead>
<tr>
<th>Topic</th>
<th>Iron</th>
<th>Iodine</th>
<th>Calcium</th>
<th>Healthy Eating</th>
<th>Folate</th>
<th>Listeria and Food Poisoning</th>
<th>Did not receive information</th>
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<td>GP</td>
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<td>Obstetrician</td>
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<td>Midwife/nurse</td>
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<td>Dietitian/nutritionist</td>
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<tr>
<td>Pharmacist</td>
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<td>Written info (e.g. pamphlet)</td>
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<td>Verbal (advice)</td>
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<td>Newspapers</td>
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<td>Magazines</td>
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<td>Radio</td>
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</table>
Section 2: The following are questions related to folate/folic acid:-

6 - Have you heard of Folate or Folic Acid?
   - Yes
   - No
   - Do not know / Not sure

7 - Which health problems are associated with not having enough folate/folic acid in the diet? (More than one answer can be ticked)

- Arthritis
- Neural Tube Defects (e.g. spina bifida)
- Goitre (enlarged thyroid gland)
- Mental retardation
- Weak bones and teeth
- Malformations in pregnancy (birth defects)
- Impaired physical development during childhood
- Blindness
- Do not know
8- At what stage is it recommended that women ideally start to increase their folate and folic acid intake? (Tick one answer only)

- Before they become pregnant
- When they discover they are pregnant
- Within the first trimester (i.e. first 3 months of pregnancy)
- Later
- At no stage
- Do not know

9- Do you believe women who are pregnant, or planning to get pregnant, can get enough folate and folic acid through what they drink and the types of food that they eat?

- Yes
- No
- Do not know

10- Which types of foods and drinks do you think are good sources of folate? (Please tick a box for each category)

<table>
<thead>
<tr>
<th>Food type</th>
<th>Yes, a good source of folate</th>
<th>No, not a source of folate</th>
<th>Do not know</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fruit</td>
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<tr>
<td>Green vegetables</td>
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<tr>
<td>Milk</td>
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<tr>
<td>Fish/Seafood</td>
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<tr>
<td>Meat</td>
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<tr>
<td>Breakfast cereals</td>
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<td></td>
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<tr>
<td>Bread</td>
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</tbody>
</table>
11- Apart from food and drink, do you know other ways that women who are pregnant or are planning to become pregnant can get folic acid?

☐ Yes
☐ No

If yes, what are they?
................................................................................................................................................
................................................................................................................................................
................................................................................................................................................
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12- The government requires by law that certain foods have folic acid added to them. Which food is this? (Tick one answer only)

☐ Orange juice
☐ Breakfast cereals
☐ Bread
☐ Biscuits
☐ Milk
☐ Do not know

13- Do you usually check food labels when buying foods? (Tick one answer only)

☐ Yes, always
☐ Sometimes/occasionally
☐ No, I do not check
☐ Do not know
14- About how many slices of bread do you have in an average day?  (Tick one answer only)

☐ Less than one slice
☐ One slice
☐ 2 slices (one sandwich)
☐ 3 slices
☐ 4 slices (two sandwiches)
☐ None/Do not eat bread
☐ Do not know

Section 3:- The following questions focus on iodine in the diet:

15- Which health problems are associated with not having enough iodine in the diet?  
(More than one answer can be ticked)

☐ Arthritis
☐ Neural Tube Defects (e.g. spina bifida)
☐ Goitre (enlarged thyroid gland)
☐ Mental retardation
☐ Weak bones and teeth
☐ Malformations in pregnancy (birth defects)
☐ Impaired physical development during childhood
☐ Blindness
☐ Do not know
16- Which of the following foods do you think are good sources of iodine?

(Please tick a box for each category)

<table>
<thead>
<tr>
<th></th>
<th>Yes, a good source of iodine</th>
<th>Not a good source of iodine</th>
<th>Do not know</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fruit</td>
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<tr>
<td>Vegetables</td>
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<tr>
<td>Eggs</td>
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<td>Meat</td>
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<tr>
<td>Salt</td>
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<td>Milk</td>
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<td>Bread</td>
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<tr>
<td>Fish /seafood</td>
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</tbody>
</table>

17- Do you use iodized salt in cooking or at the table?

☐ Yes  ☐ No  ☐ Do not know
18- The government requires by law that certain foods have iodine added to them. Which of the following foods is this? (Tick one answer only)

- Orange juice
- Breakfast cereals
- Bread
- Biscuits
- Milk
- Do not know

Section 4: Now we are going to ask you some general information about yourself:

19- How old are you?

- 16–19 years
- 20–24
- 25–29
- 30–34
- 35–39
- 40–44
- 45+

20- Which of the following best describes your highest level of education?

- Some high school
- Completed high school
- TAFE or Apprenticeship
- University degree, bachelor level
- University degree, postgraduate or higher
21- Which of the following best describes your **household** income before tax, for the last year?

- Under $40,000
- $40,000 but less than $70,000
- $70,000 but less than $100,000
- $100,000 but less than $120,000
- $120,000 but less than $150,000
- $150,000 or more
- Do not know

22- Where do you live?

Suburb………………………………
Postcode…………………………

Thank you for your participation
Appendix B  Letter of Obstetricians

Research project: Knowledge, behaviour and practices of pregnant women regarding folic acid and iodine nutrition

Dear Dr ……

My name is Souad Elmani. I am a Masters of Research student in the Faculty of Health and Behavioural Sciences at the University of Wollongong, under the supervision of Associate Professors Karen Charlton and Vicki Flood (School of Health Sciences) and Dr Judy Mullan (Graduate School of Medicine). I am conducting a research study as part of the requirements for my degree in Master of Sciences Research, and I would like to invite your practice to be a participant.

The study aims to identify the knowledge, attitudes and practices of pregnant women regarding folic acid and iodine supplementation. A secondary aim is to assess whether pharmacists have sufficient knowledge about these nutrients to provide appropriate advice to pregnant women about supplement use.

Pregnant women attending consenting obstetricians’ practices will be informed about the study via flyers placed in plastic holders within the clinic waiting rooms, that will also include an attached Participant Information Sheet. Volunteers will be asked to
complete a survey, either as a written hard copy version that will be available in sealed reply envelopes, that can be placed in a drop-box in the practice once completed, or mailed back directly to the researchers, or alternatively complete an online version using a dedicated Survey Monkey site. The survey instrument comprises a short, 10-item questionnaire about nutritional requirements during pregnancy, which will take only a few minutes to complete. Written consent will be obtained from all participants.

Your participation in this research is voluntary; you are free to withdraw your practice from the research study at any time. Your refusal to participate in the study will not affect your relationship with the University of Wollongong in any way.

Your participation will be highly appreciated and will help health providers to better focus on the nutritional needs of pregnant women in the Illawarra.

If you are interested in taking part in this study, or require further information, I can be contacted by telephone (0432-455004) or by email; sfe469@uowmail.edu.au. Alternatively, I will be visiting the invited practices over the coming few weeks to enquire in person about participation.

I look forward to further correspondence about this study.

Kind regards
Mrs Souad Elmani
Are you pregnant?
Can you spare 10mins of your time to complete a dietary questionnaire?

A survey is being conducted to identify the knowledge, attitudes, and practices of pregnant women regarding nutritional requirements for a healthy pregnancy and to determine the use of supplements by pregnant women in the Illawarra.

You will be asked to complete a short questionnaire that will take about 10 minutes.

The information you provide will be treated as confidential and the questionnaire will be anonymous.

Your participation will be highly appreciated and may help health providers to better focus on your needs.

If you are interested in taking part in this study you may either complete a survey now while you wait and place it in the drop box, mail it back in the reply addressed envelope provided, or click on the link below to access an online version:
https://www.surveymonkey.com/s/3F8MM9M

FOR FURTHER INFORMATION
contact Ms Souad Elmani, Master of Science Student, School of Health Sciences, and University of Wollongong.
Email: sfe469@uowmail.edu.au
Appendix D  Map of Illawarra Region Within Australia And Participating Pharmacies In The Study

Appendix E Letter of Pharmacy Manager

Research project: Knowledge, behaviour and practices of pregnant women regarding folic acid and iodine nutrition

Dear Pharmacy Manager:-

My name is Souad Elmani. I am a Masters of Research student in the Faculty of Health and Behavioural Sciences at the University of Wollongong, under the supervision of Associate Professors Karen Charlton and Vicki Flood (School of Health Sciences) and Dr Judy Mullan (Graduate School of Medicine). I am conducting a research study as part of the requirements for my degree in Master of Sciences Research, and I would like to invite you to participate.

The study aims to identify the knowledge, attitudes and practices of pregnant women regarding folic acid and iodine supplementation. A secondary aim is to assess whether pharmacists have sufficient knowledge about these nutrients to provide appropriate advice to pregnant women about supplement use.

If you decide to participate, you will be asked to sign the consent form and invite individual pharmacists in your practice to take part in the study by providing them with a Participant Information Sheet about the study (see attached). Pharmacists who are willing to participate will be required to complete a short, 10-item questionnaire about nutritional requirements during pregnancy, which will take a few minutes.

I will shortly be visiting your pharmacy to find out whether or not you are willing for your Pharmacy to participate in the study. Consent forms and questionnaires will be made available, if your response is affirmative.

Your participation in this research is voluntary; you are free to withdraw from the research at any time. Your refusal to participate in the study will not affect your relationship with the University of Wollongong in any way.
Your participation will be highly appreciated and will help health providers to better focus on the nutritional needs of pregnant women in the Illawarra.

If you are interested in taking part in this study, or require further information, I can be contacted by telephone (0432-455004) or by email; sfe469@uowmail.edu.au.

I look forward to further correspondence about this study.

Kind regards
Mrs Souad Elmani
Appendix F Pharmacy Survey

Survey on knowledge, attitudes, and practice of nutritional requirements during pregnancy

My name is Souad Elmani and I am undertaking this research as part of my Master of Science Degree at the University of Wollongong, under the supervision of Associate Professors Karen Charlton and Vicki Flood (School of Health Sciences) and Dr Judy Mullan (Graduate School of Medicine). The aim of this survey is to gain some insight into pharmacists’ knowledge about the requirements for supplements during pregnancy. This survey should take approximately 5-10 minutes to complete and all information is anonymous. You are free to choose not to participate at any time while completing this survey and you can choose not to answer questions if you wish. However, by completing and returning this survey you have given us permission to use this information in our study. As this survey is anonymous, researchers will not be able to identify the information you have provided as yours and therefore you will be unable to withdraw the survey information once submitted.

For each of the following question please select the correct option (choose only ONE option for each question)

1- Which of the following nutrients can prevent occurrence of neural tube defects, such as spina bifida, during pregnancy? (Tick one answer only)
   - Zinc
   - Iron
   - Folic acid
   - Iodine
   - Vitamin A
2- Deficiency of which nutrient can result in neurocognitive deficits in the fetus during pregnancy? *(Tick one answer only)*

- Zinc
- Iron
- Folic acid
- Iodine
- Vitamin A

3- What is the optimum time for initiation of folic acid supplementation for healthy pregnancy outcomes? *(Tick one answer only)*

- Before pregnancy
- After a positive pregnancy test result
- At the beginning of the second trimester
- At the beginning of the third trimester
- One month before delivery

4- What is the NHMRC recommended level of folic acid that should be included in pregnancy supplements? *(Tick one answer only)*

- 0.4 μg /day
- 4 μg / day
- 40 μg /day
- 400 μg /day
- 4000 μg /day
- I don’t know

5- Which of the following is (are) good source of folic acid? *(Tick one answer only)*

- Oranges
- A daily multivitamin supplement
- Green leafy vegetables (e.g. spinach)
- Fortified breakfast cereals
- All of the above
6- Which of the following foods are required by law to be fortified with folic acid in Australia? (Tick one answer only)
  - [ ] Orange juice
  - [ ] Breakfast cereals
  - [ ] Bread
  - [ ] Biscuits
  - [ ] Milk
  - [ ] All of the above

7- What is the NHMRC recommended level of iodine that should be included in pregnancy supplements?
  - [ ] 400 μg /day
  - [ ] 250 μg /day
  - [ ] 150 μg /day
  - [ ] There is no recommendation
  - [ ] I don’t know

8- Is salt iodisation mandatory in Australia?
  - [ ] Yes
  - [ ] No
  - [ ] I don’t know

9- Which of the following foods are required by law to be fortified with iodine in Australia?
  - [ ] Milk
  - [ ] Bread
  - [ ] Biscuits
  - [ ] Pasta
  - [ ] All of the above
10-Which of the following foods are good sources of iodine in the diet?

- Fish/seafood
- Eggs
- Fruit and vegetables
- Meat
- Dairy products
- I don’t know

11-Which supplements do you usually recommend to pregnant women?

...................................................................................................................................
...................................................................................................................................

Why do you recommend these supplements?

...................................................................................................................................
...................................................................................................................................

THANK YOU FOR YOUR PARTICIPATION
Appendix G  Ethics Approval

INITIAL APPLICATION APPROVAL
In reply please quote: HE12/297
Further Enquiries Phone: 4221 3386

7 September 2012

Associate Professor Karen Charlton
School of Health Sciences
University of Wollongong 2522

Dear Associate Professor Charlton,

Thank you for your letter dated 30 August 2012 responding to the HREC review of the application detailed below. I am pleased to advise that the application has been approved.

The Committee has noted that the application now only refers to private obstetrician practices in the Illawarra and to pharmacies in the Illawarra.

Ethics Number: HE12/297
AuRED Number: HREC/12/WGONG/75
(No longer required)

Project Title: Knowledge, behaviour and practices of pregnant women in Wollongong regarding folic acid and iodine nutrition following introduction of a mandatory fortification programme

Name of Researchers: A/Professor Karen Charlton, A/Professor Vicki Flood, Dr Judy Mullan, Mrs Souad Elmani

Documents Approved:
Further Information letter dated 30 August 2012
Participant Information Sheet received 30 August 2012
Participant Information Sheet for Pharmacists received 30 August 2012
Pharmacist Survey received 30 August 2012
Flyer/ Advertisement received 30 August 2012

Approval Date: 6 September 2012
Expiry Date: 5 September 2013
Services Office prior to the expiry date.

If you have any queries regarding the HREC review process, please contact the Ethics Unit on phone 4221 3366 or email rso-ethics@uow.edu.au.

Yours sincerely

Associate Professor Sarah Ferber
Chair, UOW & ISLHD Health and Medical Human Research Ethics Committee
AMENDMENT APPROVAL

In reply please quote: HE12/297
Further Enquiries Phone: 4221 3386

8 November 2012

A/Professor Karen Charlton
School of Health Sciences
University of Wollongong 2522

Dear A/Professor Charlton,

I am pleased to advise that the amendments to the following Human Research Ethics application have been approved.

Ethics Number: HE12/297
Project Title: Knowledge, behaviour and practices of pregnant women in Wollongong regarding folic acid and iodine nutrition following introduction of a mandatory fortification programme
Researchers: A/Professor Karen Charlton, A/Professor Vicki Flood, Dr Judy Mullan, Mrs Souad Elmani
Amendments: Advertisement material and flyers for recruitment of additional participants through Antenatal classes, Physiotherapy practices and Maternity/baby stores. Please ensure that UoW logo is on all recruitment materials and a copy is forwarded to the Research Services Office for their record.

Approval Date: 8 November 2012
Expiry Date: 5 September 2013

Please remember that in addition to reporting proposed changes to your research protocol the HREC requires that researchers immediately report:

• serious or unexpected adverse effects on participants
• unforeseen events that might affect continued ethical acceptability of the project.

The University of Wollongong/ ISLHD Health and Medical HREC is constituted and functions in accordance with the NHMRC National Statement on Ethical Conduct in Human Research.

A condition of approval by the HREC is the submission of a progress report annually and a final report on completion of your project. The progress report template is available at http://www.uow.edu.au/research/rso/ethics/UOW009385.html. This report must be completed, signed by the appropriate Head of School and returned to the Research

Ethics Unit, Research Services Office
University of Wollongong NSW 2522 Australia
Telephone (02) 4221 3386 Facsimile (02) 4221 4338
Email: rso-ethics@uow.edu.au Web: www.uow.edu.au
The University of Wollongong/ISLHD Health and Medical HREC is constituted and functions in accordance with the NHMRC National Statement on Ethical Conduct in Human Research. The HREC has reviewed the research proposal for compliance with the National Statement and approval of this project is conditional upon your continuing compliance with this document.

A condition of approval by the HREC is the submission of a progress report annually and a final report on completion of your project. The progress report template is available at http://www.uow.edu.au/research/eso/ethics/UOW002385.html. This report must be completed, signed by the appropriate Head of School and returned to the Research Services Office prior to the expiry date.

As evidence of continuing compliance, the Human Research Ethics Committee also requires that researchers immediately report:

- proposed changes to the protocol including changes to investigators involved
- serious or unexpected adverse effects on participants
- unforeseen events that might affect continued ethical acceptability of the project.

Please note that approvals are granted for a twelve month period. Further extension will be considered on receipt of a progress report prior to expiry date.

If you have any queries regarding the HREC review process, please contact the Ethics Unit on phone 4221 3386 or email rso-ethics@uow.edu.au.

Yours sincerely,

Associate Professor Sarah Ferber
Chair, UOW & ISLHD Health and Medical
Human Research Ethics Committee

cc: Governance Officer, Research Directorate, ISLHD
Appendix H Consent Form For Pregnant Women

**Research project:** - Knowledge, behavior, and practice of pregnant women in Wollongong regarding folic acid and iodine nutrition after mandatory fortification program.

**Researcher:** Souad Elmani (phone: 0432455004   email; sfe469@uowmail.edu.au)

**Supervisors:** Associate professor Karen Charlton (phone: +61 2 4221 4754   email: karenc@uow.edu.au)

Associate professor Vicki Flood (phone ; +61 2 4221 3947   email: vflood@uow.edu.au)

Dr. Judy Mullan (phone: + 61 2 42215980)   email: jmullan@uow.edu.au

**Department:** Faculty of Health and Behavioural Sciences

I have been given information about knowledge, attitude, and practice of pregnant women in Wollongong regarding folic acid and iodine nutrition and discussed the research project with Souad Elmani who is conducting this research as part of a master degree supervised by A/Prof Vicki Flood and A/Prof Karen Charlton in the department of Faculty of Health and Behavioural Sciences at the University of Wollongong.

By signing this consent form I understand that:

I need to complete the questionnaire about micronutrients related to issues during pregnancy which will take about 10 minutes.

I understand that my participation in this research is voluntary, I am free to refuse to participate and I am free to withdraw from the research at any time. My refusal to participate or withdrawal of consent will not affect my treatment and the service provide to me or my relation to Wollongong university of Wollongong in any way.
If I have any enquiries about the research, I can contact Souad Elmani or A/Prof Karen Charlton, A/Prof Vicki Flood (contact detail above) for further information. If I have any concerns or complaints regarding the way the research is or has been conducted, I can contact the Ethics Officer, Human Research Ethics Committee, Office of Research, University of Wollongong on 4221 4457

I understand that the data collected from my participation will be used for production of thesis and journal publication and I consent for it to be used in that manner.

Signed Date

..............................................................................  ....../....../......
Appendix I Consent Form For Pharmacists

Research project: - Knowledge, behavior, and practice of pregnant women in Wollongong regarding folic acid and iodine nutrition after mandatory fortification program.

Researcher: Souad Elmani (phone: 0432455004 email; sfe469@uowmail.edu.au)

Supervisors: Associate professor Karen Charlton (phone: +61 2 4221 4754 email: karenc@uow.edu.au)
Associate professor Vicki Flood (phone: +61 2 4221 3947 email: vfold@uow.edu.au)
Dr. Judy Mullan (phone: +61 2 4221 5980 email: jmullan@uow.edu.au)

Department: Faculty of Health and Behavioural Sciences

I have been given information about knowledge of pharmacists regarding folic acid and iodine nutrition and discussed the research project with Souad Elmani who is conducting this research as part of a master degree supervised by A/Prof Vicki Flood and A/Prof Karen Charlton in the department of Faculty of Health and Behavioural Sciences at the University of Wollongong.

By signing this consent form I understand that:

I need to complete the questionnaire about micronutrients related to issues during pregnancy which will take about 10 minutes.

I understand that my participation in this research is voluntary, I am free to refuse to participate and I am free to withdraw from the research at any time. My refusal to
participate or withdrawal of consent will not affect my treatment and the service provide to me or my relation to Wollongong university of Wollongong in any way. If I have any enquiries about the research, I can contact Souad Elmani or A/Prof Karen Charlton, A/Prof Vicki flood (contact detail above) for further information. If I have any concerns or complaints regarding the way the research is or has been conducted, I can contact the Ethics Officer, Human Research Ethics Committee, Office of Research, University of Wollongong on 4221 4457. I understand that the data collected from my participation will be used for production of thesis and journal publication and I consent for it to be used in that manner.

Signed

Date

.................................................................  ....../....../......
Appendix J Consent Form For Pharmacy Manager

Research Project: Knowledge, behavior, and practices of pregnant women regarding folic acid and iodine nutrition

Researcher: Ms Souad Elmani (phone: 0432455004; email: sef469@uowmail.edu.au)

Supervisors: Associate Professor Karen Charlton (phone: 02 4221 4754; email: karenc@uow.edu.au)
Associate Professor Vicki Flood (phone: 02 4221 3947; email: vflood@uow.edu.au)
Dr. Judy Mullan (phone: 02 42215980; email: jmullan@uow.edu.au)

Faculty of Health and Behavioural Sciences, University of Wollongong.

I have been given information about the above study and discussed the research project with Souad Elmani who is conducting this research as part of a Masters’ degree in the School of Health Sciences at the University of Wollongong.

By signing this consent form I understand that:

- I provide consent for the study to be conducted within this pharmacy. The study involves completion of a short questionnaire about micronutrient intake during pregnancy, which will take about 10 minutes.
- I will approach individual pharmacists to invite them to take part in the study by providing them with a Participant Information Sheet.
• I understand that my participation in this research is voluntary, I am free to refuse to participate and I am free to withdraw from the research at any time. My refusal to participate or withdrawal of consent will not affect my treatment and the service provide to me or my relation to Wollongong university of Wollongong in any way.

• If I have any enquiries about the research, I can contact Souad Elmani or A/Prof Karen Charlton, A/Prof Vicki flood (contact details above) for further information.

• If I have any concerns or complaints regarding the way the research is or has been conducted, I can contact the Ethics Officer, Human Research Ethics Committee, Office of Research, University of Wollongong on 4221 4457.

• I understand that the data collected from this study will be used for production of a thesis and journal publication and I consent for it to be used in that manner.

Signed

Date

................................................................. ....../...../......
Appendix K  Participant Information Sheet For Pregnant Women

Research project: Knowledge, behaviour, and practices of pregnant women in Wollongong regarding folic acid and iodine nutrition.

This is an invitation to participate in a study conducted by researchers at the University of Wollongong. The purpose of the research is to identify the knowledge, attitudes, and practices of pregnant women in the Illawarra regarding folate and iodine nutrition.

This is a Masters’ student project being conducted by Ms Souad Elmani (email: sfe469@uowmail.edu.au). The project supervisors are Associate Professor Karen Charlton (phone: 02 4221 4754 email: karenc@uow.edu.au) and Associate Professor Vicki Flood (phone: 02 4221 3947 email: vfloat@uow.edu.au)

Dr. Judy Mullan (phone: +61 2 42215980) email: jmullan@uow.edu.au

Why is this study being done?

Previous work by the researchers has found that pregnant women in the Illawarra have a limited knowledge about nutritional requirements during pregnancy, and may feel confused about current recommendations due to a lack of consistent information being provided. The findings of this study may allow the development of more effective ways to provide dietary information within antenatal services. Another part of the study involves interviewing pharmacists about their knowledge of nutritional supplements for pregnancy. Pharmacists are often asked for advice on which additional nutrients are required for a healthy pregnancy. It is important to understand their practices to determine whether additional training on this topic may be required. We are particularly interested in the use of supplements, and both parts of the study (ie pregnant women and pharmacists) will provide useful information in this regard.
What will I need to do?
If you agree to participate you will be asked to complete a short questionnaire about nutrition during pregnancy, which will take about 10 minutes. The survey questionnaire does contain some personal questions. This survey can be completed during your clinic visit and placed within the sealed reply envelopes, and placed in the box provided, or alternatively can be sent back by mail, or completed online at the following link:

https://www.surveymonkey.com/s/9F8MM9M

Please be sure to sign the Informed Consent form on the front page of the survey before completing it. If completing online, you will be asked to indicate your consent by clicking a tick box.

Who will have access to the information I provide?
The information you provide will be treated as confidential and the questionnaire will be anonymous. Your participation in this research is voluntary; you are free to withdraw from the research at any time. Your refusal to participate in the study will not affect your treatment and the services provided to you or your relation with the University of Wollongong in any way.

If you have any enquiries about the research, you can contact Souad Elmani or A/Prof Vicki Flood, A/Prof Karen Charlton, Judy Mullan (contact detail above) for further information. This study has been reviewed by the Human Research Ethics Committee of the University of Wollongong. If you have any concerns or complaints regarding the way this research has been conducted, you can contact the UOW Ethics Officer on (02) 4221 3386 or email rso-ethics@uow.edu.au and quote reference HE12/297.

Thank you for your interest in this study
Appendix L   Participant Information Sheet for Pharmacists

Research project: Knowledge, behaviour, and practices of pregnant women in Wollongong regarding folic acid and iodine nutrition

This is an invitation to participate in a study conducted by researchers at the University of Wollongong. The purpose of the research is to identify the knowledge, attitudes, and practices of pregnant women and pharmacists in the Illawarra regarding folate and iodine nutrition.

This is a Masters’ student project being conducted by Ms Souad Elmani (email; sfe469@uowmail.edu.au). The project supervisors are Associate Professor Karen Charlton (phone: 02 4221 4754    email: karenc@uow.edu.au ) and Associate Professor Vicki Flood (phone : 02 4221 3947 email: vflood@uow.edu.au )
Dr. Judy Mullan (phone: + 61 2 42215980)     email: jmullan@uow.edu.au

Why is this study being done?

Previous work by the researchers has found that pregnant women in the Illawarra have a limited knowledge about nutritional requirements during pregnancy, and may feel confused about current recommendations due to a lack of consistent information being provided from health care providers. The findings of this study may allow the development of more effective ways to provide dietary information within antenatal services. Pregnant women will be interviewed in from both public and private antenatal services.

Pharmacists are often asked for advice on which additional nutrients are required for a healthy pregnancy. In recent years, product formulations have changed so it is important to determine both knowledge and practices to determine whether additional training on this topic may be required. We are particularly interested in the use of supplements during pregnancy, and both parts of the study (ie pregnant women and pharmacists) will provide useful information in this regard.
**What will I need to do?**
If you agree to participate you will be asked to complete a short 10-item questionnaire about nutritional requirements during pregnancy, which will take a few minutes. All 56 pharmacies within a defined area of the Illawarra have been invited to participate in this survey, from Helensburgh in the north to Warilla and Shellharbour in the South, and your pharmacy manager has agreed to be a participating partner.

**Who will have access to the information I provide?**
The information you provide will be treated as confidential and the questionnaire will be anonymous. Your participation in this research is voluntary; you are free to withdraw from the research at any time. Your refusal to participate in the study will not affect your treatment and the services provided to you or your relation with the University of Wollongong in any way.

If you have any enquiries about the research, you can contact Souad Elmani or A/Prof Vicki Flood, A/Prof Karen Charlton, Judy Mullan (contact detail above) for further information. This study has been reviewed by the Human Research Ethics Committee of the University of Wollongong. If you have any concerns or complaints regarding the way this research has been conducted, you can contact the UOW Ethics Officer on (02) 4221 3386 or email rso-ethics@uow.edu.au and quote reference HE12/297.

**Thank you for your interest in this study**
Appendix M Availability of Pregnancy and Breastfeeding Supplements

<table>
<thead>
<tr>
<th>Brand name</th>
<th>Folic acid level μg/tablet*</th>
<th>Iodine level μg/tablet*</th>
<th>Cost $</th>
<th>Cost of recommended dose/month</th>
<th>Dosage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-Blackmores Conceive Well Gold X 56</td>
<td>500 μg</td>
<td>150 μg</td>
<td>$29.95</td>
<td>$16.00</td>
<td>1 tablet/day</td>
</tr>
<tr>
<td>2-Blackmores Folate Folic Acid 500mcg Tab X 90</td>
<td>500</td>
<td>None</td>
<td>$8.25</td>
<td>$2.75</td>
<td>1 tablet/day</td>
</tr>
<tr>
<td>3-Blackmores I-Folic Tab X 150</td>
<td>500</td>
<td>250 μg</td>
<td>$14.50</td>
<td>$2.90</td>
<td>1 tablet/day</td>
</tr>
<tr>
<td>4-Blackmores Pregnancy &amp; Breast-Feeding Gold Cap X 120</td>
<td>250</td>
<td>125</td>
<td>$34.95</td>
<td>$17.47</td>
<td>2tablets/day</td>
</tr>
<tr>
<td>5-Blackmores Pregnancy &amp; Breast-Feeding Gold</td>
<td>250</td>
<td>125</td>
<td>$44.95</td>
<td>$14.98</td>
<td>2tablets/day</td>
</tr>
<tr>
<td>Product</td>
<td>Quantity</td>
<td>Price</td>
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<td>----------------------------------------------</td>
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<tr>
<td>Cap X 180</td>
<td>250</td>
<td>$27.95</td>
<td>125</td>
<td>$27.95</td>
<td>2 tablets/day</td>
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<tr>
<td>6-Blackmores Pregnancy &amp; Breast-Feeding Gold</td>
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<tr>
<td>Cap X 60</td>
<td>250</td>
<td>$5.95</td>
<td>125</td>
<td>$25.50</td>
<td>2 tablets/day</td>
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<tr>
<td>7-Blackmores Pregnancy &amp; Breast-Feeding Gold</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>On The Go Cap X 14</td>
<td>225</td>
<td>$14.95</td>
<td>75</td>
<td>$14.95</td>
<td>2 tablets/day</td>
</tr>
<tr>
<td>8- Cenovis Pregnancy &amp; Breastfeeding Formula</td>
<td></td>
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<tr>
<td>Cap x 60</td>
<td>None</td>
<td>$23.95</td>
<td>None</td>
<td>$11.97</td>
<td></td>
</tr>
<tr>
<td>9- Efamol DOMInO Cap X 60</td>
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<tr>
<td></td>
<td>Product</td>
<td>Quantity</td>
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<td>Quantity Per Day</td>
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<tr>
<td>10</td>
<td>Elevit With Iodine Tab X 100</td>
<td>800</td>
<td>$65.95</td>
<td>$19.78</td>
<td>1 tablet/day</td>
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Mimis Online Database (data accessed 21/3/2013)
If taken at recommended dosage provided on the supplement packaging