Dietary intake and supplement use in mothers with depression in the first year postpartum

By

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A thesis submitted in partial fulfillment of the requirements for the degree of

Master of Dietetics

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Abstract

**Background:** The dietary intake of women in the weeks before and after pregnancy has important implications for health of both the mother and baby. Clinical experience suggests that during this period dietary intakes in women with mood disorders may not meet national nutrition guidelines. Furthermore, frequency and type of dietary supplement use in this population is unknown.

**Objective:** The purpose of this project was to assess BMI, dietary intakes and dietary supplement use in patients with significant depressive symptoms in the context of a mood disorder attending the Canterbury District Health Board, Mothers and Babies Outpatient Service. The information obtained will be used to improve nutrition services for patients in this service.

**Design:** The present study was a cross sectional observational exploratory study. Sixteen women with Major Depressive Disorder (MDD) aged 18-35 years and within 13 months postpartum completed the study. Participants attended a one hour assessment with the research candidate. Information was collected on participant demographics and dietary supplement use during pregnancy and the postpartum period. Following this, participants completed a multiple pass 24-hour diet recall, and weight and height were measured.

**Results:** Thirty-four different types of supplements (vitamin, mineral, oil, food and herbal) were used by the study population during pregnancy and postpartum. Fourteen
participants (87.5%) took folic acid or folic acid containing supplements during pregnancy. Thirteen participants (81%) took iodine or an iodine containing multivitamin and mineral supplement in pregnancy and seven (43.75%) during the postpartum period. Iodine and folic acid supplements were most commonly recommended by either a doctor or midwife. Iron was taken by 10/16 participants and multivitamins marketed to pregnant and breastfeeding women were taken by 8/16 participants. Four participants (25%) were taking supplements containing herbal ingredients with unknown or potentially adverse effects in pregnant and lactating women. Dietary selenium and iodine intake was inadequate in breastfeeding women. Energy, fibre, iodine, selenium, calcium, copper, manganese, potassium, folate and Vitamin D intake was inadequate in non-breast feeding women. All women were above the upper level for sodium intake.

Conclusion: This pilot study found high rates of supplement use in pregnant and postpartum women with depression. The majority was taking iodine and folic acid during pregnancy, but potentially toxic supplements were being taken by 25% of study participants. The dietary intake of postpartum women with depression may be influenced by breastfeeding status, with breastfeeding women meeting more nutrient requirements than non-breastfeeding women. As nutrient inadequacies may be implicated in depression this warrants further research. The results from this study and future research may guide and improve dietetic care in depressed postpartum women.
Preface

As part of this thesis the candidate, Melissa Butt:

- Wrote the ethics application
- Adapted the appropriate sections of the 2008/2009 National Nutrition Survey questionnaire
- Developed the breastfeeding section of the questionnaire
- Designed posters and flyers for circulation
- Liaised with Staff at the Mothers and Babies Outpatient clinic
- Compiled a list of supplements available in New Zealand from supermarket and health shop visits and an internet search
- Posted or emailed information sheet and supplement sheet to participants
- Participated in the recruitment process
- Was responsible for booking appointments
- Interviewed study participants for demographic information
- Measured weight and height
- Conducted diet recall
- Checked returned questionnaires and diet recalls for omission of information
- Entered diet recall, demographic and supplement information into the appropriate analysis programme
- Exported nutrient analysis data for statistical analysis
- Obtained nutrient intake concentrations of supplements consumed by the study population
• Performed all statistical analysis in this study
• Interpreted quantitative and qualitative data
• Conducted follow-up dietetic consultations when required
• Obtained and distributed vouchers to participants where required
• Presented preliminary findings of the thesis at the 2013 Perinatal Mental Health Symposium
• Wrote the thesis

Research supervisor, Dr Jane Elmslie:

• Developed the study idea
• Oversaw the ethics application process and applied for Maori consultation
• Meet regularly with the candidate for guidance concerning the above tasks
• Supervised thesis writing

Research supervisor, Dr Sue Luty:

• Developed the study idea
• Volunteered the Mothers and Babies Outpatient service for the study
• Participated in the recruitment process
• Supervised thesis writing
Acknowledgements

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2. The outstanding study participants, without whom this thesis would not have been possible

3. The welcoming and supportive staff at the Mothers and Babies Outpatient service for their participation in recruitment and study promotion and their patience and understanding

4. Statistician Chris Frampton for his wisdom and guidance regarding statistical analysis

5. Dr Julie Weaver, Dietetic Programme manager, for her ongoing support

6. Liz Flemming for providing tutorials and support with the use of Kai-culator

7. Dietetic tutor, Sharron Burford (and her printer) for her year round support and encouragement

8. Dr Lisa Houghton for the essential thesis preparations
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List of Abbreviations

4DDR: Four Day Diet Record
24-h recall: Twenty-four Hour recall
AA: Arachidonic Acid
AI: Adequate Intake
BDI: Beck Depression Inventory Score
BDI -II Beck Depression Inventory Score II
BMI: Body Mass Index
CES-D: Center for Epidemiologic Depression Scale
CIDI: Composite International Diagnostic Interview
CMIDI: Chicago Multiscale Depression Inventory
DASS: Depression, Anxiety and Stress Scores
DHA: Docosahexaenoic acid
DPA: Docosapentaenoic acid
DSM: Diagnostic and Statistical Manual criteria
EAR: Estimated Average Requirement
EER: Estimated Energy Requirement
EPA : Eicosapentaenoic acid
EPDS: Edinburgh Postnatal Depression Scale
FFQ: food frequency questionnaire
FODMAP: Fructo-, Oligo-, Di-, Mono- saccharides and Polyols
GAD: Generalized Anxiety Disorder
HAM-D: Hamilton Rating Scale for Depression

IU: International Unit

LC n-3 PUFA: Long Chain Omega-3 Polyunsaturated Fatty Acid

MADRS: Montgomery Asberg Depression Rating Scale

MBS: Mothers and Babies Outpatient Service

MDD: Major Depressive Disorder

MOH: Ministry of Health

MUFA: Mono-unsaturated fatty acids

n-3: Omega-3 Fatty acids

NHANES: National Health and Nutrition Examination Survey

NRV: Nutrient Reference Value


PHQ: Patient Health Questionnaire

PND: Postnatal depression

PPD: Postpartum depression

PTSD: Post-Traumatic Stress Disorder

PUFA: Poly-unsaturated fatty Acids

RCT: Randomized Control Trial

RDI: Recommended Dietary Intake

SPSS: Statistical Package for the Social Sciences

TAG: Triacylglycerol

UL: Upper level of intake

WHO: World Health Organization
1 Introduction

Depression takes the lives of over 500 New Zealanders every year by suicide [1]. The World Health Organization (WHO) estimates that by 2020, depression will be the second most common cause of ill health and premature death worldwide [2].

Reported rates of depression in New Zealand indicate that at least 20% of New Zealand women and 12.5% of men will experience serious depression at some point during their lifetime [2].

Depression is classified in different ways but the two most relevant to this research are Major Depressive Disorder (MDD) and Postpartum Depression (PPD).

Major depressive disorder is diagnosed by the presence of depressed mood for most of the day and/or a loss of interest in normal activities (anhedonia), every day for at least two weeks [3]. Depression can relapse and remit throughout an individual’s lifetime and may exist at any stage prior to, during and beyond pregnancy.

A depressive episode which commences in the weeks following birth is classified as Postpartum Depression (PPD) also known as Postnatal depression (PND)[4]. Postpartum depression is common. Each year, in New Zealand, approximately 15-25% of pregnant women will develop PPD [4-7]. For the purpose of this thesis, I will be focusing on women with major depression in the postpartum period, regardless of the time of onset. Maternal depression during the post-partum period can have devastating outcomes such as suicide (the leading cause of maternal death during pregnancy and the first 42 weeks postpartum [8]), infanticide, delayed or impaired child development (such as
internalization of problems[9], severe temper tantrums, difficulty relating to parents or peers, eating problems [9-11], and increased family stress. Twenty five percent of fathers will develop depression as a result of the stress of maternal postnatal depression [12].

There are multiple causes of depression both physiological and psychological. Before initiation of drug treatment, many individuals with mood disorders were treated with nutrient supplementation, with varying success [13]. Over the years research has found inadequate nutrient intake, and poor diet quality in depressed populations [14-17]. However it is difficult to determine whether this finding is a cause or consequence of depression since it is based on observational data. Furthermore, research focusing on the diet of mothers with depression in the postpartum period is limited. Research into supplement use during pregnancy and post-partum in women with depression could not be found. With the abundance of information available on the internet and the lack of studies supporting safe and efficacious use of herbal supplements for depression, one aim of this thesis was to observe the supplement use patterns of New Zealand women with depression in the post-partum period. This study also aims to observe the dietary intake of women with depression in the post-partum period and reflect upon the appropriateness of the methods used in this population.
2 Literature Review

2.1 Introduction

Research into the role of nutrition in the prevention and treatment of depression has focused on individual nutrients, dietary patterns and, diet quality.

There is limited research on the diets of women in the post-partum period. Most studies in post-partum women have focused on diet during pregnancy and the risk of developing post-partum depression. At the time of writing there have been no studies on the dietary intakes of postpartum women with mood disorders in New Zealand and there is little information concerning supplement use in depressed postpartum women.

Research concerning the role of nutrition in the aetiology of depression and overall mental health has produced three main hypotheses:

1. Micronutrient deficiency causes depression by impairing brain function.

2. Increased levels of oxidants in brain cells and/or insufficient dietary intake of antioxidants contribute to the development of depression.

3. Low intakes of foods which produce an anti-inflammatory effect may result in depression.

2.2 Literature search strategy

Studies were identified by searching databases (Medline 1946-present with daily update, via Ovid and The National Center for Biotechnology Information (NBCI) database via PubMed). MeSH terms used were; depression, nutrients, pregnancy, postpartum period.

Keywords/text words used were diet quality, diet patterns, women, major depressive disorder, and English (language). For specific nutrient searches keywords such as omega-
3 or folate were used. Relevant references cited in appropriate journal articles were found by title or author search using Medline, Ovid or Google Scholar.

For the purpose of this review relevant literature will be discussed in three sections: Depression and Micronutrients, Depression and Diet Quality and Depression and Supplement Use.

2.3 Depression and Micronutrients

Higher micronutrient intakes have been associated with better mental health in adult populations [18-21]. Income, relationship status, age, gender, and caloric intake have also been associated with intakes of many nutrients in mood disorder populations [20]. The most commonly implicated micronutrients are summarized below.

2.3.1 Micronutrient deficiencies in the pathophysiology of mood disorders

Nutrient requirements increase during pregnancy and lactation, increasing the likelihood of deficiencies with inadequate dietary intake. These deficiencies may be implicated in PPD [13]. Metabolic abnormalities in psychiatric patients may also increase nutrient requirements[13]. Furthermore, some research suggests dietary supplements may improve the efficacy of antidepressants [22].There have been numerous studies conducted on micronutrients and mood disorders, based on the knowledge of specific micronutrients’ involvement in brain function[23]. Micronutrient intake studies have primarily been conducted in women during pregnancy to determine risk of developing post-partum depression. Few have investigated diets of depressed postpartum mothers.
2.3.2 Iron intake in pregnancy and risk of post-partum depression

A 1991 Wellington study of women in the 2nd and 3rd trimesters of pregnancy found that 51% of Pacific Island women, 44% of New Zealand European and Other (NZEO) and 28% of Maori women were below the minimum safe intake for iron [24].

A more recent study in pregnant North Island Women found that almost all subjects had intakes below the EAR for iron [25] Anemia in pregnancy and early postpartum increases the risk of postpartum depression [26, 27]), and therefore low iron intakes in pregnant New Zealand women could increase their risk of depression during the postpartum period. In one study iron supplementation in anemic postpartum women lead to a 25% improvement in depression and stress scores [26], suggesting treating anemia in depressed women may make a large impact on recovery.

In summary it is likely that anemia contributes to some cases of depression in pregnant and post-partum women.

2.3.3 Magnesium intake and depression risk in adults

Inadequate magnesium intake may also contribute to depression, stress and anxiety. An Australian study by Forsyth et al, found that magnesium intake as a percent of EAR was negatively correlated with depression, stress and total DASS (Depression, Anxiety and Stress Scores) scores[21]. In contrast, total daily magnesium intake (mg per day) was not significantly correlated with depression in this study. Other recent studies have also found an inverse association between magnesium intake and depression risk [18, 28].
## Table 2-1 Associations between nutritional status/ nutrient intake and depression

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<tr>
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<th>Study design and participants</th>
<th>Dietary assessment method(s)</th>
<th>Mental health assessment tool</th>
<th>Relevant results / conclusions</th>
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| Bodnar et al 2012 | To investigate if there is an association between **dietary biomarker factors** (for essential fatty acids, folate, homocysteine \( \text{Hcy} \), vitamins \( \text{A, C, D and E, carotenoids and iron} \)) and \( \text{MDD} \) | 135 pregnant women from The Anti-depressant Use During Pregnancy (ADUP) Study (prospective cohort study) 21.5% had MMD | Non fasting blood drawn at enrolment (<20weeks) | Structured Clinical Interview for DSM-IV (Diagnostic and Statistical Manual of Mental Disorders, 4th edition). Depression severity via the Hamilton Rating Scale for Depression | -No association between Fatty Acids or micronutrients and \( \text{MDD} \)  
- In unadjusted analysis women with factor scores for carotenoids in the middle to upper tertiles were 60% less likely than those in the bottom tertile to have \( \text{MDD} \) during pregnancy. However, after adjustment for cofounders the association was no longer significant  
-Authors suggest larger and more diverse sample |
| Jacka et al 2012  | To examine the **dietary intake of Magnesium (Mg), folate(B9) and Zinc (Zn) and common mental disorders and symptoms, including depression** | 1046 women aged 20–93 years participating in the ten yr follow-up of The Geelong Osteoporosis Study (GOS), an epidemiological study based in south-eastern Australia | validated food frequency questionnaire | General Health Questionnaire-12 and Structured Clinical Interview for DSM-IV-TR, non-patient edition | -Each increase in the intake of \( \text{Zn, Mg and B9} \) by one SD was associated with reduced odds ratio (OR) for major depression/ dysthymia (\( \text{Zn: OR} = 0.52, 95\% \text{ confidence interval (CI) 0.31 to 0.88; Mg OR = 0.60, 95\% CI 0.37 to 0.96; B9: OR = 0.66, 95\% CI 0.45 to 0.97} \)).  
-Inverse association between GHQ-12 scores and intake of Mg and Zn |
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<th>Mental health assessment tool</th>
<th>Relevant results / conclusions</th>
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| Davison and Kaplan, 2012 | To examine the relationship between Nutrient intake and psychiatric functioning | Cross sectional 97 community based adults | 3 day food records and FFQ | -Global assessment of functioning score (GAF)  
- The Hamilton depression rating scale  
- the young mania rating scale | - Association between the dietary intakes of Mg, B9 and Zn and depressive illnesses.  
- Authors recognise possible pathway to depression based on strong anti-inflammatory effects of Magnesium, folate and zinc as well as antioxidant effects of zinc and deficiency affecting normal brain functions.  
- Significant correlations found between GAF scores and: energy, carbohydrate, fibre, total fat, linoleic acid, riboflavin, niacin, Vitamin B6, Vitamin B12, pantothenic acid, calcium, phosphorus, potassium, iron, Zinc and Magnesium  
- Higher levels of mental function were associated with higher intake of nutrients  
- depression or mania scores didn’t individually show consistent patterns  
- supplements added |
| Forsyth et al, 2012 | To observe the Nutritional | Cross sectional 32 Australian Males, Diet history | DASS – depression, | -% of participants met EAR for:  
-- folate (17%) |
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<td>Davison and Kaplan 2011</td>
<td>Nutrient intake in Mood disorder patients (bipolar or MDD)</td>
<td>Cross sectional 97 adults 69Female compared to British and Columbia Nutrition Survey (BCNS)</td>
<td>-3DDR -Blood levels compared to BCNS reference ranges</td>
<td>Structured Clinical Interview for DSM-IV Axis I Disorders, the Hamilton Depression Scale, the Young Mania Rating Scale, and the short (10-item) version of the Drug Abuse</td>
<td>- Adults with mood disorders are at risk for many nutrient inadequacies, as well as occasional excesses. - Social, demographic, and clinical factors may affect nutrient intakes (60 were Female with &lt; a university degree and 39 of these had low income). - Compared with the BCNS, a larger proportion of the sample was below the estimated average requirement for thiamin (26% vs. 8%), riboflavin (21% vs. 4%), folate (64% vs. 27%), phosphorous (12% vs. 1%), and zinc.</td>
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Dietary assessment method(s) - Mg (78%) - calcium (57%) - All other EARs met - intakes similar to those reported in the NNS - Mg intake was significantly related to depression - nutrient recommendations for patients with depression should aim to increase especially fruit, vegetables and whole-grain intake.
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<th>Relevant results / conclusions</th>
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<tr>
<td>Watson and McDonald, 2009a</td>
<td>Are social/psychological factors related to dietary intake in pregnant New Zealand women</td>
<td>Prospective cohort 196 pregnant New Zealand women between 18-35 yr</td>
<td>16 days of weighed diet records -8 in the 4th mo and -8 in the 7th mo</td>
<td>Not measured</td>
<td>(39% vs. 15%; all P &lt; 0.0001), as well as vitamin B6 (25% vs. 16%) and vitamin B12 (27% vs. 8%; both P &lt; 0.05). - Medications also determined nutrient intake/status. - Table 1: Reported brain related functions of nutrients</td>
</tr>
<tr>
<td>Watson and McDonald 2009b</td>
<td>Maternal diet and supplement use and Infant birth weight</td>
<td>Prospective cohort 504 European and Polynesian (75% NZE, 18% Maori, 7% PI) urban and rural pregnant volunteers recruited</td>
<td>Subjects were visited in mth4 and mth7 of pregnancy. - height, weight, skinfolds</td>
<td>Not assessed</td>
<td>Infant birth weight was associated with the %TE from carbohydrate, fat and protein, and with b-carotene, retinol, vitamins D and B12, pantothenic acid, biotin and magnesium intakes and iron supplementation</td>
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<tr>
<td>Beard 2005</td>
<td>Is Iron deficiency anemia related to cognitive and behavioural functioning (including depression)</td>
<td>RCT 81 South African mothers followed up from 10wks to 9mo postpartum 1- Nonanemic controls 2- Anemic mothers receiving placebo (10 µg folate and 25mg vitaminC) 3- Anemic mothers with daily iron (125 mg FeS0(4), 10µg folate, 25mg vitaminC)</td>
<td>- 24-hour recall and 3-day food record</td>
<td>the Edinburgh Postnatal Depression Scale (EPDS), the Raven’s Colored Progressive Matrices test, and 2 Perceived Stress scales (included stress, locus of control)</td>
<td>- In previously iron-deficient mothers’ iron treatment resulted in a 25% improvement (P &lt; 0.05) in depression and stress scales. -Strong association between iron status variables (haemoglobin, mean corpuscular volume, and transferrin saturation) and cognitive and behavioural variables (anxiety, stress, depression) -A relationship between iron status and depression, stress, and cognitive functioning in poor African mothers during the postpartum period.</td>
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<td>Hurley et al 2005</td>
<td>Dietary intake (at 28wks gestation) and</td>
<td>Cross sectional observational 134 low risk</td>
<td>Health habits history questionnaire</td>
<td>Spielburger</td>
<td>Pregnant women consumed more food but fewer micronutrients if they were more fatigued, stressed or anxious</td>
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| Corwin 2003 | Early postpartum anemia as a risk factor for PPD | part of a larger study by Corwin et al using a longitudinal design to investigate the role of pro-inflammatory cytokines in the development of postpartum fatigue 37 Pennsylvania women within 24 hrs of birth | Haemoglobin (Hb) concentration via finger-prick at days 7, 14, 28 | Center for Epidemiological Studies-Depressive Symptomatology Scale (CES-D) on d 28 | -Women suffering from early postpartum anemia may be at increased risk of developing PPD.  
- Negative correlation between Hb concentration on day 7 postpartum and depressive symptoms on day 28  
-CES-D scores on day 7 of women with normal Hb levels (>120 g/L) were significantly lower than those of women with Hb levels <or = 120 g/L |
|          | psychosocial characteristics (from 24-32 wks) | normal pregnant women | (HHHQ) with FFQ |                          | -The majority of participants had inadequate intakes of Iron and folate  
-More fatigued women had higher intakes of zinc and, after adjustment for energy intake lower intakes of folate  
 - Stress was associated with higher intakes of iron, and zinc.  
- Anxiety was negatively associated with vitamin C intake after adjusting for energy intake. |
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| **Benny et al, 1991** | Observe *Nutrient Intake* in pregnant NZ women                      | Prospective cohort 115 pregnant women in 2nd and 3rd trimester. European (61), Maori (29) and Pacific Island (25) In Wellington, NZ | 24hr diet recall            | N/A                           | - Energy Intake similar between ethnic groups  
- Maori and Pacific Island women had significant decrease in Energy Intake from 2nd to 3rd trimester.  
- Pacific consumed significantly more starch  
- Maori significantly more sucrose  
- The mean intake for Pacific contained significantly less calcium and zinc  
- % below the minimum safe intake for iron:  
  -- 44% NZE  
  -- 28% M  
  -- 51% PI  
- Dietary iron intake didn’t relate to anemia or iron supplements |
2.3.4 Zinc Intake and depression in adults and pregnant women

Evidence concerning the relationship between zinc status and mood is conflicting. Cross-sectional studies have occasionally found low intakes of zinc in adults with mood disorders [18, 20]. A prospective study found increased risk of depression in people with lower zinc intakes [28], possibly due to the anti-oxidant and anti-inflammatory effects of zinc. Other studies have found no association [21] and in one study a high zinc intake was associated with more symptoms of fatigue and stress in pregnant women [19].

2.3.5 Folate intake and depression

Many studies have found an inverse association between folate intake and depression risk in women [21, 28]. Furthermore, some studies, including one in pregnant New Zealand women, have found that women with depression are more likely to have intakes of folate below the Estimated Average Requirement (EAR) [20, 25]. One Australian study found that only 17% of overweight or obese adults with a mood disorder(s) were meeting the EAR for folate [21]. Furthermore, other indicators of mood such as fatigue have been associated with low intakes of folate [19]. Possible mechanisms for folate deficiency causing depression include possible anti-inflammatory effects [29], or as a consequence of disrupted one-carbon metabolism and S–adenosylmethionine (SAM) formation [30, 31] affecting methylation processes in the brain involving monoamines, neurotransmitters and membrane phospholipids [32, 33]. Furthermore, a point mutation in a gene coding for a key enzyme in folic acid metabolism is more common in depressed patients than non-depressed [34, 35] and these people have higher folic acid needs than the general population.
Table 2-2 Association between Folic Acid and B-vitamin intake and depression risk in pregnant women

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| Lewis et al, 2012  | Folic acid supplementation and risk of depressive symptoms - MTHFR genotype and depression score | Prospective cohort 6809 pregnant women | Self reported folic acid supplement                 | Edinburgh Postnatal Depression Scale (EPDS)– self reported symptoms of depression             | - supplementation did not decrease risk of depression during pregnancy or at 8mo postpartum.  
- Supplementation did decrease risk at 21mo post-partum, especially for women with the MTHFR genotype.  
- Folic acid unlikely to be important in preventing depression during pregnancy and post-partum |
| Wantanabe et al 2010 | Folate acid and Hcy levels and Depressive symptoms | Cross-sectional 86 pregnant women in first trimester | Self administer diet History questionnaire (BDHQ). - general dietary behaviours - major cooking methods - alcohol - semi-quantitative frequency of intake of 56 food/bevs, dietary supplements, 19 staple foods, open-ended questionnaire on food consumed >1wk | Japanese version of CES-D scale                  | Non-significant associations between depression in first trimester and  
-Hcy and folate deficiencies or -folate, B6 and B12 intake.  
Folate and Hcy may not be protective against depression in early pregnancy |
| 19. Miyake et al 2006b | Dietary consumption of a) folate              | 865 Japanese women            | Self administered Diet History Questionnaire during pregnancy | EPDS - score of ≥9 at 2-9mo                     | No Significant relationships between PPD and intake of:  
-folate                                                                                             |
| b) B vitamins during pregnancy and risk of PPD | post-partum -121 (14%) had PPD | -cobalamin -pyridoxine -Significant decreased risk of PPD in 3rd quartile of riboflavin intake - Moderate consumption of riboflavin maybe protective against PPD. |
However, some studies have found no significant associations between folic acid intake and antenatal, pregnant or postpartum depression [18, 22, 36-38], suggesting, no association, flaws in research design or a reflection of the heterogeneous causes of depression.

2.4 Omega 3 fatty acids and depression

2.4.1 Physiological functions

The role of omega-3 long chain fatty acids (n-3 fatty acids) in depression prevention and treatment is a contentious topic. There is endless research into the role of polyunsaturated fatty acids (PUFAs) in mental health, enough for an entire literature review on its own. In the 12 studies discussed here, the majority were specific to pregnancy and the postpartum period. Of note is the fact that the 14 study literature review and the 10 study meta-analysis did not share any studies. Both came to opposing views on the outcome of research into n-3 fatty acids and depression in pregnancy and postpartum.

What is known is that diet is an important predictor of Omega-3 fatty acid concentrations [39]. Fish is the only dietary source of Docosahexaenoic acid (DHA), Eicosapentaenoic acid (EPA), and Docosapentaenoic acid (DPA) [40]. DHA has also been associated with neuronal membrane stability and functions of serotonin and dopamine transmission [41] and EPA plays an important role in leukotriene synthesis, decreasing the inflammatory response [40]. One advocate for the use of omega-3 fatty acids for treatment of depression holds inflammation accountable in all forms of depression [42]. However, even with its anti-inflammatory effects, the power of omega-3 use to decrease depression risk or severity is yet to be proven beyond reasonable doubt.
Table 2-3 Associations between polyunsaturated fatty acids and depression risk

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| Hoffmire et al 2012 | n-3 PUFAs (estimated) from fish consumption and severity of depressive symptoms | 10480 adults from NHANES 2005-2008 survey | -30d FFQ on fish consumption - 24hr diet recall for EPA/DHA | PHQ                           | - Breaded fish increased risk of severe depressive symptoms  
- All fish, non-breaded and shellfish had no assoc  
- Any EPA and DHA intake was assoc with fewer depressive symptoms  
- No clear assoc with any intake measures and depressive symptoms |
| Da Rocha and Kac 2012 | 4 Follow Ups during pregnancy and 1 post delivery.               | Prospective cohort 106 Pueraera women between 2005-2007 26.4% of sample had PPD | FFQ in first trimester               | EPDS (PPD>11)                  | - Higher prevalence of PPD (60%) in those who had a n-6:n-3 ratio >9.1 = 2.5 times more likely to get PPD  
- Higher prevalence of PPD in those with pre-pregnancy BMI <18.5 (66.7%) = 4.1x more likely to get PPD |
| Keim 2012         | Concentrations of fatty acids in breast milk depressive symptoms during pregnancy | Prospective cohort 287 women            | LCPUFAs measured in breast milk at 4 mo postpartum | Depression scale at <20 and 24-29 weeks | - Increased depressive symptoms at <20 wks was assoc with lower DHA  
- No assoc with other FAs or at 24-29 wks  
- Depressive symptoms early in pregnancy were assoc with lower DHA in breast milk at <20 wks postpartum |
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<tr>
<td>Wojcicki and Heyman 2011</td>
<td><strong>n-3 PUFA supplement and intake in the perinatal period and risk of maternal perinatal depression</strong></td>
<td>Systematic review 10 articles 5 RCTs From yrs 2003-2009 (includes Golding 2009 and Browne 2006, No other studies examined in this table) Pregnant women and postpartum women</td>
<td>Mixed - fish intake and/or omega-3 PUFA consumption. FFQs -4 assessed blood fatty acid levels Search terms “DHA, pregnancy and depression” and “omega-3 fatty acids, pregnancy and depression”</td>
<td>Depression measured using screener such as EPDS, HAM-D, the BDI-II, or the Clinical Global Impression. Five studies also used diagnostic interview schedules</td>
<td>-6 studies found no association between omega-3 fatty acid or DHA intake and risk of depression in pregnancy or postpartum -2 mixed findings -2 found n-3 supplements (1 in pregnancy, 1 postpartum) decreased depressive symptoms. -No association between fish intake during pregnancy and risk of depression in postpartum period -Future RCTs should begin supplementation early in pregnancy and use a dose closer to 2g of DHA + EPA. Furthermore, depression should be measured by Interview and diagnostic screener.</td>
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<tr>
<td>Li et al 2011</td>
<td><strong>Depressed mood and frequency of fish consumption</strong></td>
<td>5068 25-74yr olds from NHANES 1971-1975 survey</td>
<td>3 month FFQ</td>
<td>DSM &gt;22 or taking anti-depressants</td>
<td>-Low fish consumption was a risk factor for depressed mood amongst men. -NS trend for females</td>
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<td>Cosatto et al, 2010</td>
<td>To determine if Pregnant Women and Those at Risk of Developing Post-Natal Depression Consume Lower Amounts of Long Chain n-3 fatty acids</td>
<td>Observational 94 Pregnant and 33 non-pregnant Australian women compared to Australian 1995 NNS (NNS95) data</td>
<td>Validated LC n-3 PUFA FFQ</td>
<td>EPDS assessed whether participant was at risk of developing PND</td>
<td>-Compatible with NNS95. - There were no significant differences in intakes for EPA, DPA, DHA or total LC n-3 PUFA between the ‘at risk’ and the ‘not at risk’ of developing PND groups.</td>
</tr>
<tr>
<td>Makrides et al 2010</td>
<td>fish oil vs. vegetable oil for treating depression</td>
<td>A double-blind, multicenter RCT 2399 pregnant Australian women</td>
<td>800 mg/d DHA capsule or matched vegetable oil capsules without DHA from study entry (~21 weeks) to birth</td>
<td>EPDS at 6 weeks and 6 months postpartum</td>
<td>No difference in levels of depressive symptoms at 6 weeks or 6 months postpartum based on the use of DHA-rich fish oil capsules compared with vegetable oil capsules during pregnancy - No benefit of fish oil supplement over vegetable oil supplement during pregnancy for decreasing PPD risk</td>
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<tr>
<td>Lin et al 2010</td>
<td>Comparison of PUFAs between depressed patients and non-depressed controls</td>
<td>Meta-analysis 14 studies from the yr 1981 – 2008 including 3318 subjects (648 depressive and 2670 control)</td>
<td>levels of total n-3 PUFAs, total n-6 PUFAs, EPA, DHA and AA from red blood cell (RBC) membrane, blood phospholipids, or</td>
<td>BDI, CES-D, CMDI, DSM, EPDS, HAM-D, MADRS, PHQ</td>
<td>-Lower levels of EPA, DHA and total n-3 PUFAs in depressed patients compared to controls - No significant change in AA or total n-6 PUFAs - Writers conclude: Supports Phospholipid hypothesis of depression</td>
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<td>Golding et al 2009</td>
<td>Is seafood intake associated with prevalence of depressive symptoms During pregnancy</td>
<td>9960 Women in Avon Longitudinal study 1991-1992 FFQ re seafood intake at 32 wks gestation</td>
<td>cholesteryl esters samples</td>
<td>EPDS</td>
<td>Lower intake of n-3 from seafood was assoc with increased levels of depressive symptoms during pregnancy. Those consuming no n-3 from seafood were 1.54x more likely to have depressive symptoms than those consuming 1.5g/wk. Authors suggest an association between low omega-3 intake from seafood and increased risk of high levels of depressive symptoms during pregnancy.</td>
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<tr>
<td>Freeman et al 2008</td>
<td>to investigate the feasibility, safety, and efficacy of omega-3 fatty acids for perinatal depression in addition to supportive psychotherapy</td>
<td>RCT 51 perinatal women with MDD Randomized to EPA and DHA at 1.9g/day, or placebo for 8weeks.</td>
<td>EPDS</td>
<td>HAM-D and EPDS bi-weekly</td>
<td>-Participants in both groups had significant decreases in EPDS and HAM-D scores (p .0001) from baseline. -Dietary omega-3 fatty acid intake was low among participants (&lt;0. 5 servings per month) - The benefits of supportive psychotherapy may have limited the ability to detect an effect of omega-3 fatty acids</td>
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<td>Rees et al 2008</td>
<td>To assess whether omega-3 fatty acid treatment is superior to placebo in the treatment of PND</td>
<td>Double-blind, placebo-controlled trial 26 Women (12 antenatal and 14 postnatal) with major depression receiving capsule for six weeks</td>
<td>fish oil (containing 27.3% DHA, 6.9% EPA (total n-3 fatty acids 35.6%) and 3.3% omega-6 fatty acids). Or Placebo (Sunola oil 85% MUFAs)</td>
<td>CIDI structured interview and EPDS or HDRS or MADRS</td>
<td>- No benefit of n-3 fatty acids over placebo</td>
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| Crowe 2008      | To determine the importance of sex and age in fatty acids in serum   | A sample from the 1997 National Nutrition Survey, a population-based survey that assessed the health status of non-institutionalised New Zealanders aged 15 years+ | The fatty acid composition of serum phospholipid, cholesterol ester and TAG | Not Assessed                                      | - New Zealand men and women differ in the relative proportions of n-3 long-chain PUFA in serum lipids  
- Women had lower proportions of EPA and DPA than men.  
- Women had higher levels of DHA than men.  
- Sex differences in fatty acid metabolism  
- Fish fat intake in 20y old women was 0.5g/d and in 35y old women was 1.3g/d |
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<tr>
<td>Miyake et al 2006a</td>
<td>a) consumption of high fat foods, b) consumption of specific types of Fatty Acids and risk of postpartum depression</td>
<td>Prospective cohort 865 Japanese women -121 (14%) had PPD</td>
<td>Self administered Diet History Questionnaire collected during pregnancy</td>
<td>EPDS -score of ≥9 at 2-9mo postpartum</td>
<td>- Correspondingly, levels of EPA, DPA and DHA increase with age</td>
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<td>Browne 2006</td>
<td>risk of Postnatal depression by a) Prenatal fish consumption during pregnancy b) ω3 status after birth</td>
<td>Longitudinal cohort 80 first time mothers; 41 classed as depressed 39 in control group</td>
<td>-Prenatal fish consumption was measured using an FFQ - blood samples 6 months postpartum</td>
<td>BDI–II or EPDS followed by CIDI</td>
<td>- Non-significant dose response between risk of PPD and intake of: fish, meat, eggs, dairy products, total fat, Saturated fat, MUFAs, ω3 PUFA, ω6 PUFA, linoleic acid, alpha- linolenic acid, arachidonic acid, EPA, DHA, ratio of ω3:ω6 - Significant Inverted J shape relationship between ω3 intake and DHA and PPD - No clear relationship</td>
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<td>De Vriese 2003</td>
<td>Fatty acid profile post partum (Phospholipid and</td>
<td>Observational 10 with PPD and 38 controls</td>
<td>Serum fatty acid analysis</td>
<td>6-10 mo postpartum via telephone interview using DSM</td>
<td>-decreased n-3 status and increased n-3:n-6 ratio after delivery increased risk of PPD</td>
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<td>Cholesterol ester) and risk of PPD</td>
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2.4.2 Omega-3 Research into depression- Observational Studies

Some observational studies have found that populations or individuals with higher omega-3 intake have a decreased risk of depression [41, 43]. However, other observational studies such as the NHANES study in 10480 adults found no clear association between omega-3 intake measures and depressive symptoms. Although, the NHANES study did conclude that any EPA or DHA intake was associated with a decrease in depressive symptoms. Furthermore, consumption of fish had no association with depressive symptoms, [44]. But rather a high consumption of breaded fish actually increased the risk of depression symptom severity. This may reflect a diet high in fast foods and low in essential nutrients. It is studies like this that have lead researchers to focus on diet quality discussed later in this literature review.

Another study on fish consumption found that prenatal fish intake was not associated with risk of postpartum depression [45]. While a further study found that high seafood intake decreased depressive symptoms during pregnancy [43]. Omega-3 intake from seafood has been shown to be a marker for other healthy foods and a healthier lifestyle [43] and this could explain the reduction depressive symptoms in people with higher fish intakes. One study which took this into account, found a reduction in effect size of omega-3 intake on depression symptoms. This suggests that perhaps a healthy diet, not just, omega-3 intake is implicated in depression risk.

2.4.3 Omega-6: Omega-3 ratio and postpartum depression

Other research has focused not just on the overall intake of omega-3 but also the ratio of omega-6: omega-3 and found the higher the ratio the greater the risk of postpartum
depression [46, 47]. The rationale being that while omega-3 PUFAs induce an anti-inflammatory response, omega-6 PUFAs are pro-inflammatory [48]. Omega-6 fatty acids are typically found in plant oils and small amounts in animal tissues [40]. Another study found no benefit of fish oil over vegetable oil in depressed women at 6 months postpartum [49].

2.4.4 Omega 3 fatty acids and depression- Conclusion

The results of research into omega-3 fatty acids are inconclusive despite strong advocates for its use. The role of omega-3 PUFAs in the body, and the fact that they fit all three hypotheses makes it likely that a deficiency of these nutrients is at least partly implicated in depression. However, it is still unclear which patients would benefit most from omega-3 supplements. Separating out confounders and analysis of other dietary components may help distinguish the depressed patients in whom supplementation would be an effective treatment or prophylactic.

2.4.5 Micronutrient Summary

In conclusion research into the associations between depression risk and nutrient intake is inconclusive. While deficiency of a nutrient, such as iron, may be enough to cause depression alone, others may be more of a contributing factor to the overall cause of depression. For example, if the individual is already under stress the deficiency of one nutrient in addition to those stresses may be enough to cause depression. However, a deficiency of that nutrient alone, without other stresses may not be enough to cause depression.

To disentangle the real relationships among nutrients and depression it is vital to consider
other possible confounding factors, such as seasonality of nutrient intake or overlap between symptoms of depression and iron deficiency. More thorough reviews of each nutrient should be conducted before we can make recommendations in dietetics.

2.5 Depression and Diet quality, Dietary patterns and Food groups

Some researchers believe that the inconsistencies in studies focusing on specific nutrients as the cause of depression are because nutrients do not enter the body in isolation but rather interact with other nutrients [50]. Therefore, examining overall intake of food groups, dietary patterns or a measure of diet quality may be more meaningful, than looking at nutrient intakes alone.

For this reason a handful of studies have investigated diet quality, dietary patterns, food groups and psychosocial outcomes such as depressive symptoms, weight related distress and body image in pregnant and child bearing aged women. The general consensus being that poorer diet quality is associated with increased severity of depressive symptoms, stress and anxiety [14, 15, 17, 19, 51, 52]. Only one study investigating the link between diet quality and depression symptoms during the postpartum period was found [52].

2.5.1 Mediterranean Diet pattern and the oxidative stress theory

A study on adherence to the Mediterranean diet found a negative linear relationship between depression and diet [53]. One proposed mechanism for a protective effect of the Mediterranean diet in depression is the Oxidative Stress theory. Under normal conditions the body regulates the concentration of free-radicals by controlling production and removing excesses of these products. However, some damage is unavoidable. Depending on the abundance of free-radicals, consequences can range from cellular structure damage
to necrosis/ cell death [54]. A diet rich in antioxidants may help to repair and slow oxidative damage [54]. The Mediterranean diet has larger amounts of antioxidant containing foods, such as fish, fruits and vegetables. It is therefore plausible that this diet may help protect the brain from oxidative damage and consequent depression. Furthermore, adherence to the traditional Mediterranean diet has been associated with a reduction in the concentrations of inflammation and coagulation markers [55], adding to the mix an overlap with the anti-inflammatory theory.

2.5.2 Other dietary patterns in depressed populations

An inverse relationship has been observed between certain dietary patterns and risk of mental disorders [15, 56]. An Australian study found an association between depressive disorders and a “Western diet”, consisting of processed or fried foods, refined grains, meat pies, processed meats, pizza and chips [56]. In comparison a “traditional diet” consisting of adequate amounts of fruit, vegetables, beef, lamb, fish and wholegrains was associated with a non-significant decreased risk [56]. The highly processed food dietary pattern (compared to whole food dietary pattern) has been shown to increase odds of depression [57].

2.5.3 Dietary patterns during pregnancy and risk of postpartum depression

A recent prospective cohort found that a health conscious diet during pregnancy decreased the risk of developing PPD [16]. Women in the 2nd or third tertile of a health conscious dietary pattern were approximately 50% less likely to have PPD than those in tertile one.
However, another study found no significant linear relationships between “healthy”, “Japanese” or “Western” dietary patterns and risk of PPD [58]. The dietary habits adopted during pregnancy may affect the nutrient status postpartum. Key influences on dietary choices throughout pregnancy were nausea and vomiting in the first trimester (81%), and heart burn in the third trimester (51%) [59]. However postpartum dietary intake is mostly influenced by lack of time (51%) [59].

2.5.4 Diet quality and depression in adult populations

Studies show that higher depressive symptom severity is associated with poorer diet quality in adults with mood disorders [15, 21]. One such study suggests that people with more severe symptoms of depression and anxiety are consuming less variety, fewer healthy choices, fewer servings of fruit and vegetables, and more junk (low nutrient density, high energy density) food than those with less severe depression and anxiety [21].

Another study which found poor diet quality to be associated with increased severity of depression, noted that diet quality was largely determined by intakes of saturated fat, sugar and salt [15]. The “western diet” mentioned above also has high intakes of saturated fat, sugar and sodium. These findings suggest that there is a link between energy dense and processed foods and depression severity. Studies on food groups and depression risk (Table 2-5) have found similar results [52, 60, 61].

2.5.5 Diet Quality in pregnancy and depressive symptoms

Two studies in low income pregnant women have found a positive relationship between diet quality and depression [14, 51]. One of these studies found Emotional eating,
depression, and partner support were significantly related to diet quality and the intake of micronutrients important to pregnancy\cite{14}. The other study found that poor diet quality was related to higher levels of depressive symptoms, persistent stress and overall stress \cite{51}. 
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| Appelhans et al 2012 | To examine if a) diet quality and b) Physical activity were related to MMD | 161 women with MMD and obesity (enrolled in a weight loss trial – at baseline)                   | - three 24hr diet recalls -measure of diet quality assessed by: The Alternate healthy eating index | Beck Depression Inventory 2                 | - High depression severity was associated with poorer overall diet quality, but not Physical Activity.  
- Associations with diet quality were primarily driven by: High sugar intake, High saturated fat intake and high sodium |
| Forsyth et al, 2012 | To observe diet quality in mood disorder patients                       | Cross sectional 32 Australian Males, 77 Females, 80% overweight or obese referred with depression (52%), anxiety (19%) or both (28%) | -Diet history -Aust-HEI (Australian modified Healthy Eating Index) t0 evaluate the consumption of whole foods | DASS – depression, anxiety and stress scale | -Depression was significantly negatively correlated with variety, healthy choices, fruit intake, vegetable intake and total HEI score And significantly positively associated with junk food intake  
- Anxiety was significantly negatively associated with variety, fruit intake and total HEI  
- Stress was significantly negatively associated with variety, healthy choices, fruit intake and total HEI and positively associated with junk food intake  
- DASS was significantly negatively associated with variety, healthy choices, fruit and vegetable intake and total HEI and positively associated with junk food intake. |
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<th>Reference</th>
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<th>Dietary assessment method(s)</th>
<th>Mental health assessment tool</th>
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</table>
| Chatzi et al 2011 | Dietary patterns (health conscious, western) during pregnancy and risk of Postpartum depression (PPD) | Prospective cohort 529 women participants of the Rhea Cohort | FFQ in mid-pregnancy.        | Edinburgh Postnatal depression Scale (EPDS) at 8-10 wks pp | ‘Health conscious’ classified as: Mainly F+V, pulses, nuts dairy prod, fish and olive oil  
‘Western’: mainly meat and meat products, potatoes, sugar and sweets, cereals, fats except olive oil, salty snacks, eggs, beverages and sauces -↑ adherence to health conscious diet was significantly associated with low EPDS scores.  
-Individuals with more severe symptoms of depression and anxiety are consuming fewer healthy choices, less variety, fewer serves of fruit and vegetables, and more junk (low nutrient density, high energy density) food than those with less severe depression and anxiety.  
-Women in the 2nd or 3rd tertile for health conscious diet were about 50% less likely to have high levels of depressive symptoms (EPDS ≥ 13) compared to tertile 1.  
-healthy diet during pregnancy assoc with ↓ risk of PPD |
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<tr>
<td>Okubo et al, 2011</td>
<td>Dietary patterns during pregnancy and risk of pp depression</td>
<td>Prospective study 865 Japanese women 121 with PPD</td>
<td>Validated self administered diet History questionnaire - 33 predefined food groups - 3 diet patterns: healthy, western, Japanese</td>
<td>EPDS score of ≥ 9 at 2-9mo pp -121 women (14%) had pp depression</td>
<td>- No relationship between healthy or Japanese pattern and depression - 2nd quartile of western had a ↓ risk of pp depression (OR: 0.52, CI 0.30-0.93) but P=0.36. and no linear association - Unable to find association between any dietary pattern and PPD risk</td>
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<td>Fowles et al. 2011a</td>
<td>high vs. low Frequency of fast food consumption during the first trimester and overall impact on diet quality</td>
<td>Descriptive exploratory study (Observational) 50 low income pregnant women</td>
<td>-Dietary Quality Index–Pregnancy (DQI-P) -Eating Habits subscale from the Project EAT Survey -The Emotional Eating Scale (EES)</td>
<td>10 item EPDS The stress subscale of the Prenatal Psychosocial Profile (PPP)</td>
<td>High Frequency fast food consumers: - had significantly more: vegetables, gravies, calories/day, % of total calories from fat - ate less fruit - skipped more meals - were more likely to be: obese, depressed, stressed - High frequency of fast food consumption contributed to poor dietary quality and excessive caloric intake - All but one of the participants failed to meet the dietary quality recommendations for pregnant women - Dietary quality was negatively related</td>
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<tr>
<td>Fowles et al 2011b</td>
<td>a) To examine maternal psychosocial factors and dietary quality b) to explore the relationships among dietary quality and selected biomarkers of nutrition and placental development</td>
<td>Cross-sectional 18 low-income, pregnant women</td>
<td>- Three 24 hr recalls&lt;br&gt;- DQI-P&lt;br&gt;- EES&lt;br&gt;- The presence of nausea and vomiting in pregnancy was assessed with each 24-hr recall using the Rhodes Index of Nausea and Vomiting</td>
<td>Psychosocial questionnaires including&lt;br&gt;- a demographic form,&lt;br&gt;- CES-D&lt;br&gt;- Stress and Social Support subscales of the PPP</td>
<td>- Emotional eating, depression, and partner support were significantly related to the intake of micronutrients important to pregnancy&lt;br&gt;Low-income pregnant women who eat to cope with anger and anxiety may have an inadequate intake of nutrients that contribute to positive pregnancy outcomes.&lt;br&gt;<strong>Partner support</strong> was positively related to vegetable intake and negatively related to intake of iron and grains&lt;br&gt;<strong>Emotional eating</strong> in response to <strong>anger</strong> was negatively related to intake of iron- (r = -.53) and folate-rich (r = -.75) foods&lt;br&gt;Emotional eating in response to <strong>anxiety</strong> was negatively related to intake of folate-rich foods (r = -.51).&lt;br&gt;<strong>Depressed</strong> women had an increased intake of calcium-rich foods (r = .60).&lt;br&gt;Levels of vascular endothelial <strong>growth factor</strong> (VEGF) were negatively related to:&lt;br&gt;  - <strong>depression</strong> (r = -.56)&lt;br&gt;  - intake of foods high in calcium (r = -</td>
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<td>Jacka et al, 2010</td>
<td>Habitual dietary pattern and risk of mental disorders</td>
<td>1046 Australian women aged 20-93yrs Prospective cohort (1994-97) with biennial follow-up and 2nd intake recruited between 2004-2008</td>
<td>FFQ: diet quality score -Traditional: F + V, meat, fish and wholegrains. -Western: processed or fried foods, refined grains, sugary products and beer</td>
<td>12 item general health questionnaire (GHQ-12) and clinical interview</td>
<td>-Traditional diet had ↓ risk of major depression, dysthmia and anxiety disorders. -Western diet had higher GHQ-12 score -Inverse assoc between diet quality score and GHQ-12 score -assoc between habitual diet quality and ↑ risk of mental disorders -No statistically significant difference in BMI between those with and those without depressive disorder -Reverse causality and confounding cannot be ruled out</td>
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<tr>
<td>Fowles et al, 2009</td>
<td>diet quality and maternal psychosocial status</td>
<td>Pilot study 13 low income pregnant women between 19-31yrs having their first pregnancy (av=7wks). 6 women had scores indicating a major depression</td>
<td>Dietary Quality Index pregnancy scores Nutrition knowledge scale</td>
<td>CES-D, PPP</td>
<td>-av caloric intake: 2653 kcal/d --34% fat -6women had inadequate intake of calcium -11 had low iron intake - Diet quality index scores were below recommendations -Dietary intakes did NOT meet recommendations for pregnancy</td>
</tr>
<tr>
<td>Hure et al 2009</td>
<td>To report diet quality of young Australian women by pregnancy status</td>
<td>Cohort in 7486 Australian women aged 25-30 of the ALSWH -pregnant (n 606), trying to conceive (n 454), had a baby in the last 12 months (n 829) and -other (n 5597)</td>
<td>-To calculate diet quality: the Dietary Questionnaire for Epidemiological Studies using the ARFS methodology. - Nutrient intakes were compared with the NRVs for Australia and New Zealand</td>
<td>NA</td>
<td>-Pregnancy status did not significantly predict diet quality. -Pregnant women and those who had given birth in the previous 12 months had marginally higher ARFS than ‘other’ women - No single food group predicted this small difference. - mean nutrient intakes in postpartum women were reported but not separately for lactating and non-lactating women.</td>
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| George et al 2005  | To examine the relationship between psychosocial variables and dietary compliance at 1 year postpartum [52]. | Prospective cohort 146 triethnic, Low income women at 1 year postpartum | -FFQ  
-Dietary guidelines index scores and -measures of adherence to dietary recommendations | -Psychosocial questionnaires assessing SCI, weight-related distress, stress, CES-D, Body Cathexis (body image), PSS, and Decisional Balance (pros and cons toward weight loss) scales. | - Psychosocial variables, including depressive symptoms were associated with less healthful diets and lifestyle at one year postpartum  
Dietary compliance:  
- 60% had adequate meat intakes  
- <30% met recommendations for grains, vegetables, fruits, dairy foods, total fat, and added sugar  
- 37% had BMI <25  
Individuals in the highest tertile of dietary compliance compared to those in the lowest tertile had:  
- A more positive body image  
- Less neglect of self-care  
- Less weight-related distress  
- Less stress  
- Fewer depressive symptoms  
- Fewer perceived barriers to weight loss (P .05). |
<p>| Hurley 2005       | Dietary intake (at 28wks gestation) and Cross sectional observational health habits questionnaire 134 low risk | -Health habits history questionnaire | Spielburger | -Women who were more fatigued reported higher intakes of energy, carbohydrates, fats and proteins. |</p>
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<tr>
<td>Hurley 2005</td>
<td>psychosocial characteristics (from 24-32 wks)</td>
<td>normal pregnant women</td>
<td>(HHHQ) with FFQ</td>
<td></td>
<td>- Stress was associated with higher intakes of energy, fats and proteins</td>
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<td>- Women who were more hassled than uplifted by the pregnancy reported lower intakes of protein.</td>
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<td>- Food groups:</td>
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<td></td>
<td>- Stress was associated with higher intakes of breads and foods from the fats, oils, sweets, and snack group.</td>
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<td>- Anxiety was associated with higher intakes of foods from the fats, oils, sweets, and snack group.</td>
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<td></td>
<td>- Women who were more hassled than uplifted by the pregnancy reported lower consumption of foods in the meat Group</td>
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<td>No significant relationships were detected for depressed mood, anger, or social support.</td>
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ALSWH: the Australian Longitudinal Study on Women's Health, ARFS: Australian Recommended Food Score, DQI-P: The Dietary Quality Index–Pregnancy, EES: The Emotional Eating Scale, EPDS: Edinburgh Postnatal depression scale, CES-D: Center for Epidemiologic Studies-Depression scale, FFQ: Food Frequency Questionnaire, NRV: Nutrient Reference Values, PPP: Prenatal Psychosocial Profile, PSS: Postpartum Social Support, SCI: Self-Care Inventory
Diet quality is also related to sociodemographic factors [62, 63], particularly in pregnant and postpartum women [64, 65]. A New Zealand study found that in pregnant women nutrient intakes and median weight of food were significantly lower in the less educated, the young, the welfare dependant, smokers and those who vomited during pregnancy [25].

**2.5.6 Diet quality, obesity and depression**

Body weight and physical activity have also been associated with quantity and quality of dietary intake [66, 67]. There is a known relationship between depression and obesity [68, 69]. Longitudinal studies have shown obesity increases depression risk and depression can be predictive of obesity [69]. Postpartum weight retention has been significantly associated with PPD and these women are more likely to report they are not eating as healthily as they would like [70].

Obesity and depression both promote pro-inflammatory states as do a range of other health conditions comorbid with depression, such as cardiovascular disease, diabetes and osteoporosis [22, 71, 72]. As some diets such as the Mediterranean diet may contain more anti-inflammatory properties than other traditional or western diets [55] this may be one way that improving diet quality could help to treat depression.

**2.5.7 Food groups and Depression**

In a prospective cohort which aimed to look at dietary patterns as a predictor of depression 5yrs later, Akbaraly et al found, that a diet high in processed foods increased the odds of depression whereas a diet high in fruits vegetables and fish had a protective effect [57]. This could suggest that either there is something in processed foods which
increases an individual’s risk of depression or that these foods are displacing more nutrient rich foods, such as fruit, vegetables and fish; possibly a combination of both. Therefore, future studies could benefit from looking at the numbers of servings of each food as well as overall diet quality. For instance someone who consumes not only a large amount of refined grains, but also large amounts of fruit and vegetables may have a lower risk. There is also evidence that the consumption of whole nutritious foods provides greater benefit than simply meeting nutrient requirements by means of supplements[50].

2.5.7.1 Sugar

Cross sectional studies have shown associations between sugar/sweet food intake and depression. Rates of per capita sugar consumption in six countries were compared with annual rates of depression for that country and showed a positive linear relationship [73]. Of the 6 countries for whom data were available for this study New Zealand had the highest per capita sugar consumption and highest incidence of depression [73]. However this study in no way implies causality or even an interaction between the two variables and therefore, is rather weak evidence alone. In 2002, a study by Barkeling et al found that intakes of sweet foods were positively associated with anxiety and depression [61]. Furthermore, an observational study conducted in 2008 which found a positive association between BMI and depression, suggested that this relationship may be mediated by sweet food intake [74]. This appears to imply that a relationship exists between BMI and depression, if the individuals high BMI is due to consumption of sweet (sugary) foods. Furthermore, a recent study found high sugar consumption during pregnancy was associated with an increased risk of PPD [16].
2.5.7.2 Fast foods

In an attempt to look at causality, a Spanish prospective cohort study assessed intakes of fast foods and baked products at baseline in non-depressed individuals. At approximately 6 years follow up, incidence of depression was assessed. This study found high fast food and baked products consumption increased the risk of depression [75]. Consumption of fast food and depression shared a significant dose response relationship, in which the highest category of fast food consumption was associated with a 40% increased risk of depression [75].

2.5.7.3 Fast foods and PPD

An observational study examined the impact of fast food consumption on diet quality in low income pregnant women. This study found those who frequently consumed fast food were more likely to be depressed, obese, stressed and more likely to skip meals [51]. These women also had a higher energy intake and a higher percentage of total calories from fat. A similar study found an increased frequency of fast food consumption contributed to a poorer diet quality and excessive caloric intake [76].

2.5.7.4 Fruit and vegetables

Fewer serves of fruit and vegetables have been associated with increased severity of depression symptoms [21]. Fewer servings of fruit was more significantly associated with depression, anxiety and stress score than vegetables.

2.5.7.5 Meat and protein sources

No significant associations were found between meat fat intake or milk fat intake and depression severity[21].
In conclusion it is important to acknowledge that research in this area is based predominantly on observational data and therefore, diet may not be the initial cause of depression but depression may cause a poor diet.
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<tbody>
<tr>
<td>Prairie et al, 2012</td>
<td>Cross-sectional -total cholesterol -LDL -HDL -TAGs all measured fasting 1 and 14wks pp</td>
<td>120 postpartum women with major depression (DSM-4)</td>
<td>-Nil. -biochemistry</td>
<td></td>
<td>Total, HDL and LDL are elevated early pp (&gt;200mg/dL in 45% of sample at baseline) do not return to &lt;200 until 6 wks. -TGs stable within normal range</td>
</tr>
<tr>
<td>Sanchez Villegas et al, 2011</td>
<td>Prospective cohort. Ave FU= 6.2yrs I: consumption of fast foods and baked products D: incidence of depression</td>
<td>8694 from the SUN project (Spanish cohort). -493 cases of depression</td>
<td>-Validated semiquantitative FFQ -Fast food: hamburgers, sausages, pizza -processed pastries: muffins, donuts, croissants</td>
<td></td>
<td>-A ↑ risk of depression assoc with consumption of fast food (Q1 : Q5) - No linear relationship between baked goods and depression, h/w Q2-5 had ↑ risk c.f Q1 (lowest consumption) -fast food and commercial baked goods consumption may have detrimental effect on depression risk</td>
</tr>
<tr>
<td>Chatzi 2011</td>
<td>Dietary patterns during pregnancy and risk of PPD</td>
<td>Prospective 529 women from the ‘Rhea’ cohort</td>
<td>250 item FFQ in mid-pregnancy 17 food groups</td>
<td>EPDS at 8–10 weeks postpartum</td>
<td>Olive oil intake.40 g/d was inversely associated with high levels of PPD symptoms -Increased intake of sugar products (.29 g/d) showed a</td>
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<td>Cosatto et al, 2010</td>
<td>To determine if Pregnant Women and Those at Risk of Developing Post-Natal Depression Consume Lower Amounts of Long Chain n-3 fatty acids</td>
<td>Observational 94 Pregnant and 33 non-pregnant Australian women compared to Australian 1995 NNS (NNS95) data</td>
<td>Validated LC n-3 PUFA FFQ</td>
<td>EPDS assessed whether participant was at risk of developing PND</td>
<td>Positive association with PPD symptoms &lt;br&gt;- ↑ olive oil ↓ risk of PPD &lt;br&gt;- ↑ sugar ↑ risk of PDD</td>
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<tr>
<td>Murakami et al, 2008</td>
<td>I: dietary GI and GL &lt;br&gt;D: Pp depression</td>
<td>865 Japanese women</td>
<td>Validated self administered Diet History Questionnaire.</td>
<td>EPDS &lt;br&gt;-score of ≥9 at 2-9mo pp &lt;br&gt;-121 (14%) had pp</td>
<td>-NS assoc between dietary GI and pp (P=0.18). &lt;br&gt;-Significant assoc: dietary GI in 3rd quart had ↓ risk of PPD c.f 1st. (but no significant assoc in 4th quart) &lt;br&gt;-NS assoc for GL</td>
</tr>
<tr>
<td>Miyake et al 2006a</td>
<td>Consumption of high fat foods and risk of postpartum depression</td>
<td>Prospective cohort 865 Japanese women</td>
<td>Self administered Diet History Questionnaire collected during pregnancy</td>
<td>EPDS &lt;br&gt;-score of ≥9 at 2-9mo postpartum</td>
<td>-Non-significant dose response between PPD and intake of: fish, meat, eggs, dairy products, total fat, Saturated fat, MUFAs, ω3</td>
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<td>22. Barkeling et al 2002</td>
<td>Cross sectional I: intake of sweet foods (habitual and premenstrual) D: a) BMI and b) psychometric variables</td>
<td>362 women aged 34-64 Part of the SPAWN (Stockholm Pregnancy and Women’s Nutrition) study</td>
<td>Questionnaire on sweet food intake. Validated by mutan streptococci and lactobacilli in saliva</td>
<td>Self rating scale on psychometric variables (CPRS-S-A)</td>
<td>Intake of sweet foods correlated with CPRS scores - possible link between mood regulation and ↑ intake of sweet foods</td>
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2.5.8 Depression and diet quality conclusion

Research directed at diet quality or dietary patterns is in some ways much less precarious than nutrient research. We cannot overdose on nutrients by improving our dietary pattern and in fact this has many other benefits to health which can improve mental well-being. Simply adding a supplement to our diet each day does not improve other co-morbidities which may affect our mental well-being, such as obesity or diabetes. Furthermore, if a combined effect of nutrients is implicated, then an omega-3 supplement daily will not treat other nutrient deficiencies and thereby, have no effect.

2.6 Depression and supplement use

2.6.1 Safety concerns with vitamin A during pregnancy

Consuming vitamin A at amounts of 10,000-15,000IU has previously been found to have teratogenic effects in infants [77]. Hence the UL for pregnant women in New Zealand is 10,000 IU or 3000 μg/d [78]. Given that the average vitamin A intake from food in pregnant New Zealand women is 1075-1138 μg/d [79] supplementation of vitamin A should be kept well below 1500μg/d (5000IU). Recent research in Wellington found 9.5% of vitamin recommendations from pharmacies and 19.0% of health food shop recommendations to pregnant customers were unsafe due to the potential risk of vitamin A overdose [80]. Clinical Prescribers need to ensure vitamin A supplementation is not at dangerous limits.
2.6.2 Safety of herbal supplements during pregnancy and lactation

Several studies have found that some women, particularly mood disorder patients, prefer herbal remedies over pharmaceutical treatment during pregnancy [81-83]. This is due to anxieties about harmful effects of medication on their child [81, 82]. However, just because something is termed natural does not make it safe or effective [84]. A New Zealand study published last year found that 66.7% of pharmacies and 33.3% of health shops were selling supplements to pregnant women for nausea in early pregnancy which did not adhere with New Zealand MOH safety guidance[80]. Furthermore, there is a lack of training in obstetric botanical medicine use [85]. Probably due to the fact, that there is limited evidence to support safe use.

Of further concern is the fact that medical records often do not contain information about herbal supplements [86]. This is important as some herbal supplements can interact with medication, or have toxic effects [82]. Furthermore, the combination of herbs may have adverse effects [87, 88]. The Swedish medical products agency recorded adverse reactions associated with complementary and alternative medicine reported from 1987 to 2006 [88]. The herbal substance(s) which were most commonly reported to adverse effects were Echinacea purpurea (8.1%), Echinacea with siberian ginseng and malabar nut (7.3%) and ginkgo leaf (6.7%)[88]. Serious reactions were reported in 221 cases with the most frequent being pulmonary embolism, mixed liver reaction, and anaphylactic reaction. In Eleven reports the outcome was fatal. A lack of data regarding the safety of herbal dietary supplements in pregnancy and lactation and the potential for adverse effects should discourage their use [82].
2.6.3 Prevalence of Supplement use in mood disorder patients

Little research has been carried out to assess the prevalence of supplement use in mood disorder patients [89]. Given that micronutrients may play a key role in the aetiology of mood disorders and herbal supplements as yet have no evidence base for safe use in the treatment of mood disorders, assessing the prevalence, frequency and type of supplement use in mood disorder patients is greatly needed.

A recent study on nutrient intakes and psychiatric functioning in Canada reported, 25% of the adults sampled with bipolar or depression combined their medication with herbal remedies and 50% were taking at least one multivitamin [18].

2.6.4 Supplement use in pregnant and postpartum New Zealand women.

Supplement use during pregnancy may delay or prevent nutrient deficiencies during pregnancy and the postpartum period [13]. In 1999 the prevalence of supplement use in 26yr old females, was estimated from the Dunedin Multidisciplinary Health and Development Study to be 20.4%. Of the supplement users, over half were taking a multivitamin preparation [90]. In a Northern New Zealand study, of pregnant women without mood disorders, only 31% (predominantly of European ethnicity) of women reported taking any supplement(s) in months 4 and 7 of pregnancy. Iron, multivitamins and minerals and folate were the most common [91]. Herbal remedies were not reported. In conclusion, more research into supplement use in women with depression prior to pregnancy, during pregnancy and in the post-partum period is needed to assess safety and efficacy of supplement use. Differing beliefs of health professionals on the efficacy and
safety of certain nutrient supplements in depression it is likely to impact treatment
efficacy.
Table 2-6 Supplement use in pregnant or postpartum women with depression

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</table>
| Leung 2013         | Prenatal micronutrient supplement use and risk of post-partum Depression | 475 women of the Canada APrON study (longitudinal prospective) in first or second trimester (<27wks gestation) | Supplement intake questionnaire: multivitamin/minerals, single nutrient supplements, herbal products, probiotics, homeopathic remedies, and traditional medicines | EPDS at each trimester and 12 weeks postpartum 88% <10 12% >10 | -Mean nutrient intakes from supplements were higher in women with lower EPDS scores, particularly selenium ($p = 0.0015$) and omega-3s ($p = 0.01$)  
-prenatal supplemental selenium was protective |
| Miller et al 2013   | Selenium vs. placebo  
-EPA vs. placebo  
-DHA vs placebo  
-EPA vs. DHA And risk of PPD | Cochrane review. 2 trials met criteria including Mokhber 2011 [92] | Supplementation  
Selenium study used EPDS and EPA/DHA study used Beck Depression Inventory (BDI) |                                                    | Non-significant effect of Selenium over placebo  
No effect for EPA or DHA  
No evidence for advocacy of any other dietary supplements in preventing postnatal depression |
| Davison and Kaplan, 2012 | Nutrient intake and psychiatric functioning | Cross sectional 97 community based adults | 3 day food records and FFQ  
-Global assessment of functioning score (GAF)  
-The Hamilton |                                                    | -When dietary supplement use was added to nutrient intakes from food, GAF scores were positively correlated ($P < 0.05$) with calcium, |
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<tr>
<th>Reference</th>
<th>Aim</th>
<th>Study design and participants</th>
<th>Dietary assessment method(s)</th>
<th>Mental health assessment tool</th>
<th>Relevant results / conclusions</th>
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</thead>
<tbody>
<tr>
<td>Davison and Kaplan 2011</td>
<td>To investigate the nutrient intakes of people with mood disorders and compare to British Columbia Nutrition Survey (BCNS) data</td>
<td>Cross sectional survey of 97 (69 female) Adults with bipolar or MDD taking various antidepressants (72.9%) and mood stabilizers (52.9 %).</td>
<td>-3DDR -Blood analyses -FFQ -Anthropometry</td>
<td>Depression rating scale -the young mania rating scale</td>
<td>Magnesium, phosphorus, potassium, iron, and zinc. -HDRS scores correlated with only one nutrient, iron -the following nutrient supplements were taken by 32-44% of participants: Vitamins B1, B2, B3, B5, B6, B9, B12 and C, calcium, magnesium, zinc, phosphorous, potassium, sodium and iron -combined intake of supplements and food helped reduce the prevalence of inadequacy - with supplementation the proportion of participants exceeding the tolerable UL for niacin, B6, B9, Vitamin C, Ca, Mg, Fe and Zn was 1-8% - lower intakes of thiamine and phosphorous were found with antidepressant use - higher Ca and Fe intakes were assoc with anti-anxiety medication use - Mg intakes were increased with mood stabilizers</td>
</tr>
</tbody>
</table>
### Smith – Fawzi et al 2007

The effect of vitamin supplementation on health-related QOL and risk of elevated depressive symptoms comparable to MDD.

- **Study design and participants**: RCT 1078 HIV-positive pregnant women in Tanzania.
- **Dietary assessment method(s)**: Multivitamin (B-complex, C and E supplementation) vs. vitamin A supplementation.
- **Mental health assessment tool**: Validated subset of Hopkins Symptom Checklist-25 (HSCL-25) - 4th edition (DSM-IV) criteria.
- **Relevant results / conclusions**: B-complex, C and E supplementation resulted in a reduction in risk of elevated depressive symptoms comparable to MDD and improvement in quality of life. Vitamin A showed no effect on these outcomes.

MDD: Major Depressive Disorder, PPD: Postpartum depression, QOL: Quality of life

### Table 2-7 Supplement use in mothers without depression

<table>
<thead>
<tr>
<th>Reference</th>
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<th>Study design and participants</th>
<th>Dietary/supplement assessment method(s)</th>
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<tbody>
<tr>
<td>Gardiner et al 2013</td>
<td>To determine the prevalence of herbal use in low income postpartum women</td>
<td>Cross sectional 160 women from the inpatient postpartum unit of Boston Medical Center. Boston, USA.</td>
<td>The research assistant administered the survey during the inpatient.</td>
<td>-39% reported using herbs during pregnancy. -65% took a prenatal vitamin. -57% of herb users (n = 40) reported taking prenatal vitamins. -11% of herb users and 18% of non-users reported a mental/ neurological comorbidity= NS diff in supplement use between those with and without mental/neurological comorbidities.</td>
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<td>Reference</td>
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<td>Dietary/supplement assessment method(s)</td>
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| Jefferies et al 2012 | Safety of advice given to pregnant women regarding 1. Nausea 2. Folic acid use 3. Vitamin A containing products | 21 HFS (health food shops) and 21 geographically-matched pharmacies in the Greater Wellington region | Researcher questioned shop assistant re herbal products for nausea, vitamins, and supplements to avoid | -Herb users were significantly more likely to report making any dietary change during their pregnancies than non-herb users (P = .03).  
-Only 38% of herb users discussed it with their prenatal providers, and 82% were satisfied with the conversation.  
-Vitamin use was not significantly different between herb and non-herb users.  
- The most common herbal products were peppermint and ginger (14% ea.)  
-Of all 160 participants, 125 had prenatal vitamin use documented, and no women had herbal medicine use documented in the medical record during their birth hospitalization.  
-66.7% of pharmacies (14/21) and 33.3% of HFS (7/21) recommended products for nausea contrary to MOH guidelines.  
-A greater proportion of pharmacies (95.2%) gave advice consistent with MOH recommended dosage of folic acid supplementation than HFS (47.6%).  
-2/21 (9.5%) of pharmacies and 4/21 (19%) of HFS gave advice with a potential risk of vitamin A overdose. |
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<tr>
<td>Watson and McDonald 2009b</td>
<td>Maternal diet and supplement use and Infant birth weight</td>
<td>Prospective cohort 504 European and Polynesian (75% NZE, 18% Maori, 7% PI) urban and rural pregnant volunteers recruited from northern New Zealand clinics</td>
<td>Subjects were visited in mth4 and mth7 of pregnancy. - Height, Weight, skinfolds - 24-hour recall and 3-day food record</td>
<td>- Up to three different dietary supplements were taken by 31.5% of women (mostly Europeans) in mth4, and 31.3% in mth7. The most common were iron, multivitamins and minerals, and folate. It was more significant that a supplement was taken, than the actual dose. - There was a 129-g increase in birth weight (P ¼ 0.002) in those who took dietary supplements compared to those who did not - Iron supplementation, was associated with an increase in birth weight.</td>
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<tr>
<td>Holst et al 2009</td>
<td>To review the literature on safety and efficacy of the most commonly used herbs by pregnant women</td>
<td>Survey and review of the scientific literature. 578 women who were at least 20 weeks pregnant presenting at the antenatal clinics held within Norfolk</td>
<td>Survey</td>
<td>- 57.8% of the participants used one or more herbal remedies. - The most commonly used herbal preparations during pregnancy were ginger (33.6%), cranberry (25.3%), raspberry leaf (23.7%), chamomile (13.1%), peppermint (9.3%) and echinacea (4.3%). - Only 14 studies focusing on the safety and/or efficacy of these herbals in human pregnancy were identified; ginger (10), cranberry (1), raspberry leaf (2) and Echinacea (1) - In total, 96 different reasons for the use of herbs were given, but only 50 of these were traditional uses - 25.3% were taking 1 herbal supplement, 16.1% were taking 2, 9.9% were taking 3 and 6.2% were taking 4-10. - Four women reported simultaneous use of a tannin-containing herb (chamomile, raspberry leaf, valerian) and iron</td>
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<td>Reference</td>
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<td>Study design and participants</td>
<td>Dietary/ supplement assessment method(s)</td>
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<tr>
<td>Arkkola et al 2006</td>
<td>to examine food choices, nutrient intake and dietary supplement use of pregnant Finnish women in association with demographic variables</td>
<td>797 Finnish mothers of newborns</td>
<td>FFQ</td>
<td>-Nine clinical trials and a prospective study found no adverse effects of ginger when used for four days to three weeks in a dose of 1 g daily. -Nutrient supplements were used by 85% of the women. -31% received vitamin A-containing supplements, although it is not recommended during pregnancy. Supplements were favoured by the older and well-educated women and by those who had normal weight before pregnancy. The results of the present study suggest that healthy food choices are rather common among pregnant Finnish women and the choices are positively correlated with age and education. -With analysis of food plus supplementation, the intake of vitamin D (and folic acid for 44% of women) did not meet the dietary recommendations.</td>
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<tr>
<td>Gallo et al 2000</td>
<td>To evaluate the safety of Echinacea in pregnancy</td>
<td>prospective study 206 women were enrolled after reporting echinacea</td>
<td>Questionnaire on supplement use and follow up</td>
<td>-There were no statistical differences between users and non-users of echinacea during pregnancy in spontaneous abortions or malformations. -The remedy was used for five to seven days in various</td>
</tr>
<tr>
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</table>
| Allen et al 2000 | To estimate the prevalence of use of nutritional supplements among young adults in Dunedin | 26yr adults, 479 women (6.5% of the women were pregnant) from the Dunedin Multidisciplinary study | Supplement containers were brought to the general medical examination and recorded or if forgotten, a follow up call was made | -The prevalence of supplement use was 20.4% among females.  
-Multivitamin preparations were the most widely consumed by 45 females (9.4%), followed by water-soluble vitamin supplements 6.9% in females but 32.3% in pregnant women (such as folate (32.3% of water soluble vitamins) and vitamin C).  
-Mineral supplements 20 (4.2%), but 12.9% in pregnant women, most commonly iron and calcium in pregnant women  
-Botanical, micro-organism and bee products 13 (2.7%), Garlic supplements 7 (1.5%), Oils 6 (1.3%), Bran/fibre supplements 4 (0.8%), Other supplements 2 (0.4%), Fat-soluble vitamin and beta-carotene 2 (0.4%), Sports supplements 1 (0.2%)*  
-Folate was taken by 35.7% of pregnant females. 50% self...

When used for URTI treatment: 112 women used the herb in the first trimester and 206 women in the control group. Doses from 250 to 1000 mg as tablets or five to 30 drops as tincture. -This study alone is not sufficient to document safety of this remedy in pregnancy.
<table>
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<tr>
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<td>prescribed and 50% doctor prescribed.</td>
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<td>- Most supplements were self-prescribed, a doctor had prescribed over one-third of the mineral supplements.</td>
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<tr>
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<td></td>
<td></td>
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<td>- Most supplements were taken for weeks or months, rather than years</td>
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<tr>
<td></td>
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<td>- Prescriber: Multivitamins; 80 self, 3 dr. Water-soluble vitamins; 43 self, 10 dr. Mineral; 16 self, 9 dr. Botanical, micro-organism and bee products; 24 self, 0 dr. Garlic; 11 self, 0 dr. Oils; 8 self, 1 dr. Bran/fibre; 5 self, 0 dr. Other supplements; 5 self, 0 dr. Fat-soluble vitamin and beta-carotene; 1 self, 1 dr. Sports supplements; 5 self, 0 dr</td>
</tr>
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</table>

URTI: Upper respiratory tract infection
2.7 Literature Review conclusions

There are multiple causes of depression. Diet is only one element in a myriad of aetiologies. It is no surprise that there is no definitive cause or link between a single nutrient and all depression. Traumatic life events, brain function and genetics all play a part. An intricate web of causes and effects are involved. Each effect is likely to amplify another and even small effects may combine to cause or exacerbate depression.

Something as subtle as dietary habits may make all the difference to the burden an individual feels from depression, the speed of recovery or the onset itself. As fantastic as it would be to have a “cure”, depression is not that simple. It is a balancing act between all pillars of health and wellbeing be they mental, physical, social or spiritual.

One thing the myriad of conflicting studies tells us is that there is not one treatment for depression and we must be able to look at not just the whole person, but the whole diet as well.

I developed the following mind map (Figure 1) to help explain my conclusion.
Figure 1 Links between depression and diet

Food insecurity, low SES

Inadequate intake of nutrients

Poor diet quality

Other co-morbidities; obesity, CVD, Diabetes, Metabolic Syndrome

Diet low in anti-inflammatories

Decreased psychosocial wellbeing
- ↑fatigue
- ↑body image concerns

Nutrient deficiencies

Inadequate intake of antioxidants

Genetics

↑ Stress response

Depression

Increased nutrient requirements

Affected brain functions

Sleep deprivation etc

Pregnancy and breastfeeding

Other external or psychological causes e.g. trauma, PTSD
3 Objective Statement

Very little research is available on the dietary habits of women with mood disorders in the postpartum period. Given the extensive research on the importance of diet in the prevention and treatment of depression, it is useful to observe the dietary patterns of women with mood disorders in the first year postpartum. I will assess nutrient intake as a starting point, which may lead to further research into dietary patterns. For example, if these women are not meeting the requirements for a certain nutrient, further investigation may provide details of why. For example, what are the reasons and beliefs around nutrient intake and dietary patterns and what are the potential effects this has on both mother and child.

It is likely that there are complex associations between overweight/obesity, nutrient intake diet quality, and mood disorders, especially depression. However, analyzing the direction of causality is difficult because the relationship is likely to be bidirectional. For example, emotional state can either increase or decrease energy intake, and as a consequence nutrient intake as well as decrease physical activity levels resulting in weight gain. Weight gain can then drive an individual further into anxiety or depression through the negative effects on body image. Therefore, a vicious cycle can ensue.

There is also little research on the types of supplements taken by pregnant and postpartum women with mood disorders. Women with depression can be taken off their antidepressant medication during pregnancy as some medications can have teratogenic effects. Whether or not these women switch to herbal or other supplements during this
time has not been studied. With the myriad of information available on the internet it is possible for women to obtain controversial and misleading information about “natural” and untested supplements which may help their mood and be “safe” during pregnancy. The aim of this study is to begin exploring the supplement use patterns in a group of depressed women in the postpartum period. The results from this study will assist in increasing the understanding of dietary habits during the postpartum period for mothers with depression. This will help identify areas where dietary intervention or education is needed. This may also have implications in the clinical setting, when prescribing dietary treatment for a patient with a mood disorder in the post-partum period.

3.1 Aims

1°: To assess nutrient intakes and compliance with nutritional recommendations in postpartum women according to the Nutrient reference values in Australia and New Zealand among lactating and non-lactating postpartum women with depression

2°: To assess the prevalence of dietary supplement use among pregnant and postpartum women with depression

3: To reflect upon the appropriate areas for future research in this area

3.2 Objectives

1. To evaluate the diets of a sample of postpartum women with depression living in Christchurch and determine whether they are meeting the minimum requirements for nutrient intakes.
2. To assess dietary supplement use (type and frequency) among women with depression, during the postpartum period.

3.3 Hypotheses

1. Postpartum women with depression may not be meeting the recommended energy requirements and have an inadequate intake of some nutrients

2. Pregnant and postpartum women with depression will be consuming a range of supplements (herbal, mineral, vitamin, multivitamin and mineral, oil, food and beverage related) throughout pregnancy and the postpartum period.
4 Participants and Methods

4.1 Study design

The study was an observational exploratory study of depressed mothers within 13 months of the postpartum period. Eligible participants were attending the Canterbury District Health Board Mothers and Babies Mental Health Outpatient Service. Data were collected during an individual interview with each participant. The assessment involved a questionnaire, a multiple pass twenty four hour diet recall and measurement of weight and height.

4.2 The Mothers and Babies Mental Health Service

The Mothers and Babies Service (MBS) provide specialist psychiatric treatment for pregnant women and parents with babies up to 12 months of age upon referral. The Outpatient Staff at the Mothers and Babies Service form an interdisciplinary team of Consultant Psychiatrists, Clinical Psychologists, Dietitian, Maori Health Worker, Nurse Specialists, Physiotherapist, Registrar and Social Workers as well as the Clinical Head, Clinical Manager and Service Manager. Mothers attending the Outpatient service with a diagnosis of depression were considered for the study.

Service users are mothers, fathers or primary caregivers who:

- Are over 18 years or will turn 18 in the following six months and generally under 50 years
- (Mother) is between 12 wks pregnant and 1 year postpartum on referral
- The primary psychiatric disorder is not drug/alcohol related
- Reside in the South Island of New Zealand, most typically the geographic location of the Canterbury District
• Have a confirmed psychiatric disorder(s) to a level which cannot be managed by their GP.

Previous auditing of the MBS outpatient service has found 74% of mothers have a unipolar mood disorder and 36% had an anxiety diagnosis [93]. A significant proportion of women (95%) suffer from chronic recurrent psychiatric disorders. Pure ‘postnatal depression’ is uncommon [93, 94].

Typical patients are women from the Canterbury region, who are pregnant or within 1 year postpartum between the ages of 18-50 years with a confirmed psychiatric disorder.

4.3 Participant Selection

Participants were recruited from patients attending the Mothers and Babies Mental Health Outpatient Service. The inclusion criteria were:

1. Women aged 18 years or over
2. ≤ 13 months postpartum
3. A diagnosis of depression with or without a coexisting mental health disorder.

4.4 Depression diagnosis criteria

Study participants were women who were receiving treatment for a current episode of depression confirmed by the treating clinician (usually a psychiatrist/psychiatric registrar) at the initial clinical assessment visit. The clinical assessment consisted of a detailed interview with additional information from the Edinburgh Postnatal Depression Scale (EPDS) (although this was not used to establish the diagnosis rather as a measure of current symptoms). Patients may or may not have had a previous episode of depression. The diagnosis of depression could have been made at any point throughout the
participant’s life and was not limited to postpartum depression. Participants were eligible if they had another concurrent mental illness occurring in the postpartum period, such as anxiety, adjustment disorder or Post Traumatic Stress Disorder (PTSD).

4.5 Participant Recruitment

Initial Recruitment Strategy 1

Each patient attending the Outpatient service is assigned a case manager. The case manager’s role is to oversee the patient’s progress and communicate with the patient and other team members regarding treatment. There were 13 case managers at MBS with access to diagnostic information and therefore, able to identify potential participants for the study.

For our initial recruitment strategy we asked these members of staff to alert their patients to the fact that the study was happening at MBS and may be of interest to them. An overview of the study was presented to the team at a scheduled team meeting; this explained how case managers would play a role in recruitment, explained the inclusion and exclusion criteria and gave information on how to refer to the study.

Case Managers were asked to identify individuals who fitted the inclusion criteria and introduce the study to them at their scheduled appointments. The staff were all given information sheets explaining the study in more detail, to pass on to interested patients. Staff could either book the participant in for an appointment at that time or give them the information to take home and consider before phoning the research candidate at a later date.
The initial recruitment strategy was unproductive (see results section) so an alternative strategy was devised by the research candidate and both supervisors.

**Strategy 2**

The two Psychiatrists at the service examined their patient list to identify women who met the study criteria. The research candidate then met with the consulting psychiatrist on four separate occasions to identify potential participants. These women were phoned to establish if they were interested in participating. Those who were interested were able to discuss the study in more detail and make an appointment for their study assessment. Participants were sent the information sheet and supplement example sheet before their visit. Case Managers were encouraged to continue referring participants as before.

In addition to active recruitment by staff, colour posters were displayed in the waiting room of the service with detachable tabs containing contact details. Posters were also displayed in each staff member’s office, to remind staff and be visible to patients during consultations. Flyers were displayed on the magazine stand in the waiting room to be easily accessible to patients and were given to staff to hand out to any interested party.

**4.5.1 Participant Assessment**

Assessments took place at the MBS Outpatient rooms.

**4.5.2 Informed consent**

Each participant gave written informed consent. Prior to signing informed consent there was an opportunity for discussion and clarification of the study with the research
candidate. Each participant completed the consent process before beginning the
assessment.

4.6 Questionnaire (see Appendix C)

4.6.1 Section 1: Demographic Information

The Demographic Questionnaire was based on the sections A1 (Initial Demographics) and
C4 (Additional socio demographics) of the 2008/09 New Zealand Adult National Nutrition
Survey (NNS) Questionnaire [95]. The Questions were chosen based on their relevance i.e.
Question 1 of the NNS; “Are you male/female?” was irrelevant as only females were in
our study population. The questions were chosen to determine the ages of mother and baby,
ethnicity, education level, income and income support (see Appendix C for further details).

4.6.2 Section 2: Previous Pregnancies and Breastfeeding

Questions in this section covered previous pregnancies (both Gravidity and Parity) and
current breastfeeding habits (see Appendix C). Open ended questions were used regarding
reasons for stopping breastfeeding. Questions were developed by the research candidate
and evaluated by both supervisors before being approved by the ethics committee.

4.6.3 Section 3: Dietary Habits

These Questions were based on section C2 (Nutrition related health questionnaire) of the
2008/09 NNS regarding diabetes, alcohol and special diets [95] (see Appendix C).

4.6.4 Section 4: Dietary Supplement Questions

The Dietary Supplement Questions were based on section C1 (dietary habits) of the
2008/09 NNS [95](see Appendix C). In addition to this section, two further questions
regarding folic acid and Iodine supplement use during pregnancy were added (see Appendix C for further details).

A list of commonly available supplements was compiled based on an internet search and surveillance of local supermarkets, chemists and health food/supplement stores. Following the Questionnaire, each participant was asked to identify any supplements on the list that they had taken in the past 12 months.

### 4.7 Dietary Assessment

The initial Dietary Assessment consisted of a Multiple Pass Twenty-four Hour Recall (24-h recall). Participants were also asked to complete a four day diet record (4DDR) at home after the interview.

#### 4.7.1 Four Day Diet Records

During the first month of recruitment participants were given written instructions for completing the 4DDR to assist them in completing this, prior to their second study visit. After one month of recruitment, as no participants to date had attempted their 4DDR and recruitment numbers were low, it was decided to discontinue collection of the 4DDR.

#### 4.7.2 Twenty-four Hour Recall

The structure of the recall was based on recommendations by Gibson 2005 [96] and used the same four stages as used in the 2008/09 NNS [97]. Participants were asked to use the time frame of Midnight to Midnight, or “from midnight two nights before, until they woke up yesterday and then again from when they woke yesterday until midnight, last night”.
4.7.3 The Recall Process

The Twenty-four hour recall was conducted as follows:

Stage 1: Quick List

The Participant was asked to verbally list everything they had to eat and drink over the 24 hour period.

Stage 2: Detailed description

The interviewer and participant went back over the items collected in the quick list to ascertain the following for each food/ beverage:

- Mealtime/ Time of day consumed
- Brand and product name e.g. bluebird potato chips
- Flavour/type e.g. salt and pepper, reduced sugar, green top milk
- Where the food/ main ingredient was sourced if appropriate e.g. cafe, restaurant, supermarket, home-grown
- Cooking method e.g. boiled, steamed, grilled, shallow or deep fry
- Addition(s) made to the plate before consumption e.g. milk with cereal, condiments; sauces, mayonnaise, salt, pepper, gravy
- Recipe for mixed dishes when known

Stage three: Amount consumed

There were several ways participants were able to estimate the amount of food/ drink they consumed.

- Weight e.g., milliliters, grams, pounds, ounces
- Volume e.g. number of cups, t-spoons, tablespoons
- Food portion aids. A measuring cup, measuring spoons (1/2 t-spoon, 1 t-spoon, 1/2 tbsp and 1 tbsp), a 750ml water bottle were always in view for reference. A 2L jug of rice bubbles was also available for participants to measure out in the cup, or bowl (and then poured into the measuring jug) to get an estimate of portion size.
• Packaging information. The weight was obtained from the product packaging if both the brand name and flavour/type was known. For example, “one bar” or “½ the packet” could be appropriate responses.
• Food photographs. 17 photographs from a diet record booklet were available. Each photograph contained three separate 22cm diameter plates, each with a small, medium or large portion of the food on the plate. Each portion was marked A, B or C and had a corresponding known weight. The foods were chicken, cheese, roast meat, vegetable/meat stew, vegetable pie, spaghetti, pudding, cake, potato, marmite/vegemite, jam, muesli, cauliflower, carrots, beans, rice, salad.

Stage four: Review of recall

The recall was reviewed in chronological order including details and amounts of each food/beverage. Any necessary additions or changes were made.

4.8 Anthropometry

Weight and height were measured in one clinic room at MBS using the same equipment for each participant.

The protocol for measuring body mass and stature, recommended by the International Standards for Anthropometric Assessment (ISAK) 2008 was used [98]. The research candidate completed her level 1 ISAK accreditation in 2011.

A digital Wedderburn weighing scale with 130kg max limit was used to weigh participants.

A Seca wall stadiometer (230cm max) was used to measure participant’s height.

4.9 Data Analysis

4.9.1 Dietary Data

24 hour recall information was entered into the dietary assessment programme Kai-culator (version 1.08s ©2013) developed by the Department of Human Nutrition, Otago University,
New Zealand [99]. The Kai-culator food composition database is based on New Zealand Plant and Food research FOODFiles (2010) for 2700 foods as well as 3000 recipes analysed from the 2008 Adult Nutrition Survey.

Records were entered under the participant’s code. Foods/beverages were entered using 24 hour time to indicate eating occasion. The amount of food consumed was entered as weight (g, Kg) or volume (mL, L) as often as possible. Where this was not appropriate household measures were used and translated to weight/volume by Kai-culator. Where the exact brand or flavour of a particular food item was not available, the same type of food, most similar in nutrient composition was used. For example, brand A Colby cheese would be substituted for brand B Colby cheese, if this was not in the database. If the dietary data were insufficiently detailed the participant was contacted by phone and the information collected to clarify specific details. All dietary information was checked for correctness after data entry was completed. Following this the recall data was entered, a nutrient analysis was performed by Kai-culator, which also checked for missing information. The research candidate checked the output values for each record. If any nutrient value appeared implausibly high or low the 24-hour recall was checked and amendments were made if necessary.

4.9.2 Supplement Data

Supplements taken on the day of recording were included in the day’s overall nutrient intake. When nutrient information of supplements was unavailable in Kai-culator, intake
of macro and micronutrients from supplements was added manually to the participant’s nutrient intake output in excel.

4.10 Statistical Analysis

4.10.1 Sample size calculation

A sample size calculation was not undertaken for this pilot study. Associate Professor Chris Frampton advised that 20-30 participants would be sufficient to inform sample size calculation for a larger future study.

4.10.2 Data entry

All raw demographic and supplement information was entered directly into the Statistical Package for the Social Sciences [SPSS] version 21 (IBM). Dietary data output was analysed in Kai-culator and exported to SPSS for statistical analysis.

4.10.3 Categorising variables and Nutrient Reference Values

Variables were coded by breastfeeding or non-breastfeeding status, to allow separate analysis of Nutrient Reference Values (NRV) for the two groups.

NRVs were used to categorise the level of a nutrient consumed by each group. The NRVs were based on the Ministry of Health’s Nutrient Reference Values for Australia and New Zealand [78]. For non-breastfeeding women the NRVs were based on the
recommendations for women between 19-50yrs and for breastfeeding women the NRVs for lactating women aged 19-50yrs were used.

The group mean for each nutrient was then categorised as falling within a particular NRV category. These are defined below:

**Estimated Average Requirement (EAR):**

The daily nutrient level estimated to meet the needs of half the healthy individuals of a particular life stage and gender group.

**Recommended Daily Intake (RDI):**

The daily nutrient level estimated to meet the nutrient requirements of nearly all (97-98%) of healthy individuals in a particular life stage and gender group.

**Adequate Intake (AI):**

When an RDI cannot be determined the AI is used instead of the EAR. This is the average daily nutrient intake level based on observed or experimentally determined approximations of nutrient intake by group of apparently healthy people that are assumed to be adequate.

**Below Adequate intake/ Estimated Average Requirement:**

When the group mean was less than the level considered to be of adequate intake, based on the EAR or AI.
Upper Level of Intake (UL):

The highest average daily nutrient intake level likely to pose no adverse health effects to almost all individuals in the general population.

Estimated Energy Requirement (EER):

The average dietary energy intake that is predicted to maintain energy balance in a healthy adult of defined age, gender, weight, height and level of physical activity consistent with good health.

4.10.4 Breast feeding questions

Answers to the question “when you stopped breast feeding what was your main reason(s) for stopping”, were grouped into themes based on the response given.

4.10.5 Statistical Methods

Descriptive statistics were completed for all variables, and group means or frequencies as appropriate.
4.10.6 Estimating effect sizes

An independent sample t-test determined variability in means for breastfeeding and non-breastfeeding groups. Cohen’s d was then used to estimate effect size using the formula:

$$\text{Cohen's d} = \frac{\text{Difference of means}}{\text{Square root of pooled variance}}$$
5 Results

5.1 Response Rate  (See Figure 2)

Recruitment strategy 1
In the first month this strategy resulted in a total of three mothers being referred. Two completed the assessment. One woman was readmitted as an inpatient and therefore, did not meet inclusion criteria. In the subsequent 2 months, a further ten women were recruited by MBS staff. Two of these women could not be contacted and one decided not to participate. Over a total of three months, 13 women were recruited using this strategy and 9 of these women participated in the study.

Recruitment strategy 2
Over a 2 month period, a further twenty-two women attending the MBS were identified as eligible for our study. They were contacted by the MBS psychiatrists and the research candidate; ten agreed to participate. Of these, one woman was pregnant and ineligible for participation and two were unable to attend appointments within the time frame for data collection. One further woman contacted the research candidate after seeing a flyer. She was 16 months postpartum and ineligible for the study. This method of recruitment resulted in seven participants completing this study.

For the two strategies combined, thirty-five women were identified as eligible for the study and sixteen women completed the study. All participants, except one who refused to answer a demographic question relating to household income, completed all elements of the study.
(demographic questionnaire, supplement questionnaire, 24hr diet recall, and weight and height measures).

Figure 2 Comparison of Recruitment Strategies

5.2 Appointment rescheduling and Cancellations

Sixteen appointments were rescheduled over the course of the study. The reasons for rescheduling are listed below in Table 5-1 below.
Table 5-1 Reasons for rescheduling

<table>
<thead>
<tr>
<th>Reason</th>
<th>N of times reason used</th>
</tr>
</thead>
<tbody>
<tr>
<td>Did Not Attend- No reason given</td>
<td>3</td>
</tr>
<tr>
<td>Rang to cancel but no reason given</td>
<td>1</td>
</tr>
<tr>
<td>Became too busy on the day</td>
<td>3</td>
</tr>
<tr>
<td>Personal distress</td>
<td>2</td>
</tr>
<tr>
<td>Support person unable to drive participant to service</td>
<td>1</td>
</tr>
<tr>
<td>Unwell child</td>
<td>1</td>
</tr>
<tr>
<td>To have the appointment sync with another appointment</td>
<td>1</td>
</tr>
<tr>
<td>Participant had double booked appointment</td>
<td>1</td>
</tr>
<tr>
<td>Unable to get babysitter</td>
<td>1</td>
</tr>
<tr>
<td>Participant was unwell</td>
<td>1</td>
</tr>
<tr>
<td>On holiday</td>
<td>1</td>
</tr>
</tbody>
</table>

5.3 Sample Characteristics

5.3.1 Maternal age

Range; 18 years to 35 years. The mean age was 28.7 years and the mean time since birth for the group was 7.8 months postpartum.

5.3.2 Ethnicity

Our study population was predominantly New Zealand European 14/16 (87.5%) with 2/16 (12.5%) participants identifying as both Maori and New Zealand European.

5.3.3 Income Support

Of the 16 participants, 10 (62.5%) received some form of income support.

Nine participants (56.3%) received support from Working for Families (e.g. Family Support, In work Payment, Family tax credit etc), three participants (18.8%) received the domestic purposes benefit, two (12.5%) received a disability allowance, two (12.5%) received another government benefit and 1 (6.3%) was receiving the Invalids Benefit.
5.3.4 BMI

BMI ranged from 19.6 to 42.19. The median BMI for the group was 30.12.

Using the WHO international BMI classification for adults, eight participants were classified as obese (three as obese class 1, four as obese class 2 and 1 as obese class 3). Four participants were classified as overweight and four participants were in the normal BMI weight range. None was underweight.

5.3.5 Diagnosis

All participants had MDD; forty-four percent (7/16) had a diagnosis of MDD alone and the remaining 56% had MDD and at least one other diagnosis. Six participants (37.5%) also had a diagnosis of Generalized Anxiety Disorder (GAD). Four participants (25%) had Post Traumatic Stress Disorder (PTSD) and 3 participants (19%) had Panic disorder without Agoraphobia. Alcohol dependency, Anxiety Disorder- not otherwise specified, Body Dysmorphic disorder, Conversion Disorder and Social phobia were also diagnosed in 1 participant each.
Table 5-2 Characteristics of study population
<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Mean ± Std. Deviation or n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age (yrs)</strong></td>
<td>28.72 ± 4.7</td>
</tr>
<tr>
<td><strong>Ethnicity</strong></td>
<td></td>
</tr>
<tr>
<td>NZ European</td>
<td>14 (87.5%)</td>
</tr>
<tr>
<td>NZ Maori and European</td>
<td>2 (12.5%)</td>
</tr>
<tr>
<td><strong>BMI (kg/m²)</strong></td>
<td>30.11 ± 6.8</td>
</tr>
<tr>
<td><strong>Diagnosis (%)</strong></td>
<td></td>
</tr>
<tr>
<td>Major Depressive Disorder</td>
<td>16 (100%)</td>
</tr>
<tr>
<td>Generalized Anxiety Disorder</td>
<td>6 (37.5%)</td>
</tr>
<tr>
<td>Post Traumatic Stress Disorder</td>
<td>4 (25%)</td>
</tr>
<tr>
<td>Panic Disorder without Agoraphobia</td>
<td>3 (18.8%)</td>
</tr>
<tr>
<td>Alcohol dependency</td>
<td>1 (6.3%)</td>
</tr>
<tr>
<td>Anxiety Disorder Not Otherwise Specified</td>
<td>1 (6.3%)</td>
</tr>
<tr>
<td>Body dysmorphic disorder</td>
<td>1 (6.3%)</td>
</tr>
<tr>
<td>Conversion Disorder</td>
<td>1 (6.3%)</td>
</tr>
<tr>
<td>Social phobia</td>
<td>1 (6.3%)</td>
</tr>
<tr>
<td><strong>Medication</strong></td>
<td></td>
</tr>
<tr>
<td>Quetiapine</td>
<td>7 (43.75%)</td>
</tr>
<tr>
<td>Sertraline</td>
<td>5 (31.25%)</td>
</tr>
<tr>
<td>Citalopram</td>
<td>4 (25%)</td>
</tr>
<tr>
<td>Nortriptyline</td>
<td>2 (12.5%)</td>
</tr>
<tr>
<td>Fluoxetine</td>
<td>2 (12.5%)</td>
</tr>
<tr>
<td>Risperidone</td>
<td>1 (6.25%)</td>
</tr>
<tr>
<td>Propranolol</td>
<td>1 (6.25%)</td>
</tr>
<tr>
<td>Ecitalopram</td>
<td>1 (6.25%)</td>
</tr>
<tr>
<td>Venlafaxine</td>
<td>1 (6.25%)</td>
</tr>
<tr>
<td>Mirtazapine</td>
<td>1 (6.25%)</td>
</tr>
<tr>
<td>No Medication</td>
<td>1 (6.25%)</td>
</tr>
<tr>
<td><strong>High School Qualification</strong></td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>3 (18.8%)</td>
</tr>
<tr>
<td>NCEA Level 1 or equivalent</td>
<td>3 (18.8%)</td>
</tr>
<tr>
<td>NCEA Level 2 or equivalent</td>
<td>6 (37.5%)</td>
</tr>
<tr>
<td>NCEA Level 3 or equivalent</td>
<td>3 (18.8%)</td>
</tr>
<tr>
<td>Overseas education</td>
<td>1 (6.3%)</td>
</tr>
<tr>
<td><strong>Higher Education Qualification</strong></td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>5 (31.3%)</td>
</tr>
<tr>
<td>Trade or Certificate</td>
<td>11 (68.8%)</td>
</tr>
<tr>
<td><strong>Individual Income</strong></td>
<td>$12610 ± $12752</td>
</tr>
<tr>
<td><strong>Household Income</strong></td>
<td>$56617 ± $25609</td>
</tr>
<tr>
<td><strong>Receiving Income support</strong></td>
<td>10 (62.5%)</td>
</tr>
<tr>
<td>Characteristic</td>
<td>Mean ± Std. Deviation or n (%)</td>
</tr>
<tr>
<td>----------------------------------------</td>
<td>--------------------------------</td>
</tr>
<tr>
<td>Infant Age (months)</td>
<td>7.84 ± 3.85</td>
</tr>
<tr>
<td>Gestational age (wks)</td>
<td>39.09 ± 2.74</td>
</tr>
<tr>
<td>Gravidity</td>
<td>2.56 ± 1.21</td>
</tr>
<tr>
<td>Parity</td>
<td>1.81 ± 0.75</td>
</tr>
<tr>
<td>Breastfeeding</td>
<td></td>
</tr>
<tr>
<td>Any Breast feeding attempt since birth</td>
<td>16 (100%)</td>
</tr>
<tr>
<td>Currently breastfeeding (%)</td>
<td>7 (43.75%)</td>
</tr>
<tr>
<td>Duration breastfeeding before stopped</td>
<td>9.67 weeks</td>
</tr>
<tr>
<td>Special diet (%)</td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>13 (81.3%)</td>
</tr>
<tr>
<td>Vegetarian</td>
<td>1 (6.3%)</td>
</tr>
<tr>
<td>Low Gluten</td>
<td>1 (6.3%)</td>
</tr>
<tr>
<td>Low FODMAP</td>
<td>1 (6.3%)</td>
</tr>
<tr>
<td>Diabetes History</td>
<td></td>
</tr>
<tr>
<td>No Diabetes</td>
<td>13 (81.3%)</td>
</tr>
<tr>
<td>Gestational Diabetes</td>
<td>2 (12.5%)</td>
</tr>
<tr>
<td>Pre-diabetes and gestational diabetes</td>
<td>1 (6.3%)</td>
</tr>
<tr>
<td>Alcohol consumption</td>
<td>Drinks per occasion</td>
</tr>
</tbody>
</table>

### 5.3.6 Demographic data by breastfeeding status

Significantly more breastfeeding women had a current diagnosis of GAD than non-breastfeeding women (p = 0.011). Significantly more non-breastfeeding women were taking citalopram than breastfeeding women (p = 0.035). No other demographic variables or supplements showed significant differences by breastfeeding status. Duration of breastfeeding, alcohol consumption and gravidity all had large but not significant effect sizes (1.21, 0.82 and 0.88 respectively).

### 5.4 Breastfeeding

All study participants had attempted to breastfeed their child. Seven participants (43.8%) were breastfeeding at the time of the study. Of the 9 (56.2%) who concluded breastfeeding prior to the study, the shortest duration of breastfeeding was 3 days, the
longest 6 months and the mean duration was 2.41 months (±2.01 months). In those seven still breastfeeding at the time of the study the average duration of breastfeeding was 6.57 months (±4.69 months).

The main reasons women decided to stop breast feeding are in Table 5-3 below. Some women had more than one explanation for discontinuing breastfeeding.

Table 5-3 Themes for stopping breastfeeding

<table>
<thead>
<tr>
<th>Reason for stopping</th>
<th>n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Insufficient milk supply</td>
<td>8 (88.9%)</td>
</tr>
<tr>
<td>2. Switched to formula feeding as their baby was “hungry” or “losing weight”</td>
<td>2 (22.2%)</td>
</tr>
<tr>
<td>3. Mother was expressing breast milk but stopped as it was “too hard” or they found expressing a “hassle”</td>
<td>2 (22.2%)</td>
</tr>
<tr>
<td>4. Mother had a history of breast cancer with mastectomy</td>
<td>1 (11.1%)</td>
</tr>
<tr>
<td>5. Mother was “too busy” to breast feed</td>
<td>1 (11.1%)</td>
</tr>
<tr>
<td>6. Baby had a tongue-tie</td>
<td>1 (11.1%)</td>
</tr>
<tr>
<td>7. Baby had colic/tummy bug which improved with formula feeding</td>
<td>1 (11.1%)</td>
</tr>
</tbody>
</table>

Reason 1. Any response in which the mother believed she did not have a sufficient milk supply were grouped together. This included such responses as “I ran out of milk/ dried up” or “I was not producing enough”.

Reason 2. Responses where the mother believed the baby needed more than she was producing for its growth were grouped together. In these responses mothers described their baby as “hungry” or “losing weight” so they switched to formula.
Reason 3. Some mothers chose to express breast-milk to fit with their busy schedule, however, found expressing difficult or time consuming.

Reasons 4-7 are self explanatory.

5.5 Supplementation

A total of 88 supplements grouped into thirty-four different types, were consumed by the participants over a 12 month period (or before 12 months including iodine and folic acid taken at the beginning of pregnancy). For example, Elevit and Blackmore pregnancy and Breastfeeding Gold were grouped into multivitamins for pregnancy/breastfeeding.

Fourteen participants (87.5%) took folic acid (75%) or folic acid containing multivitamins (12.5%) surrounding and/or during pregnancy. Thirteen participants (81%) took iodine (69%) or an iodine containing multivitamin and mineral supplement (12.5%) in pregnancy. Both iodine and folic acid supplements were most commonly recommended to participants by either a doctor or midwife. Iron was consumed in 10/16 participants and multivitamins marketed to pregnant and breastfeeding women were consumed by 8/16 participants.

The number of supplements consumed per participant ranged from two to 15 supplements over the previous 12 months (or before including iodine and folic acid).

5.5.1 Supplements taken during pregnancy

Six participants (37.5%) reported having electrolytes during pregnancy either in the form of sports drinks for morning sickness or as replacement fluids whilst in hospital or prescribed by the After Hours service for hyperemesis. Complan, Vitaplan Ensure,
Fortisip and Up and Go were used by one participant (6.25%) each as a supplement drink during periods of heightened morning sickness.

Kiwicrush was used by 4 women (25%) during pregnancy for constipation.

Vitamin C and Fish Oil Capsules were consumed by 3 participants (18.75%) each.

Iron and B vitamin complex tablets and everesences were also taken by 3 participants (18.75%).

Both Arnica drops and rescue remedy were used for pain relief and healing in 2/16 participants (12.5%).

5.5.2 Postpartum supplement use

Two women had used Fenugreek as a supplement to aid in milk production in the previous 13 months.

The following were consumed by 1 participant each: general adults multivitamin, Immunofort, herbal Iron, calcium, magnesium, Concentrated Mineral Drops, whey protein, weight loss supplement, evening primrose oil, brewers yeast, flaxseed, spirulina, echinacea, rescue remedy, bee pollen, linseed and goji berries.
Figure 3 Incidence of Supplement use by women with MDD during pregnancy and up to 12 months postpartum

5.5.3 Folic Acid use

Fourteen of the sixteen participants (87.5%) took folic acid surrounding and/or during pregnancy. Twelve participants (75%) were taking folic acid and two participants (12.5%) were taking folic acid containing multivitamin and mineral supplements. In those who consumed folic acid, the shortest course of supplementation was 2 weeks during pregnancy. The longest period of supplementation was three years; starting before
pregnancy and continuing into the postpartum period. Folic acid supplements were advised or prescribed by either a doctor (six participants [46%]) or midwife (six participants [46%]) or for one participant (6.25%), her pharmacist. Of the 12 participants taking folic acid, one had folic acid prescribed by both a doctor and a midwife, totaling 13 recommendations.

5.5.4 Iodine Supplementation

Iodine Supplementation was taken for a duration of 2 months to 2 years in the 13/16 participants (81%) who took Iodine as a single nutrient supplement or Iodine containing supplements (multivitamin and mineral) for pregnancy. Prescriptions/recommendations for iodine supplements were made by midwives (6) or doctors (5).

5.5.5 Pregnancy/breastfeeding specific multivitamins and minerals

Nine participants (56.3%) were consuming pregnancy/breastfeeding specific multivitamins. One participant (6.25%) took 2 different brands both recommended from the same person, resulting in 10 supplements taken for the group and 9 recommendations/prescriptions. Most of the recommendations (5/9) came from doctors (55.6% of recommendations).

5.5.6 Iron Supplementation

Ten participants (62.5%) took an iron specific supplement prescribed by, a doctor (5 prescriptions), midwife (4 prescriptions) or dietitian (1 prescription). Two participants
(12.5%) took an iron plus B vitamin complex (iron, folic acid, B12 and vitamin C), including ‘Iron Fizz’ (self initiated) or Thompsons Organic Iron (recommended by midwife). One participant (6.25%) was taking a herbal mix, made and recommended by her naturopath.

5.5.7 Other Supplements
Pregnant women in this study obtained advice about supplements for pregnancy from a range of sources. The most common were midwife and doctor. However certain supplements were taken on the advice of a dietitian, nurse, pharmacist, lactation consultant, naturopath, friend, family member, online breastfeeding support group or from their own research or prior knowledge.
Table 5-4 Total number of supplements arranged by prescriber/ adviser and type
<table>
<thead>
<tr>
<th>Supplement Type</th>
<th>Prescriber/ Advisor</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Midwife</td>
</tr>
<tr>
<td>Folic Acid</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>75%</td>
</tr>
<tr>
<td>Iodine</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>68.8%</td>
</tr>
<tr>
<td>Iron</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>62.5%</td>
</tr>
<tr>
<td>Multivitamin for pregnancy/breastfeeding</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>62.5%</td>
</tr>
<tr>
<td>Electrolytes</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>37.5%</td>
</tr>
<tr>
<td>Kiwi Crush</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>25%</td>
</tr>
<tr>
<td>Vitamin C</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>18.8%</td>
</tr>
<tr>
<td>Fish Oil</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>18.8%</td>
</tr>
<tr>
<td>Iron and B vitamin complex</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>12.5%</td>
</tr>
<tr>
<td>Fenugreek</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>12.5%</td>
</tr>
<tr>
<td>Vitaplan/ Complan/ Up and Go</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>18.8%</td>
</tr>
<tr>
<td>Arnica</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>12.5%</td>
</tr>
<tr>
<td>General Multivitamin</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>12.5%</td>
</tr>
<tr>
<td>Fortisip/ Ensure</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>12.5%</td>
</tr>
<tr>
<td>Flaxseed/ Linseed</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>12.5%</td>
</tr>
<tr>
<td>Supplement Type</td>
<td>Midwife</td>
</tr>
<tr>
<td>------------------------</td>
<td>---------</td>
</tr>
<tr>
<td>Herbal Iron</td>
<td>0</td>
</tr>
<tr>
<td>Magnesium</td>
<td>1</td>
</tr>
<tr>
<td>Calcium</td>
<td>0</td>
</tr>
<tr>
<td>Concentrated Mineral Drops</td>
<td>0</td>
</tr>
<tr>
<td>Whey protein</td>
<td>0</td>
</tr>
<tr>
<td>Evening primrose oil</td>
<td>1</td>
</tr>
<tr>
<td>Brewers Yeast</td>
<td>0</td>
</tr>
<tr>
<td>Spirulina</td>
<td>0</td>
</tr>
<tr>
<td>Echinacea</td>
<td>0</td>
</tr>
<tr>
<td>Weight loss drink</td>
<td>0</td>
</tr>
<tr>
<td>Berroca</td>
<td>0</td>
</tr>
<tr>
<td>Bee pollen</td>
<td>0</td>
</tr>
<tr>
<td>Goji Berries</td>
<td>0</td>
</tr>
<tr>
<td>Rescue Remedy</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total n (%)</strong></td>
<td><strong>25 (28.1%)</strong></td>
</tr>
</tbody>
</table>
* 1 supplement recommended by 2 people

5.5.8 Prescriber/Advisor

Of the prescriptions/recommendations 28% came from midwives, 27% from doctors and 22.5% were self initiated. This accounted for 77.5% of prescriptions/recommendations.
Table 5-5 Stage of pregnancy journey when supplements taken
<table>
<thead>
<tr>
<th>Supplement Type</th>
<th>N (%) taking supplement during time period</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Prior to pregnancy</td>
</tr>
<tr>
<td>Folic Acid</td>
<td>2</td>
</tr>
<tr>
<td>Iodine</td>
<td>8</td>
</tr>
<tr>
<td>Iron</td>
<td>7</td>
</tr>
<tr>
<td>Multivitamin for pregnancy/breastfeeding</td>
<td>1</td>
</tr>
<tr>
<td>Electrolytes</td>
<td></td>
</tr>
<tr>
<td>Kiwi Crush</td>
<td></td>
</tr>
<tr>
<td>Vitamin C</td>
<td></td>
</tr>
<tr>
<td>Fish Oil</td>
<td></td>
</tr>
<tr>
<td>Iron and B vitamin complex</td>
<td></td>
</tr>
<tr>
<td>Fenugreek</td>
<td></td>
</tr>
<tr>
<td>Vitaplan/ Complan/ Up and Go</td>
<td></td>
</tr>
<tr>
<td>Arnica</td>
<td></td>
</tr>
<tr>
<td>General Multivitamin</td>
<td>1</td>
</tr>
<tr>
<td>Fortisip/ Ensure</td>
<td>2</td>
</tr>
<tr>
<td>Herbal Iron</td>
<td></td>
</tr>
<tr>
<td>Magnesium</td>
<td></td>
</tr>
<tr>
<td>Calcium</td>
<td></td>
</tr>
<tr>
<td>Concentrated Mineral Drops</td>
<td>1</td>
</tr>
<tr>
<td>Whey protein</td>
<td>1</td>
</tr>
<tr>
<td>Evening primrose oil</td>
<td>1</td>
</tr>
<tr>
<td>Brewers Yeast</td>
<td>1</td>
</tr>
<tr>
<td>Flaxseed/ Linseed</td>
<td>2</td>
</tr>
<tr>
<td>Spirulina</td>
<td>1</td>
</tr>
<tr>
<td>Echinacea</td>
<td>1</td>
</tr>
<tr>
<td>Weight loss drink</td>
<td>1</td>
</tr>
<tr>
<td>Berroca</td>
<td>1</td>
</tr>
<tr>
<td>Bee pollen</td>
<td>1</td>
</tr>
<tr>
<td>Goji Berries</td>
<td>1</td>
</tr>
<tr>
<td>Rescue Remedy</td>
<td>1</td>
</tr>
</tbody>
</table>
### Supplement Type

<table>
<thead>
<tr>
<th></th>
<th>Prior to pregnancy</th>
<th>Prior to and during pregnancy</th>
<th>During pregnancy only</th>
<th>During pregnancy and post-partum</th>
<th>Post-partum only</th>
<th>Pre-pregnancy, pregnancy and post-partum</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total n</strong></td>
<td>1</td>
<td>2</td>
<td>45</td>
<td>21</td>
<td>15</td>
<td>4</td>
</tr>
</tbody>
</table>

5.5.9 **Number of supplements taken by stage of pregnancy**

From the total of 88 supplements, 7 supplements (8%) were taken prior to pregnancy, 72 (81.8%) during pregnancy, and 40 (45.45%) during the postpartum period.

100% of participants (n=16) were taking at least one supplement during pregnancy. 50% (8 participants) were taking at least one supplement in the postpartum period; four of which were breastfeeding and four who were not breastfeeding.

34.72% of supplements taken during pregnancy were continued into the postpartum period. The mean intake was 4.5 supplements per participant during pregnancy and 2.5 in the postpartum period.
Figure 4 Venn diagram showing when supplements were taken

5.5.10 Folic Acid supplementation by stage of pregnancy

Three participants (18.75%) were taking folic acid prior to becoming pregnant. One participant (6.25%) began taking folic acid prior to pregnancy, one participant (6.25%) was taking a folic acid containing multivitamin before pregnancy and one participant was taking both (6.25%). Ten participants (62.5%) began taking folic acid or a folic acid containing supplement during pregnancy and two participants (12.5%) never took folic acid. Table 5-6 below shows the number of participants taking folic acid as recommended by the Ministry of health guidelines [100].

Table 5-6 Number of participants meeting New Zealand guidelines for folic acid supplementation in pregnancy

<table>
<thead>
<tr>
<th>Folic acid supplementation</th>
<th>n (%)</th>
</tr>
</thead>
</table>

95
Taken as recommended (1 month prior to pregnancy until at least 3 months post conception) at 400μg/d or more | 3 (18.75%)
---|---
Started within first 3 months of pregnancy for at least 3 months duration | 7 (43.75%)
Started after 3 months of pregnancy for at least 3 months duration | 2 (12.5%)
Taken intermittently throughout pregnancy for <3 months total | 2 (12.5%)
Not taking any folic acid | 2(12.5%)

5.5.11 Iodine supplementation by stage of pregnancy

Six participants (37.5%) were taking iodine, two participants (12.5%) were taking iodine containing supplements and five participants (31.25%) were taking both; two (12.5%) began supplementation prior to pregnancy and 11 participants (68.75%) began supplementation during pregnancy with three participants (18.8%) continuing supplementation until the conclusion of breast feeding. Table 5-7 below shows the ways in which iodine was taken, including the New Zealand guidelines for iodine supplementation during pregnancy and breastfeeding.

Table 5-7 Number meeting New Zealand guidelines for iodine supplementation during pregnancy and lactation

<table>
<thead>
<tr>
<th>Iodine supplementation</th>
<th>n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Taken as recommended (From conception until conclusion of breastfeeding at 150μg/d or more)</td>
<td>2 (12.5%)</td>
</tr>
<tr>
<td>Started within first 3 months of pregnancy until conclusion of breastfeeding</td>
<td>1 (6.25%)</td>
</tr>
<tr>
<td>Started within first 3 months of pregnancy and continued for part of breastfeeding</td>
<td>4 (25%)</td>
</tr>
<tr>
<td>Taken during pregnancy only</td>
<td>6 (37.5%)</td>
</tr>
<tr>
<td>Not taking Iodine supplement</td>
<td>3 (18.75%)</td>
</tr>
</tbody>
</table>
5.5.12 Pregnancy/breastfeeding specific multivitamin and mineral supplementation by stage of pregnancy

Of the ten pregnancy and breastfeeding specific supplements taken, 2 (12.5%) began supplementation prior to pregnancy, 7 (43.75%) began supplementation during pregnancy, with 3 of these continuing into the postpartum period and 1 (6.25%) was taken postpartum only.

5.5.13 Iron supplementation by stage of pregnancy

All participants taking iron supplements, began iron supplementation during pregnancy. Seven supplements were taken during pregnancy only and three during pregnancy and postpartum. Of the iron and B vitamin complex supplements, both were taken during pregnancy only. The herbal iron was taken during pregnancy and postpartum.

5.5.14 Other Supplements taken by stage of pregnancy

Electrolytes, kiwi crush and Supplement drinks (Ensure/ Fortisip) were taken during pregnancy for hyperemesis or constipation, not prior to pregnancy or in the postpartum period. One participant (6.25%) consumed Echinacea during pregnancy and post-partum and one participant (6.25%) consumed evening primrose oil during pregnancy and post-partum

5.5.15 Supplement use by breastfeeding status

When analysed by breastfeeding status, there were no significant differences in group means for the number of supplements taken overall or by stage of pregnancy. The mean (±SD) of supplements consumed per participant for all stages of pregnancy was 6(±3.16) in the breastfeeding group and 5 (±4.39) in the non-breastfeeding group
During the postpartum period the mean (±SD) of supplements taken by breastfeeding women was 3.29 (±3.59) and by non-breastfeeding women, 1.89 (±3.30). Effect sizes were small and not significant (0.38 for pregnancy (p=.464) and 0.41 for postpartum (p=.432)).

Table 5-8 Mean number of supplements taken per participant by stage of pregnancy and breastfeeding status

<table>
<thead>
<tr>
<th></th>
<th>Mean (±SD) n of supplements taken during pregnancy</th>
<th>Mean (±SD) n of supplements taken postpartum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-breastfeeding n= 9</td>
<td>4.11 (±2.47)</td>
<td>1.89 (±3.30)</td>
</tr>
<tr>
<td>Breastfeeding n=7</td>
<td>5.0 (±2.16)</td>
<td>3.29 (±3.59)</td>
</tr>
<tr>
<td>Combined n=16</td>
<td>4.5 (±2.31)</td>
<td>2.5 (±3.39)</td>
</tr>
</tbody>
</table>
Table 5-8 Supplement intake by category

<table>
<thead>
<tr>
<th>Category Name</th>
<th>Supplements included</th>
<th>n of supplements taken (% of total supplements)</th>
<th>n (%) of participants consuming supplement type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single mineral</td>
<td>Iodine, iron, magnesium, calcium</td>
<td>23 (26.1%)</td>
<td>14 (87.5%)</td>
</tr>
<tr>
<td>Food or beverage</td>
<td>Electrolytes, Kiwi Crush, Vitaplan/Complan, Fortisip, Ensure, whey protein, brewers yeast, weight loss drink, goji berries</td>
<td>19 (21.6%)</td>
<td>10 (62.5%)</td>
</tr>
<tr>
<td>Multivitamin and Mineral combinations</td>
<td>Pregnancy and/or breastfeeding specific multivitamins, General multivitamins, Iron and B vitamin complexes, Concentrated Mineral Drops, Berroca</td>
<td>16 (18.2%)</td>
<td>12 (75%)</td>
</tr>
<tr>
<td>Single vitamin</td>
<td>Folic Acid, Vitamin C</td>
<td>15 (17 %)</td>
<td>12 (75%)</td>
</tr>
<tr>
<td>Oils and Drops</td>
<td>Fish oil, arnica drops, evening primrose oil, bee pollen, rescue remedy drops</td>
<td>8 (9.1%)</td>
<td>4 (25%)</td>
</tr>
<tr>
<td>Herbal</td>
<td>Fenugreek, herbal iron mix, flaxseed/ linseed, spirulina, echinacea,</td>
<td>7 (7.95%)</td>
<td>3 (18.75%)</td>
</tr>
</tbody>
</table>

Of the 88 supplements consumed, 23 (26.1%) were single mineral supplements. Nineteen (21.6%) were in the food or beverage category, 16 (18.2%) were multivitamin and minerals, 15 were single vitamin supplements (17%), eight (9.1%) were oils or drops and seven (7.95%) were in the herbal supplement category.

Fourteen participants (87.5%) were consuming at least one single mineral supplement, ten participants (62.5%) a food or beverage, 12 participants (75%) were consuming a single vitamin supplement and multivitamin and mineral supplements, four participants (25%) took a oil based supplement and 3(18.75%) were taking herbal supplements.
Two participants (12.5%) consumed at least one supplement from each category in the previous 12 months.

5.6 Dietary Analysis

None of the participants (n=3) who were asked to complete a 4DDR managed to do so. All 16 participants completed the 24 hour recall. Dietary analysis is based on 24 hour recall results.

Seven of the 16 participants (43.8%) were breastfeeding at the time of data collection. Breastfeeding and non-breastfeeding women were analysed separately due to differences in Nutrient Reference Values (NRV), such as Adequate Intake (AI).
Table 5-10 Mean Nutrient Intake by group
<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Non-Breastfeeding Mean (±SD)</th>
<th>Breastfeeding Mean (±SD)</th>
<th>Mean difference</th>
<th>95% CI of the difference</th>
<th>p-value</th>
<th>Effect Size (Cohen’s d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water (g)</td>
<td>2992.23 (±1333.88)</td>
<td>3836.86 (±2058.28)</td>
<td>844.62</td>
<td>-974.44 – 2663.69</td>
<td>.336</td>
<td>0.50</td>
</tr>
<tr>
<td>Energy (kJ)</td>
<td>8189.22 (±4663.14)</td>
<td>12299.57 (±3584.74)</td>
<td>4110.35</td>
<td>-466.85 – 8687.55</td>
<td>.075</td>
<td>0.97</td>
</tr>
<tr>
<td>Protein (g)</td>
<td>68.28 (±43.66)</td>
<td>113.14 (±40.48)</td>
<td>44.87</td>
<td>-.88 – 90.61</td>
<td>.054</td>
<td>1.06</td>
</tr>
<tr>
<td>Fat (g)</td>
<td>84.52 (±40.71)</td>
<td>129.97 (±42.44)</td>
<td>45.45</td>
<td>.63 – 90.27</td>
<td>.047</td>
<td>1.10</td>
</tr>
<tr>
<td>MUFA (g)</td>
<td>30.87 (±13.40)</td>
<td>47.65 (±16.58)</td>
<td>16.78</td>
<td>.73 – 32.83</td>
<td>.042</td>
<td>1.13</td>
</tr>
<tr>
<td>PUFA (g)</td>
<td>13.43 (±7.04)</td>
<td>16.29 (±5.55)</td>
<td>2.86</td>
<td>-4.11 – 9.83</td>
<td>.394</td>
<td>0.44</td>
</tr>
<tr>
<td>Linolenic Acid (g)</td>
<td>0.18 (±0.35)</td>
<td>0.31 (±0.31)</td>
<td>0.13</td>
<td>-.23 – .49</td>
<td>.459</td>
<td>0.38</td>
</tr>
<tr>
<td>Linoleic Acid (g)</td>
<td>1.81 (±2.25)</td>
<td>2.17 (±1.94)</td>
<td>0.35</td>
<td>-1.94 – 2.65</td>
<td>.746</td>
<td>0.17</td>
</tr>
<tr>
<td>Total omega 3 (g)</td>
<td>0.40 (±0.69)</td>
<td>1.27 (±0.85)</td>
<td>0.87</td>
<td>.04 – 1.70</td>
<td>.041</td>
<td>1.14</td>
</tr>
<tr>
<td>Sodium (mg)</td>
<td>2372.06 (±2226.48)</td>
<td>3697.03 (±2608.81)</td>
<td>1324.97</td>
<td>-1266.76 – 3916.70</td>
<td>.291</td>
<td>0.55</td>
</tr>
<tr>
<td>Fibre (g)</td>
<td>19.75 (±19.21)</td>
<td>31.29 (±7.59)</td>
<td>11.55</td>
<td>-5.05 – 28.14</td>
<td>.158</td>
<td>0.75</td>
</tr>
<tr>
<td>Calcium (mg)</td>
<td>746.17 (±538.41)</td>
<td>1659.87 (±869.88)</td>
<td>913.70</td>
<td>157.13 – 1670.28</td>
<td>.021</td>
<td>1.31</td>
</tr>
<tr>
<td>Copper (mg)</td>
<td>1.15 (±0.92)</td>
<td>2.15 (±0.63)</td>
<td>1.00</td>
<td>.12 – 1.87</td>
<td>.029</td>
<td>1.23</td>
</tr>
<tr>
<td>Iodine (µg)</td>
<td>39.36 (±27.40)</td>
<td>159.02 (±149.00)</td>
<td>119.66</td>
<td>-18.27 – 257.58</td>
<td>.078</td>
<td>1.20</td>
</tr>
<tr>
<td>Iron (mg)</td>
<td>9.54 (±7.41)</td>
<td>27.13 (±27.54)</td>
<td>17.60</td>
<td>-2.81 – 38.00</td>
<td>.086</td>
<td>0.93</td>
</tr>
<tr>
<td>Magnesium (mg)</td>
<td>277.04 (±173.69)</td>
<td>519.43 (±173.05)</td>
<td>242.38</td>
<td>54.94 – 429.83</td>
<td>.015</td>
<td>1.40</td>
</tr>
<tr>
<td>Manganese (µg)</td>
<td>2815.42 (±2494.22)</td>
<td>6201.10 (±1625.64)</td>
<td>3385.68</td>
<td>1045.52 – 5725.84</td>
<td>.008</td>
<td>1.56</td>
</tr>
<tr>
<td>Phosphorous (mg)</td>
<td>1161.91 (±822.38)</td>
<td>2202.93 (±852.216)</td>
<td>1041.02</td>
<td>138.16 – 1943.87</td>
<td>.027</td>
<td>1.25</td>
</tr>
<tr>
<td>Nutrient</td>
<td>Non-Breastfeeding Mean (±SD)</td>
<td>Breastfeeding Mean (±SD)</td>
<td>Mean difference</td>
<td>95% CI of the difference</td>
<td>p-value</td>
<td>Effect Size (Cohen’s d)</td>
</tr>
<tr>
<td>---------------</td>
<td>-----------------------------</td>
<td>--------------------------</td>
<td>-----------------</td>
<td>--------------------------</td>
<td>---------</td>
<td>------------------------</td>
</tr>
<tr>
<td>Potassium (mg)</td>
<td>2122.33 (±1107.89)</td>
<td>4391.80 (±1105.53)</td>
<td>2269.47</td>
<td>1073.07 – 3465.86</td>
<td>.001</td>
<td>2.05</td>
</tr>
<tr>
<td>Selenium (µg)</td>
<td>40.01 (±23.89)</td>
<td>64.28 (±18.84)</td>
<td>24.27</td>
<td>.64 – 47.91</td>
<td>.045</td>
<td>1.11</td>
</tr>
<tr>
<td>Zinc (mg)</td>
<td>8.91 (±7.80)</td>
<td>36.99 (±56.30)</td>
<td>28.08</td>
<td>-24.01 – 80.17</td>
<td>.237</td>
<td>0.75</td>
</tr>
<tr>
<td>Vitamin A (µg)</td>
<td>698.06 (±486.94)</td>
<td>1309.54 (±545.53)</td>
<td>611.49</td>
<td>57.14 – 1165.84</td>
<td>.033</td>
<td>1.19</td>
</tr>
<tr>
<td>Thiamin (mg)</td>
<td>.91 (±1.00)</td>
<td>2.20 (±1.16)</td>
<td>1.29</td>
<td>.13 – 2.45</td>
<td>.032</td>
<td>1.20</td>
</tr>
<tr>
<td>Riboflavin (mg)</td>
<td>1.36 (±1.05)</td>
<td>3.35 (±1.86)</td>
<td>1.99</td>
<td>411.97 – 3.57</td>
<td>.017</td>
<td>1.36</td>
</tr>
<tr>
<td>Niacin (mg)</td>
<td>26.13 (±17.04)</td>
<td>46.92 (±14.12)</td>
<td>20.79</td>
<td>3.65 – 37.93</td>
<td>.021</td>
<td>1.31</td>
</tr>
<tr>
<td>Vitamin B6 (mg)</td>
<td>1.33 (±.97)</td>
<td>2.87 (±1.70)</td>
<td>1.55</td>
<td>101.97 – 2.99</td>
<td>.037</td>
<td>1.16</td>
</tr>
<tr>
<td>Folate (µg)</td>
<td>293.08 (±279.82)</td>
<td>661.02 (±702.68)</td>
<td>360.28</td>
<td>-297.85 – 1018.41</td>
<td>.240</td>
<td>0.71</td>
</tr>
<tr>
<td>Vitamin B12(µg)</td>
<td>5.62 (±5.57)</td>
<td>5.34 (±3.48)</td>
<td>-.28</td>
<td>-5.45 – 4.90</td>
<td>.911</td>
<td>-0.057</td>
</tr>
<tr>
<td>Vitamin C (mg)</td>
<td>177.07 (±276.25)</td>
<td>193.72 (±170.16)</td>
<td>16.66</td>
<td>-239.16 – 272.48</td>
<td>.891</td>
<td>0.07</td>
</tr>
<tr>
<td>Vitamin D (µg)</td>
<td>4.65 (±8.63)</td>
<td>17.31 (±19.51)</td>
<td>12.66</td>
<td>-2.84 – 28.16</td>
<td>.102</td>
<td>0.88</td>
</tr>
<tr>
<td>Vitamin E (mg)</td>
<td>12.34 (±6.17)</td>
<td>15.45 (±8.57)</td>
<td>3.12</td>
<td>-4.76 – 11.01</td>
<td>.410</td>
<td>0.43</td>
</tr>
</tbody>
</table>

SD: Standard deviation, CI: Confidence Interval, MUFA: Mono-unsaturated fatty acids, PUFA: Polyunsaturated Fatty Acids

5.6.1 Dietary Intake of Breastfeeding participants

5.6.1.1 Estimated Energy Requirements (EER)

The average EER for breastfeeding women was 12282kJ (±1339kJ). The Average Energy Intake for breastfeeding women was 12300kJ (±3585kJ).

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5.6.1.2 *Means below the Adequate Intake (AI)*

Breastfeeding women were below the recommended Adequate Intake (AI) consistent with the amount needed to meet requirements of 50% of breastfeeding New Zealand women for iodine and selenium.

5.6.1.3 *Means which exceeded the Upper Level (UL)*

The group means for breastfeeding participants which were above the level considered consistent with good health for the majority of the breastfeeding population of New Zealand were sodium and niacin.

The mean group intake of all other nutrients fell within the recommended AI or EAR range.

5.6.2 *Dietary intake  Non-breastfeeding participants*

5.6.2.1 *Estimated Energy Requirement (EER)*

The group average EER for non-breastfeeding women was 9749kJ (±811kJ). The Average Energy Intake for non-breastfeeding women was 8189kJ (± 4663kJ).

5.6.2.2 *Mean intake below the Adequate Intake (AI)*

The group mean for fibre, Copper, Iodine, Manganese, Potassium, Selenium and Vitamin D were all below the AI.
5.6.2.3 Mean Intakes below the Estimated Average Requirements (EAR)

Where an AI could not be established for a nutrient the EAR for non-breastfeeding women was used. The mean group intake for Calcium and Folate in non-breastfeeding women was below the EAR.

5.6.2.4 Mean intake above Upper Level (UL)

The group mean was above the level consistent with good health for Sodium intake.

The mean group intake of all other nutrients fell within the recommended AI or EAR range.

5.6.3 Effect Sizes of group means

5.6.3.1 Macronutrients

There were significantly different mean intakes for protein, fat, mono-unsaturated fatty acids, total omega-3 and lactose between the breastfeeding and non-breastfeeding groups.

5.6.3.2 Micronutrients

The mean intake of the breastfeeding and non-breastfeeding groups differed significantly for calcium, copper, magnesium, manganese, phosphorous, potassium, selenium, vitamin A, thiamin, riboflavin, niacin and Vitamin B6. All of these had a Cohen’s d >0.8. Fibre, iodine, iron, zinc, folate and vitamin D all had large but not significant effect sizes.
### Table 5-11 Mean Nutrient Intake by NRV category

<table>
<thead>
<tr>
<th>Category</th>
<th>Breastfeeding</th>
<th>Non-Breastfeeding</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper Level</td>
<td>Sodium</td>
<td>Sodium</td>
</tr>
<tr>
<td></td>
<td>Niacin</td>
<td></td>
</tr>
<tr>
<td><strong>Recommended Dietary Intake</strong></td>
<td>PROTEIN</td>
<td>PROTEIN</td>
</tr>
<tr>
<td></td>
<td>PHOSPHOROUS</td>
<td>PHOSPHOROUS</td>
</tr>
<tr>
<td></td>
<td>ZINC</td>
<td>ZINC</td>
</tr>
<tr>
<td></td>
<td>RIBOFLAVIN</td>
<td>RIBOFLAVIN</td>
</tr>
<tr>
<td></td>
<td>VITAMIN B6</td>
<td>VITAMIN B6</td>
</tr>
<tr>
<td></td>
<td>VITAMIN B12</td>
<td>VITAMIN B12</td>
</tr>
<tr>
<td></td>
<td>VITAMIN C</td>
<td>VITAMIN C</td>
</tr>
<tr>
<td></td>
<td>CALCIUM</td>
<td>CALCIUM</td>
</tr>
<tr>
<td></td>
<td>IRON</td>
<td>IRON</td>
</tr>
<tr>
<td></td>
<td>MAGNESIUM</td>
<td>MAGNESIUM</td>
</tr>
<tr>
<td></td>
<td>VITAMIN A</td>
<td>VITAMIN A</td>
</tr>
<tr>
<td></td>
<td>THIAMIN</td>
<td>THIAMIN</td>
</tr>
<tr>
<td></td>
<td>FOLATE</td>
<td>FOLATE</td>
</tr>
<tr>
<td><strong>EAR/ AI</strong></td>
<td>WATER</td>
<td>WATER</td>
</tr>
<tr>
<td></td>
<td>FAT</td>
<td>FAT</td>
</tr>
<tr>
<td></td>
<td>VITAMIN E</td>
<td>VITAMIN E</td>
</tr>
<tr>
<td></td>
<td>TOTAL OMEGA-3</td>
<td>TOTAL OMEGA-3</td>
</tr>
<tr>
<td></td>
<td>ENERGY</td>
<td>ENERGY</td>
</tr>
<tr>
<td></td>
<td>FIBRE</td>
<td>FIBRE</td>
</tr>
<tr>
<td></td>
<td>COPPER</td>
<td>COPPER</td>
</tr>
<tr>
<td></td>
<td>MANGANESE</td>
<td>MANGANESE</td>
</tr>
<tr>
<td></td>
<td>POTASSIUM</td>
<td>POTASSIUM</td>
</tr>
<tr>
<td></td>
<td>VITAMIN D</td>
<td>VITAMIN D</td>
</tr>
<tr>
<td><strong>Below EAR/AI</strong></td>
<td>IODINE</td>
<td>IODINE</td>
</tr>
<tr>
<td></td>
<td>SELENIUM</td>
<td>SELENIUM</td>
</tr>
<tr>
<td></td>
<td>LINOLEIC ACID</td>
<td>LINOLEIC ACID</td>
</tr>
<tr>
<td></td>
<td>LINOLENIC ACID</td>
<td>LINOLENIC ACID</td>
</tr>
<tr>
<td><strong>5.6.4 Eating frequency</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The mean number of eating occasions (meal or snack) per day was analysed. Only occasions where food was consumed were counted. Drinks such as coffee, water, tea, juice or soft drinks were not counted as an eating occasion, however, milk based drinks such as up and go or supplement drinks were counted.

Table 5-12 Number of eating occasions per day by breastfeeding status

<table>
<thead>
<tr>
<th></th>
<th>Breastfeeding n (± std.dev)</th>
<th>Non-breastfeeding n (± std.dev)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of participants</td>
<td>7</td>
<td>9</td>
</tr>
<tr>
<td>Mean number of eating occasions</td>
<td>5.43 (± 1.13)</td>
<td>3.44 (± 1.24)</td>
</tr>
<tr>
<td>Median number of eating occasions</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>Min number of eating occasions</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>Max number of eating occasions</td>
<td>7</td>
<td>5</td>
</tr>
<tr>
<td>N of participants with ≤ 3 eating occasion per day</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>N of participants with ≥ 4 eating occasions per day</td>
<td>7</td>
<td>4</td>
</tr>
</tbody>
</table>

There was a significant difference between the mean number of eating occasions per group (p=.005, Cohen’s d=1.66).
6 Discussion

6.1 Summary of main findings

The present study evaluated the adequacy of nutrient intake of women with depression in the postpartum period using the NRVs for Australia and New Zealand. Selenium and iodine intake was inadequate in breastfeeding women, while energy, fibre, iodine, selenium, calcium, copper, manganese, potassium, folate and Vitamin D intake was inadequate in non-breastfeeding women. All women were above the upper level for sodium intake. These results suggest that in women with depression, diet in the postpartum period, may depend on breastfeeding status. Why women decide to begin or stop breastfeeding and whether the reasons for these decisions differ between depressed and non-depressed individuals may impact on their nutritional adequacy postpartum and therefore, warrant further study.

Participants took a large range of supplements during both pregnancy and in the postpartum period. Folic acid, iodine, iron and pregnancy/breastfeeding specific multivitamins were the most common. Supplements were most commonly prescribed by doctors or midwives. All participants took supplements during pregnancy and half took supplements during the postpartum period. Twelve herbal, oil or food supplements had unknown or potentially adverse effects during pregnancy and postpartum [88, 101-104].

6.2 Reasons participants stopped breastfeeding

The majority of women in the present study stopped breastfeeding because of insufficient milk supply. This finding is in agreement with previous research in non-depressed New Zealand mothers [105, 106] and suggests that depression does not influence a mother’s
decision to breastfeed. Having recently given birth and being depressed can both result in tiredness, or feeling overwhelmed so perhaps women accept this as a normal part of motherhood. Depression can be associated with inadequate micronutrient intake but whether this inadequate intake decreases breast milk production is not known [107, 108]. Severe energy restriction has been shown to affect breast milk production [109]. The volume of milk produced is more often the result of infant demand than a maternal capacity [110].

6.3 New Zealand recommendations for supplementation during pregnancy
To reduce the risk of neural tube defects in the developing infant 800μg of folic acid daily is recommended for all pregnant women in New Zealand for one month periconceptionally and for three months following conception [111]. Three women (18.75%) were taking folic acid periconceptionally and 12 (75%) took a folic acid supplement during pregnancy. A previous study in pregnant Christchurch women found similar results; 17% took periconceptual folic acid and 62% took folic acid at some stage during pregnancy [112].
To decrease the risk of adverse effects on fetal and infant development, spontaneous abortions, stillbirths, congenital abnormalities, increased perinatal mortality, and cretinism iodine supplementation of 150μg/day is recommended for pregnant and breastfeeding women in New Zealand [113-116]. In the present study 2 participants (12.5%) were taking iodine at the dosage and duration recommended by the MOH and 11 (68.8%) were taking iodine during pregnancy. Although iodine supplementation is
recommended during lactation and all participants began breastfeeding, only 7 (43.75%) continued taking iodine after birth and just 3 (18.75%) until they had finished breastfeeding. This suggests that New Zealand women may not be aware of the importance of iodine during lactation. A previous study in Palmerston North mothers found similar trends [116]. The 2011 study found, that although 70% of women were taking iodine during pregnancy this had decreased to 35% during breastfeeding. The results of the present study suggest that the majority of New Zealand women with depression may be taking some folic acid and iodine during pregnancy. However, only two (12.5%) were taking both folic acid and iodine supplements at the dose and duration recommended for pregnancy and lactation.

6.4 Unsafe use of supplements

Seven herbs consumed by participants (fenugreek, fennel, Echinacea, spirulina, evening primrose oil, bee pollen and ginseng) have been found to have toxic effects in some individuals. These can range from headaches and skin reactions to anaphylaxis, liver necrosis and death [88]. See table 9.1 in appendix F for more details. Case reports or studies reporting adverse effects of complementary and alternative dietary supplements during pregnancy or lactation could only be found for flaxseed, fenugreek, fennel and spirulina [103, 104, 117, 118] Published studies were few and often limited. Twenty-five per cent of participants in the present study were consuming at least one of these seven supplements. However a safe dose of these herbal ingredients has not been established. Nor is there any evidence to indicate whether some individuals are more susceptible than
others to the potential adverse effects. Advocating these supplements during pregnancy and postpartum is potentially dangerous; despite this they were recommended by a wide range of individuals; lactation consultant, self, midwife, pharmacist, doctor, naturopath, dietitian, friend and online breastfeeding support group. The fact that study participants had received advice from health professionals without evidence to support the use of the supplements they were prescribing is concerning. However, there is a lack of information about which supplements should be avoided during pregnancy and which can be used with caution. Such information is greatly needed. The current legislation states that the individual/organisation selling the product is responsible for ensuring it is “made to an acceptable quality, is safe to use and complies with the law” [119]. However this does not protect the public, as some herbal supplements can be as dangerous as taking the wrong dose of medication [85].

In the present study of greatest concern was the one participant who reported taking 6 supplements containing ingredients which can cause adverse effects; flaxseed, spirulina, vitamin A (although at a safe limit; 750 μg/d), echinacea, ginseng, and a concoction of unknown herbal ingredients, supposedly high in iron, during pregnancy and lactation. This participant also took Rescue Remedy and Arnica on occasion, and although no studies were found suggesting these are unsafe, the literature warns against consuming multiple herbal ingredients together based on the potential for interactions which may cause adverse effects [87, 88].
6.5 Dietary analysis

As most populations with MDD have inadequate dietary intakes of many nutrients [18, 20], it might be expected that postpartum women with MDD would show similar inadequacies. However, the present study showed that the extent to which the diet was inadequate was dependent on breastfeeding status. Only selenium and iodine intakes were inadequate in lactating women, two nutrients which are notoriously low in the New Zealand diet [115, 116]. In contrast, women who were not breastfeeding shared similar nutrient inadequacies with populations from previous MDD research [18, 20, 22]. These were potassium, folate, vitamin D and selenium, which have also been found to be inadequate in pregnant women in New Zealand [25]. Intakes of fibre, iodine, calcium and copper were also low. However, the 2008-2009 National Nutrition Survey (NNS) suggests these intakes may be typical of non-pregnant non-breastfeeding New Zealand women [120]. The energy and calcium intakes were similar to those of women aged 19-50 in the NNS and fibre intake was actually higher in our sample. Again, low selenium and iodine intakes may be typical of the majority of New Zealanders [120, 121]. Both breastfeeding and non-breastfeeding women had low intakes of selenium. Randomized controlled trials have found that selenium supplementation pre-pregnancy and during pregnancy can decrease risk of PPD [92, 122]. The main dietary sources of selenium for New Zealand women aged 25-44 are fish and seafood [115]. Other studies have found an association between fish intake and depression, despite studies of omega-3 supplementation being inconclusive, leading some researchers to recommend further investigation into the possible influence of selenium and other antioxidants on depression [23, 123]. This implies that consuming adequate amounts of whole foods, such as fish to
decrease depression risk could be more beneficial than individual nutrients in supplement form.

Repeat dietary data in a larger sample of postpartum New Zealand women could assess whether there are significant differences between nutrient intake in depressed and non-depressed post-partum women.

6.6 Significant mean differences and effect size

In the present study, differences in nutrient intake between breastfeeding and non-breastfeeding participants could be non significant due to the small sample size. Therefore effect size was used to determine if the differences were likely to be significant in a larger study. The requirement for most nutrients increases during lactation [78], so mean intakes should be significantly higher in breastfeeding women than non-breastfeeding women or the general population. In the present study intakes of energy, fibre, zinc, folate and vitamin D were higher in breastfeeding women than non-breastfeeding women, however this was not significant. Nevertheless these nutrients had large effect sizes, suggesting that in a larger sample the differences may be significant. This could be explored further in subsequent studies.

Although breastfeeding women had higher intakes of vitamin C, linoleic acid, linolenic acid, PUFAs, vitamin E, water and sodium, these intakes were not significantly different, nor did they have large effect sizes. This suggests that intakes of these nutrients are likely to be similar in a larger sample regardless of breastfeeding status. Low intakes of Vitamin C, linoleic acid, linolenic acid, PUFAs and vitamin E all have the potential to cause depression [18, 22, 23] and may be associated with poor diet quality [15, 66]. Research in
a larger sample could clarify whether there is a link between these nutrients, depression and diet quality in the postpartum period.

Linoleic and linoleic acid intake was low in all study participants. Previous studies have found an increased risk of developing PPD with decreasing linoleic and linolenic acid intakes in pregnant women [60]. However it is likely that the true intake of linoleic and linoleic acids has been underestimated in the present study because Kai-calculator [99], does not contain complete data for these nutrients. Despite this likely underestimation, the intake of total omega-3 fatty acids meets the AI in both breastfeeding and non-breastfeeding women. There are no published studies on omega-3 intake in postpartum women with depression. However, research in other depressed populations is conflicting with some suggesting that intake of omega-3s is as likely to be inadequate in depressed individuals [41, 43] and others research suggesting it is adequate [124]. The present study supports the latter hypothesis. Studies which have reported plasma omega-3 fatty acid levels during postpartum suggest a high omega-6:omega-3 ratio may increase depression risk [46, 47]. However, it was not possible to assess the omega-6:omega-3 ratio in the present study due to insufficient dietary data.

6.7 Implications for future research

Recruitment strategies: After 1 month of recruiting, strategy one attracted only three participants, hence, strategy 2 was developed. Of the women identified as eligible for the study, 23 (65.7%) agreed to participate and 16 (45.7%) completed the study. Other studies in depressed mothers have also found recruiting difficult [125]. This suggests that
future studies should aim to recruit over twice the number of participants required. Furthermore, to obtain sufficient participants, more than just the MBS would be needed, as only 35 potential participants were identified in this service. A multi-center approach using similar services around the country would be one way to increase numbers of participants.

**Cancellations:** As with previous research in populations with perinatal depression the number of cancelled and rescheduled appointments was high [125]. A previous RCT in pregnant women with depression had high drop-out rates due to difficulty with scheduling or transportation [126]. Another RCT recruited 26 participants over 15 months [127], showing that recruiting and maintaining large numbers of participants in this population can be very difficult. The two most common reasons for rescheduling in the present study were that participants were ‘too busy’ or ‘under distress’. Future research should allow for a prolonged period for recruitment and data collection to accommodate the number of rescheduled appointments. Home visits, could be a good way to retain participants, especially if collecting follow up data.

**Dietary assessment methods:** The 4 stage Multiple Pass Twenty-four Hour recall was chosen for this population as it has a low participant burden [96]. As diet records are considered the gold standard of dietary assessment, the present study also aimed to assess the appropriateness of using a diet record in this population. Participants in the first month of recruitment were given the choice of completing a 4-day diet record (4DDR). However, this method was abandoned due to poor recruitment and subsequently the rate of recruitment using strategy 1 increased. Although, the 4DDR was optional for all study participants it is possible that anxiety about completing this may have discouraged
participation. One woman (out of 3 approached) said she would be interested in completing a 4DDR. However, at her follow up visit 2 weeks later, she had not begun the record. This suggests even mothers who are willing, may not necessarily have the time.

**Additional Information:** Many other factors may be associated with MDD or PPD such as food security, emotional eating, smoking status, biochemical markers, diet and supplement use prior to pregnancy, pre-pregnancy weight, weight gain during pregnancy, hyperemesis and other pregnancy related complications, functional foods, energy drink use and caffeine consumption. Future research into this area, could also focus on, or collect information concerning these factors. This would allow researchers to gain a better understanding of how these factors affect and are affected by depression and diet. This could also ensure that future studies account for the potential of these factors to skew results.

### 6.8 Strengths and limitations

#### 6.8.1 Strengths

An important strength of this study was that women attending the MBS already had a current diagnosis of depression based on the Edinburg Postnatal Depression Scale, so additional screening was not required. Recruiting from the general population would have required assessment for depression and would have greatly added to the complexity of the study and the difficulty recruiting participants. A previous RCT conducted in
Christchurch found that depressed pregnant, women were willing to complete the initial screening questionnaire but did not participate in additional contact or assessment[125].

6.8.2 Limitations

Too little time was the major limitation of the present study. This severely limited the number of participants and hence the sample size. Future research should allow for at least 6 months of data collection and recruitment as participants may be few and far between. Furthermore, due to time constraints only one day of dietary data could be collected. Future research using 24hr recalls, should attempt to collect a repeat 24hr recalls, in a subset of the sample, as is best practice [96].

A further limitation of this study was that the participants were asked to only include supplements taken in the past 12months. It is possible that some participants were taking other supplements during pregnancy or postpartum which fell outside the 12 month timeframe and were therefore not included. Consequently, the data collected was not a complete list of all supplements taken during pregnancy and postpartum.

6.9 Conclusion

This pilot study found high rates of supplement use in pregnant and postpartum women with depression. The majority was taking iodine and folic acid as recommended during pregnancy, but potentially toxic supplements were also being taken by 4 study participants (25%). The results suggest that the dietary intake of postpartum women with depression may be influenced by breastfeeding status, with breastfeeding women meeting
more nutrient requirements than non-breastfeeding women. As nutrient inadequacies may be implicated in depression this warrants further research.
7 Application to Dietetic Practice

It is important for dietitians and other health professionals to give the correct advice regarding the use of iodine and folic acid supplementation during pregnancy and lactation. All pregnant women should start taking iodine and folic acid as soon as they find out they are pregnant, if not before. Many women in the present study stopped iodine supplementation before the conclusion of breastfeeding suggesting that health professionals, such as dietitians need to check that pregnant women are taking these supplements postpartum.

Dietitians should always ask their patients about herbal supplement use. Although it is the choice of the patient to use herbal remedies, dietitians should always check for contraindications of use and advise against any untested supplements during pregnancy and lactation. Furthermore dietitians should only support the use of herbal supplements in amounts proven to be safe during pregnancy and lactation.

It is generally assumed that dietitians know which supplements are safe to use, however with continual changes and additions to the herbal supplements on the market is it almost impossible to keep up. Information regarding which herbal supplements are safe is limited and there is a need for up to date information for dietitians and other health professionals to ensure that the correct and most up to date advice is given.
Dietitians need to be aware that the diet in postpartum women is likely to be affected by breastfeeding status and mood. Links between BMI and depression, anxiety and stress have begun to emerge in the literature. As dietitians we need to understand that nutrition education cannot always be the primary focus in this population. Before specific dietary interventions can be effective, the psychological determinants of mood disordered eating behaviours may need to be addressed. A key skill for dietitians, is knowing when small dietary goals will be achievable and help to build the patient’s confidence, and when goals are likely to be unachievable and detrimental to mental wellbeing.

As dietitians our primary focus should be the mental wellbeing of the patient. Only after we understand the patient can we help them. We must be compassionate and address dietary change holistically.
8 References


47. De Vriese, S.R., A.B. Christophe, and M. Maes, *Lowered serum n-3 polyunsaturated fatty acid (PUFA) levels predict the occurrence of postpartum*


9 Appendices

9.1 Appendix A: Ethics Approval
Dr J Elmslie  
Department of Psychological Medicine (ChCh)  
Terrace House, 4 Oxford Terrace  
University of Otago, Christchurch  

4 June 2013  

Dear Dr Elmslie,  

I am again writing to you concerning your proposal entitled "The Diets in Mothers and Babies' Service Outpatients", Ethics Committee reference number H13/005.  

Thank you for your letter dated 4 June 2013 addressing the Committees concerns. These were: 1) The need to have a confidentiality statement for Melissa Butt; the Committee acknowledges receipt of the copy of the signed form; 2) Clarification on who will have access to patient identifiable information. The Committee note that you have amended the application form and Information Sheet to note that additional researchers may have access to the data in potential future research.  

3) The Committee also appreciates the further information you have provided in relation to Melissa Butt’s experience and qualifications, as requested.  

The Committee is also grateful that you reconsidered the wording of the Information Sheet and also takes note of the change of study title to “The Diet in Mothers and Babies’ Service Outpatients study” and that this has been reflected in the advertisement. However, the title has not been reflected in the copies received of the Information Sheet or Consent Form. The titles will need to be consistent and the Committee requests copies once this small amendment has been done.  

On the basis of this response, I am pleased to confirm that the proposal now has full ethical approval to proceed.  

Yours sincerely,  

[Signature]  

Mr Gary Witte  
Manager, Academic Committees  
Tel: 479 8256  
Email: gary.witte@otago.ac.nz  

cc Professor R Mulder Head Department of Psychological Medicine (ChCh)
9.2 Appendix B: Maori consultation
26 April 2013

Dr Jane Etelée
University of Otago, Christchurch
Department of Psychological Medicine
CHISI CHURCH

He te rangahau Heaura e taumako te whakapiti ake te Heaura Mōtūi
All health research in Otago New Zealand benefits the Heaura (health and wellbeing) of tāngata whenua

Tenia Koe Jane,

Thank you for taking the time to meet with me at the University of Otago, Christchurch on the 23rd April 2013, to discuss your student, Melissa Butt’s research study titled:

Dietary intakes of outpatients attending a Mothers and Babies’ Clinic

I note that this research project will be undertaken by Melissa Butt with you as her supervisor. I also understand from our meeting that this is a student’s project and has to external funding requirements.

Commentary on Proposed Research

From our meeting I established that this project will look at eating habits of young pregnant women with mental health or women who develop a mental illness after their baby is born. Your project will assess dietary intake and dietary supplement use in women attending an outpatients Mother and Babies’ Clinic.

Specifically in your application we discussed the following:

1. It was agreed that there is a need to acknowledge the issues pertaining to ethnicity and to consider how ethnicity data will be collected in your study. Through our discussion, the Census 2006 ethnicity question was considered to be the preferred tool in recording ethnicity alongside background details collected from each participant. If the participant identifies as Māori, but this was not recorded in the participants records, this should be reflected by informing the clinic and ensuring the participant is correctly recorded as being Māori.

2. Your application would be strengthened by including any known documented literature national or international highlighting issues affecting pregnant women with mental health or post natal women and mental health issues and their dietary intake, and the benefits gained for this choice.

3. That your application should document direct health benefits/gains for individual Māori participants who consent to be part of this research to further improve support services, access and quality of care giving equitable outcomes.

Research Office, Department of the Dean
University of Otago, Christchurch
PO Box 430, Christchurch 8011, New Zealand
Tel +64 3 479 5500 Fax +64 3 479 5550 Email research@otago.ac.nz
www.dde.otago.ac.nz
Potential Further Support Resources

Further resources that you might want to access to strengthen you responsiveness to Maori within your research are: 1. HRC’s Nga Pau Rangahau Hauora Kia Whakapikia Ake Te Hauora Maori 2004-2008, 2. The Health Research Strategy to Improve Maori Health and Well Being 2004-2008. The other reference that is available is 3. Hauora Maori Standards of Health IV: A Study of the Years 2000-2005 by Bridget Robson and Ricci Harris, Maori Health Research Unit, Wellington School of Medicine, University of Otago, Wellington. All provide Maori specific information on a range of health issues.


Dissemination of Results

As stated in the HRC’s Guidelines for Researchers on Health Research Involving Maori, it is important that research results contribute to Maori health gain. This should occur not only in an academic forum, but also within the community from whence the data is drawn. Therefore the findings from this study should be further discussed with relevant Maori stakeholders. For your project this should involve a further discussion with the Maori mental health team at Te Korowai Atawhai within the CDHB.

Ethics

It is a requirement of the ethics approval process, that a final report be submitted when the research is complete. A copy of the report should also be supplied to me at that time, as findings from this project may contribute to the development of future research hypotheses or projects. It is therefore important that appropriate Maori organisations, Maori health professionals and Maori researchers are aware of your findings. The Research Manager - Maori would be willing to assist in the dissemination of your findings once your project has reached a successful conclusion.

I wish you well in your research

Ka nui tonu nga mihi

[Signature]

Wendy Dallas-Kataa
Acting Research Manager – Maori
Appendix C: Participant demographic Questionnaire

Thank you for agreeing to participate in this study. I will start by asking you some basic demographic questions followed by some questions about whether you use dietary supplements.

Section 1

Demographic Information

1. Introduction: Before we begin I need to collect some basic background information.

What is your date of birth?
___/_______/______

2. Which ethnic group or groups do you belong to?
- New Zealand European
- Maori
- Samoan
- Cook Island Maori
- Tongan
- Niuean
- Chinese
- Indian
- Other, such as Dutch, Japanese, Tokelauan

specify______________________________________________________________

Now some questions about your education.
3. What is your highest secondary school qualification?
   ○ None
   ○ NZ School Certificate in one or more subjects or National Certificate Level 1 or NCEA Level 1
   ○ NZ Sixth Form Certificate in one or more subjects or National Certificate Level 2 or NZ UE before 1986 in one or more subjects or NCEA Level 2
   ○ NZ Higher School Certificate or Higher Leaving Certificate or NZ University Bursary/Scholarship or National Certificate Level 3 or NCEA Level 3 or NZ Scholarship Level 4
   ○ Other secondary school qualification gained in NZ.
   ○ Other secondary school qualification gained overseas

4. Apart from secondary school qualifications, do you have another completed qualification? Please do not count incomplete qualifications or qualifications that take less than 3 months of full-time study to get.
   Please tell us your highest qualification.
   ○ No qualification beyond secondary school
   ○ Bachelors degree, eg BA, BSc
   ○ Bachelors degree with honours
   ○ Masters degree, eg MA, MSc
   ○ PhD
   ○ Diploma (not post-graduate)
   ○ Diploma - Postgraduate
   ○ Trade or technical certificate which took more than 3 months full-time study
   ○ Professional qualification, eg ACA, teachers, nurses
   ○ Other

5. What is the total income that you yourself got from all sources, before tax or anything was taken out of it, in the last 12 months?
   ○ Less than $5,000
   ○ $5,001 - $10,000
   ○ $10,001 - $15,000
   ○ $15,001 - $20,000
   ○ $20,001 - $25,000
   ○ $25,001 - $30,000
6. Are you currently receiving income support from any of these sources?

- NZ Superannuation
- Working for Families (Family Support, In Work Payment, Family Tax Credit)
- Unemployment benefit
- Domestic purposes benefit
- Sickness benefit
- Invalids benefit
- Student allowance
- Disability allowance
- ACC (as income support, not reimbursement for health services)
- Other government benefits (youth benefit, war pension, etc)
- None of the above

Section 2

Previous pregnancies and breastfeeding

1. Gravidity and Parity

a. How many times have you been pregnant? [Note - This includes
b. How many times have you given birth? [Note - this includes still born]

I would like to now ask you a couple of questions about breastfeeding. This may be useful to us when analysing the results of the study. I realise there are lots of reasons why women are unable to or choose not to breastfeed and that is okay.

2. Have you breastfeed your child at any point since their birth?

   **Yes / No**

   - If **Yes**: Are you currently breast feeding?  **Yes / No**
     
     How long were you able to breastfeed / How long have you been breast feeding for? _______________ exclusive/ intermittent

   If applicable:
   
   When you stopped breast feeding what was your main reason for stopping? __________________________________________________________________________
   
   __________________________________________________________________________________
   
   __________________________________________________________________________________
   
   Were there any other factors that influenced your decision to stop breastfeeding? __________________________________________________________________________
   
   __________________________________________________________________________________
   
   __________________________________________________________________________________
   
   - If **No**: What was your main reason for not breast feeding? __________________________________________________________________________
   
   __________________________________________________________________________________
   
   __________________________________________________________________________________
   
   Were there other factors that influenced your decision not to breast feed? __________________________________________________________________________
   
   __________________________________________________________________________________
Section 3
Dietary Habits

1. Do you follow any type of special diet such as:
   - Vegetarian
   - Vegan
   - Gluten free
   - Dairy free
   - Diabetic
   - Other (please specify)

2. Have you ever been told by a doctor that you have diabetes?
   - Yes
   - No

Is your diabetes gestational (as a result of being pregnant)?
What age were you when you were first told that you had diabetes?

3. How many drinks containing alcohol do you have on a typical day when you are drinking?
   - One or two
   - Three or Four
   - Five or Six
   - Seven to Nine
   - Ten or more

[Interviewer: Take average and round to nearest whole number if necessary e.g. if respondent says 4 or 5, average is 4.5, round to nearest whole number = 5.]

Section 4
Dietary Supplement Questions

Now a few questions on dietary supplements.
Firstly I have a few specific questions about supplement use before and during pregnancy.
1. Did you take an iodine supplement or a supplement containing Iodine before or during pregnancy?  Yes / No  
If yes:  When did you start your Iodine supplement?_____________________________  
When did you stop taking your Iodine supplement?_____________________________  
If no: Were you taking an Multivitamin before or during pregnancy that may have contained Iodine? Yes / No

2. Did you take a folate / Folic acid or folate/folic acid containing supplement before or during pregnancy?  Yes / No  
If yes:  When did you start your folate supplement? ____________________________  
When did you stop taking your folate supplement?___________________________  
If no: Were you taking an Multivitamin before or during pregnancy that may have contained folate? Yes / No

For the following questions please think back over the past 12 months.

3. Did you take any supplements at any time during the last 12 months?  
   ○ Yes  
   ○ No

4. For each supplement taken we have a series of questions.
Which did you take? Can you please tell me the type OR do you have the supplement container?

   ○ Multivitamin and multiminerals  
   ○ Multivitamins  
   ○ Multiminerals  
   ○ Single vitamin and/or single mineral  
   ○ Oil  
   ○ Other supplement  
   ○ Unsure of classification
Interviewer will record all available information from the container which should include:

- brand name
- product name
- single vitamin
- multi-vitamin
- single mineral
- multi-mineral
- dosage/length

5. Please specify "the type of single vitamin and/or single mineral."/"the type of oil."/"as much detail about the supplement as possible."

- Bran
- Lecithin
- LSA (linseed, sunflower and almond)
- Kelp
- Spirulina
- Glucosamine and/or chondroitin
- Echinacea
- Ginkgo
- Hypericum (St John’s Wort)
- Sports supplement
- Other

6. Was it prescribed to you by a doctor / nurse practitioner / mid-wife?

- Yes
- No

7. How often did you take the supplement in the last 12 months?
8. Are there any other supplements you have taken in the last 12 months you can tell me about?

- Yes
- No
**Anthropometry**

I am now going to take two measurements from you – height and weight, in that order. I'm then going to take those measurements again, and if any of the second measurements are not close enough to the first ones, I'll measure you for a third time. Could you please remove your shoes and all heavy outer clothing so we can obtain accurate measurements. Thank you.

1a. First height

1b. First weight measurement

2a. Second Height

2b. Second weight measurement

3a Third weight

3b. Third height
Additional Supplements Page 1

What type of supplement did you take? Can you please tell me the type OR do you have the supplement container?

- Multivitamin and multiminerals
- Multivitamins
- Multiminerals
- Single vitamin and/or single mineral
- Oil
- Other supplement
- Unsure of classification

Interviewer will record all available information from the container which should include:

- brand name
- product name
- single vitamin
- multi-vitamin
- single mineral
- multi-mineral
- dosage/strength

2. Please specify "the type of single vitamin and/or single mineral."/"the type of oil."/"as much detail about the supplement as possible."
Q05. Was it prescribed to you by a doctor / nurse practitioner / mid-wife?
  
  ○ Yes
  ○ No

Q06. How often did you take the supplement in the last 12 months?
  
  ○ Daily
  ○ More than once per week
  ○ Once per week
  ○ Monthly
  ○ Episodic (REGULAR use but for a limited time period)
  ○ Infrequent and irregular use
  ○ Other
  ○ Don't know

Q07. Are there any other supplements you have taken in the last 12 months you can tell me about?
  
  ○ Yes
  ○ No
9.4 Appendix D: Compiled list of dietary supplements

Dietary Supplements

What do we mean by dietary Supplements?
For the purpose of this study we define a dietary supplement as:
Any pill, capsule, tablet, powder, liquid/oil, food/ food product that is taken by mouth
with the intention of supplementing the diet. I.e. taking a vitamin, mineral, herb, oil or
synthetic product.

Important: Please bring along ALL supplement containers/packaging to your first
appointment. The following pages contain an alphabetical list of examples of dietary
supplements. If you have a product with these ingredients/ labels please bring them
along. If you are unsure, either contact Melissa or bring the product to your first
appointment to be safe. The first 5 pages are examples of typical vitamins, minerals, oil
supplements and ingredients in herbal remedies/supplements. The remaining pages are
examples of food, drinks, sports related and weight management supplements.
Please note: Where there is a herb mentioned which is typically used in cooking e.g., sage
or fenugreek, we are only interested in the herb in supplement form i.e. within a capsule.
Not as added to food during cooking. You do not need to bring your herbs and spices.

Vitamin, Mineral, Herbal or Oil Supplements

A
- Acai
- Algae
- Aloe Vera
- Angelica
- Anise seed
- Arnica
- Astragalus
- Vitamin A (Retinoids/ Carotenoids/ Betacarotene/ Retinyl Acetate)

B
- Bee Pollen capsules / dried bee pollen
- Bilberry
- Bitter Orange/ orange peel
- Black Cohosh
- Blue Cohosh / squaw root/ papoose root
- Boron
- Botanical Dietary Supplements
- Buckthorn
- Burdock/ taproot
- Butchers broom
- Butterbur
- B complex Vitamins, including 2 or more of the following:
  - Vitamin B1 (Thiamin / Thiamine Nitrate)
  - Vitamin B2 (Riboflavin)
  - Vitamin B3 (Niacin/ Nicotinamide)
  - Vitamin B5 (Pantothenic acid)
  - Vitamin B6 ( Pyrodoxine/ Pyridoxine hydrochloride)
  - Vitamin B7 ( Biotin / Vitamin H)
  - Vitamin B9 (Folate / Folic acid)
  - Vitamin B12 (Cobalamin / Cyanocobalamin)

C
- Calcium
- Calendula (Marigold)
- Carnitine
- Caraway seeds
- Cat's Claw
- Caprylic acid
- Chamomile
- Charcoal
- Chasteberry / Chaste tree/ Abrahams Balm/ Monks pepper
- Choline
- Chlorella
- Chondroitin
- Chromium
- Cinnamon
- Cobalt
- Cod liver oil
- Coenzyme Q10
- Colloidal Silver
- Collagen
- Coltsfoot
- Comfrey
- Concentrated mineral drops
- Copper
- Cranberry
- Vitamin C / Ascorbic acid/ Calcium Ascorbate / ester-C

D
- Dandelion
- Dong quai / female ginseng
- Vitamin D (Vitamin D3 / Cholecalciferol)

E
- Echinacea
- Ephedra / Ma huang
- Essiac/Flor-Essence
- European Elder
- Evening Primrose Oil
  Vitamin E (Alpha-Tocopherol)

F
- Fenugreek
- Fennel
- Feverfew
- Fish Oil
- Flaxseed
- Floradix
- Fluoride
- Folate / Folic Acid
- Forskolin

G
- Garlic
- Ginger
- Ginkgo
- Ginseng
- Glycine betaine
- Goldenseal
- Grape Seed Extract
- Green Tea/ Green tea leaf

H
- Hawthorn
- Herbal Dietary Supplements
- Hoodia
- Hops
- Horse Chestnut
- Horseradish extract

I
- Iodine
- Irish Moss
- Iron

J
- Japanese mint
- Juniper

K
- Kava/ Kava-kava/ Awa/ Ava/ Yaqona/ Sakau
- Kelp/ Sea Kelp
- Krill Oil
Vitamin K (Vitamin K1/Phytomenadione)

L
- Labrador tea/ trappers tea
- Lavender
- Lemon balm/ balm mint/ Lemon Verbena
- Licorice Root
- Linden/ Tilia/ Basswood
- Lobelia
M
- Magnesium
- Manganese
- Melilot (sweet clover)
- Milk Thistle
- Mistletoe
- Molybdenum
- Morningmed Relief spray
- Multivitamin/mineral Supplements

N
- Nickel
- Noni

O
- Olive leaf
- Omega-3 Fatty Acids
- Omega-3 and 6 Fatty acids
- Omega-3, -6 and -9 Fatty acids

P
- Passionflower
- PC-SPES
- Pennyroyal / squaw mint/ mosquito plant/ pudding grass
- Peppermint (including oil)
- Phosphates/ phosphorous
- Phytoplankton
- Potassium
- Prebiotics
- Probiotics
- Propolis
• Red bush tea/ Rooibos tea
• Red Clover
• Red raspberry leaf
• Rose hip
• Rosemary

S
• Safflower oil
• Sassafras
• Sage
• Salmon oil
• SAMe (S-Adenosyl-L-Methionine)
• Saw Palmetto
• Selenium
• Senna
• Silicon
• Herbal Sleeping Tablets
• Sodium
• Soy
• Spirulina
• St. John's Wort
• Sulphur (dimethyl sulfoxide (DMSO) /methlysulfonylmethane (MSM))
• Sunflower oil
• Sweet woodruff

T
• Tart cherry
• Tea
• Tea tree oil/ melaleuca oil
• Thuja
• Thunder God Vine
• Turmeric

U
• Uva-ursi / bearberry leaves
V
- Valerian/ garden valerian/ garden helitropo/ all heal
- Vitamin/ Mineral Dissolvable Tablets e.g. Berroca, Boost, Hairy Lemon
- Vitamin A
- B Vitamins or Vitamin B1 or B2 or B3 or B5 or B6 or B9 or B12
- Vitamin C
- Vitamin D
- Vitamin E
- Vitamin K

W
- Wild yam
- Willow bark
- Womens Multivitamin
- Wheat grass

Y
- Yohimbe

Z
- Zinc

Food / Sport/ Weight Management Supplements

A
- Acetyl L-Carnitine / L-Carnitine
- Almond meal
- Amino Acids
- Anabolic Steroids

B
- BCAA ( Branched Chain Amino Acids)
- Bran powder

C
• Caffeine pills e.g. No Doze
• Cartilage
• Low Carbohydrate bars, e.g. Carb Less bars
• Co-enzymes
• Complan
• Creatine

D
• Detox products
• Dietary Supplement Drink

E
• Electrolytes
• Ensure/ Ensure Plus

F
• “Fat burning” label
• Fibre/ Metamucil/ Psyllium
• Fortijuice
• Fortimel

G
• Garcina Cambogia
• Glucosamine (Joint supplements)
• Glucose tablets
• Glutamine powder/ capsules
• Goji berries (dried)
• Green bean extracts e.g. stevol

K
• Kiwifruit juice/extract, e.g. kiwi crush, phloe bowel care
• Ketones
• Kre- Alklayn

L
• Linseed
• Liver detox
• L-Lysine
• LSA (Linseed Sunflower Almond)
- Maltexo
- Melatonin

N
- Nucleic Acids

P
- Prebiotics e.g. Inulin
- Probiotics
- Protein bars
- Protein Powder (Mixture of Whey Protein and Creatine)
- Psyllium

S
- Sports drink powders (e.g. Powerade, Horleys Replace)
- Sustagen

V
- Vitaplan

W
- Weight Management Capsules/powders/drinks
- Whey Protein

Any other supplement, In any form (tablets, oil, powder, food, drink) made from a mixture of ingredients/vitamins/minerals/oils/herbs for Anxiety, Depression, Mood, Sleep or Stress

Any other supplement, In any form (tablets, oil, powder, food, drink) made from a mixture of ingredients/vitamins/minerals/oils/herbs for Pregnancy, Breastfeeding, New mothers, Women, Adults
9.5 Appendix F: Evidence for adverse effects of herbal supplements
<table>
<thead>
<tr>
<th>Supplement taken</th>
<th>Herbal ingredient</th>
<th>When it was taken</th>
<th>Adverse effects</th>
<th>References</th>
<th>Safe to recommend</th>
</tr>
</thead>
</table>
| Flaxseed/ Linseed   | Flaxseed/ Linseed               | Postpartum        | - No adverse effects reported to my knowledge  
- More studies needed to confirm safety and efficacy in pregnancy and lactation                                                                 | [117]      | Yes in amounts commonly found in foods |
| Fenugreek           | Fenugreek                       | Postpartum        | - Can induce labour in pregnancy  
- Adverse effects uncommon? Unknown? in postpartum,  
- Need more studies to determine ability to increase milk production in breastfeeding women                                                                 | [85, 102]  | Pregnancy: No  
Postpartum: Appears safe in amounts commonly consumed |
| Morlife’s Fenugreek tea | Fennel (Foeniculum Vulgare) | Postpartum        | - Premature thelarche in infants  
- Adverse effects during lactation  
- Malignant tumors found in rats, unknown whether it forms mutagenic metabolites in humans.  
- Amount of fennel not documented on packet. Has potential to vary greatly between teabags                                                                 | [103, 118, 128] | No |
| Vitamin C with Echinacea | Echinacea (Echinacea Purpurea) | Pregnancy and post-partum | - Skin reactions, liver and biliary system disorders, fever, anaphylaxis, decrease in prothrombin and abdominal pain.  
- One fatal case was reported whereby a 28yr old male consumed more than the recommended dose, resulting in liver necrosis and death  
- Only one study found in pregnant humans.                                                                 | [88, 129]  | No |
<table>
<thead>
<tr>
<th>Supplement taken</th>
<th>Herbal ingredient</th>
<th>When it was taken</th>
<th>Adverse effects</th>
<th>References</th>
<th>Safe to recommend</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spirulina Beverage</td>
<td>Spirulina</td>
<td>Postpartum</td>
<td>No significant differences in spontaneous abortions or malformations were found however, study lacked statistical power. - Adverse effect documented in pregnancy, more research needed. - Studies in pregnant mice had no adverse effects - Exposure to vitamin D supplementation at the beginning of pregnancy, followed by daily exposure to spirulina from the fourth month of pregnancy resulted in severe neonatal hypercalcemia - Amounts in beverages may be safe but cannot guarantee, particularly in tablet form. - Concentrations of vitamins and minerals in spirulina show varying results.</td>
<td>[104, 130, 131]</td>
<td>No</td>
</tr>
<tr>
<td>Herbal iron</td>
<td>Unknown</td>
<td>Pregnancy and postpartum</td>
<td>Unsure, herbal concoction unknown therefore, cannot guarantee safety</td>
<td>N/A</td>
<td>No</td>
</tr>
<tr>
<td>Evening primrose oil</td>
<td>Evening primrose oil</td>
<td>Pregnancy and postpartum</td>
<td>Adverse effects</td>
<td>[103]</td>
<td>Unknown</td>
</tr>
<tr>
<td>Rescue Remedy</td>
<td>Rock rose, cherry plum, impatiens, clematis, and star of Bethlehem</td>
<td>Pregnancy and postpartum</td>
<td>- No adverse affects documented - Studies show no benefit of rescue remedy over placebo</td>
<td>[84]</td>
<td>Probably</td>
</tr>
<tr>
<td>Supplement taken</td>
<td>Herbal ingredient</td>
<td>When it was taken</td>
<td>Adverse effects</td>
<td>References</td>
<td>Safe to recommend</td>
</tr>
<tr>
<td>------------------</td>
<td>-------------------</td>
<td>-------------------</td>
<td>-----------------</td>
<td>------------</td>
<td>------------------</td>
</tr>
</tbody>
</table>
| Arnica drops     | Arnica            | Pregnancy and postpartum | - No adverse affects documented  
- Studies show no benefit of Arnica over placebo | [84] | Probably |
| Bee pollen       | Bee pollen        | Pregnancy and postpartum | - Anaphylaxis, acute renal failure, adverse skin reactions, elevated Transaminase ALP/GT, fever, photosensitivity  
- No known studies on use in pregnant women or chance of affect on unborn infant with allergy | [88, 132, 133] | No |
| Brewers Yeast    | Brewers yeast (Saccharomyces Cerevisiae) | Postpartum | Adverse affects unknown  
- Limited research, none found on pregnancy or postpartum  
- More research needed for efficacy in increasing milk production | [134] | Unknown |
| Immunofort       | -Olive leaf (Olea europaea)  
- Echinacea purpurea  
- Shitake mushroom  
- Andrographis  
- Siberian ginseng (Eleutherococcus Senticosus)  
- Korean ginseng (Panax ginseng)  
- Vitamin A | Pregnancy | - Olive leaf oil: has well documented antihypertensive and glucose lowering effects  
- Echinacea-see above  
- Mushroom – unknown, small amounts safe in elderly  
- Andrographis- some adverse effects reported more research needed  
- Siberian and Korean ginseng: adverse skin reactions, liver and biliary system disorders, fever, anaphalsis, headaches and abdominal pain (jacobson09). Particular warning has been placed on consuming ginseng with fish oil supplements high in retinol (ref). Avoid | [88, 101, 135-137] | No |
<table>
<thead>
<tr>
<th>Supplement taken</th>
<th>Herbal ingredient</th>
<th>When it was taken</th>
<th>Adverse effects</th>
<th>References</th>
<th>Safe to recommend</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>during pregnancy (romm). -Vitamin A: 750μg/d –doesn’t exceed UL</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
9.6 Appendix G: Preliminary results poster presented at the Perinatal Mental Health Symposium
Diet and supplement use in postpartum women with Major Depressive Disorder: A pilot study

Melissa Butt, PGDipSci; Dr Jane Elmslie, NZRD, PhD; Associate Professor Sue Luty, DRCOG, PhD (Otago) FRANZCP 1,2
1Dietetic Training Programme, University of Otago, Dunedin, 2Professional Advisor for Dietitians, CDHB Specialist Mental Health Service, 3Mothers and Babies Service, Specialist Mental Health Service, Christchurch

Introduction

Poor nutrition could be both a cause of and a result of depression and other mental illness.

A deficiency of particular nutrients such as omega 6 and 3 fatty acids 3-5, or B vitamins such as folate or B12, have been suggested as possible etiologies for depression 6.

Studies have found that depressed individuals tend to have poorer diet quality than non-depressed individuals 7,8. They consume greater amounts of sugar, fat and salt in their diet than their non-depressed counterparts.

Furthermore, studies have found strong associations between MDD and obesity 9. One such study found women were twice as likely to develop the metabolic syndrome if they were depressed 10. Clinical experience suggests that during the postpartum period New Zealand women with mood disorders may not be meeting national guidelines for healthy eating.

Very few studies have assessed the supplement use in women with depression in the post-partum period. This is of concern as some herbal supplements may interact negatively with antidepressants or worsen symptoms of anxiety. The safety and efficacy of other supplements have received little if any research attention in post partum populations with depression.

Methods

Sixteen women with Major Depressive Disorder (MDD) aged 18-35 years and within 13 months postpartum completed the study.

Participants attended a one hour assessment with the research candidate. Information was collected on participant demographics and dietary supplement use during pregnancy and the postpartum period, using a questionnaire.

Following this, participants completed a multiple pass 24-hour diet recall, and weight and height were measured.

Results

Dietary Intake of Non-breastfeeding participants:
• The mean Energy Intake (8189kJ ± 4869kJ) was below the mean Estimated Energy Requirement (9749kJ ± 8111kJ).
• The mean intake of the following nutrients were below the recommended intake: Fibre, Calcium, Copper, Iodine, folate, Manganese, Potassium, Selenium and Vitamin D
• Mean intake of sodium was above the Upper Level

Dietary Intake of Breastfeeding participants:
• Mean intakes for breastfeeding women reached adequate intake levels for all nutrients except Iodine and selenium
• Mean intake of sodium was above the Upper Level

Supplement Use:
• 34 different supplements were taken by the study population over the previous 12 months
• 87.5% took Folic acid or Folic acid containing supplements during pregnancy

Discussion

Non-breastfeeding women, had a low mean energy intake and nutrient intakes were often inadequate as a result. This is because some women in the non-breastfeeding group were only having one meal a day with fluids and/or snacks. One of these women was referred for further assessment for an eating disorder as a result of this study. As Depressed individuals are more likely to have a co-existing mental disorders it is possible that under-eating is the result of an unrecognized eating disorder, anxiety

Table 1. Dietary Analysis Results

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Mean Intake</th>
<th>RNI</th>
<th>Mean Intake</th>
<th>RNI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy</td>
<td>8189kJ</td>
<td>9749kJ</td>
<td>8189kJ</td>
<td>9749kJ</td>
</tr>
<tr>
<td>Protein</td>
<td>0.85</td>
<td>0.98</td>
<td>0.98</td>
<td>0.98</td>
</tr>
<tr>
<td>Carbohydrate</td>
<td>265.6</td>
<td>237.2</td>
<td>265.6</td>
<td>237.2</td>
</tr>
<tr>
<td>Fat</td>
<td>71.4</td>
<td>55.8</td>
<td>71.4</td>
<td>55.8</td>
</tr>
<tr>
<td>Cholesterol</td>
<td>222</td>
<td>222</td>
<td>222</td>
<td>222</td>
</tr>
<tr>
<td>Sodium</td>
<td>2127</td>
<td>2031</td>
<td>2127</td>
<td>2031</td>
</tr>
<tr>
<td>Magnesium</td>
<td>464</td>
<td>443</td>
<td>464</td>
<td>443</td>
</tr>
<tr>
<td>Calcium</td>
<td>1244</td>
<td>1200</td>
<td>1244</td>
<td>1200</td>
</tr>
<tr>
<td>Iron</td>
<td>14.0</td>
<td>14.0</td>
<td>14.0</td>
<td>14.0</td>
</tr>
<tr>
<td>Iodine</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Folic acid</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
</tr>
</tbody>
</table>

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Objectives

This exploratory study aimed to:
1. Assess whether mean nutrient intakes were meeting standards for adequate intake for New Zealand women in the postpartum period
2. Describe supplement use patterns in postpartum women with depression
3. Describe the characteristics of women with depression in the postpartum period

Table 2. Participant Characteristics

<table>
<thead>
<tr>
<th>Supplement Use Pre-pregnancy</th>
<th>i.e. 2017</th>
<th>Postnatal</th>
<th>2017-2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tocotrienol supplement</td>
<td>12.4%</td>
<td>0.7%</td>
<td>0.4%</td>
</tr>
<tr>
<td>Iron supplement</td>
<td>18.4%</td>
<td>0.4%</td>
<td>0.5%</td>
</tr>
<tr>
<td>Folic acid supplement</td>
<td>12.4%</td>
<td>0.4%</td>
<td>0.4%</td>
</tr>
<tr>
<td>Calcium supplement</td>
<td>10.4%</td>
<td>0.4%</td>
<td>0.4%</td>
</tr>
<tr>
<td>Magnesium supplement</td>
<td>10.4%</td>
<td>0.4%</td>
<td>0.4%</td>
</tr>
<tr>
<td>Vitamin B12 supplement</td>
<td>8.4%</td>
<td>0.4%</td>
<td>0.4%</td>
</tr>
<tr>
<td>Omega-3 fatty acid supplement</td>
<td>6.4%</td>
<td>0.4%</td>
<td>0.4%</td>
</tr>
<tr>
<td>Multivitamin supplement</td>
<td>4.4%</td>
<td>0.4%</td>
<td>0.4%</td>
</tr>
<tr>
<td>Protein supplement</td>
<td>1.4%</td>
<td>0.4%</td>
<td>0.4%</td>
</tr>
<tr>
<td>Other supplements</td>
<td>0.4%</td>
<td>0.4%</td>
<td>0.4%</td>
</tr>
</tbody>
</table>

Supplements during pregnancy:
- 81% took folic acid or supplements containing folic acid during pregnancy

Participant Characteristics:
- Participants had a mean age of 28.7 years.
- 56.2% had a coexisting mental illness
- Half of participants were classified as obese
- 62.5% were receiving income support
- No participant had a qualification greater than a certificate, including trade certificates
- 100% of participants attempted breastfeeding
- The most common reason women reported stopping breastfeeding was inadequate milk production.

Further research could also include information about appetite, pre-pregnancy weight and pre-pregnancy dietary patterns. An FFQ may be a better dietary assessment method to use in this population as it gives a measure of usual intake with a lower respondent burden to other methods.

Conclusions

Further research into the diet of mothers with depression is essential for understanding what dietetics related care is best suited to this demographic.

There are a wide variety of supplements being used by women with depression during pregnancy and the first 12 months postpartum.

References


Contact

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E-mail: PositiveWellnessResearch@unitec.ac.nz

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