Iron-containing supplement use from preconception to six weeks postpartum: a secondary data analysis from a cross-sectional survey among postpartum women in New Zealand

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Abstract

Background: The increased iron intake requirement during pregnancy makes it a more vulnerable time for women to become iron deficient, and oral iron supplement (FeS) is often needed to prevent iron deficiency (ID) and treat ID or iron deficiency anaemia. In New Zealand, the Ministry of Health does not routinely recommend taking oral iron-containing supplements during pregnancy and lactation unless clinically indicated. Limited studies have examined iron-containing supplements use in New Zealand. This study aimed to investigate oral iron-containing supplements usage before, during, and after pregnancy among a cohort of postpartum women in New Zealand.

Methods: This secondary data analysis used data from an anonymous online questionnaire completed by women within six months postpartum, recruited between February and mid-August 2022. This study examined data from demographic and maternal information, and oral FeS and multivitamin supplement (MMNS) use. The formulation and number of women using the different brands of oral FeS and iron-containing MMNS were reported. The average daily elemental iron intake was calculated and categorised into five dose levels: low dose (<30 mg/day), preventative dose (30-65 mg/day), intermediary dose (66-99 mg/day), treatment dose (100-200 mg/day), and high dose (>200 mg/day). Descriptive statistics were reported, including frequencies, percentages, and median (25th, 75th).

Results: Of the 863 women who completed the questionnaire, 600 were included in this analysis. Forty-seven oral iron-containing supplements, including 17 types of oral FeS and 30 types of iron-containing MMNS, were reported taken, with an elemental iron dosage between 5-105 mg per tablet/capsule. Six types of iron-containing MMNS were general MMNS, potentially unsuitable for preconception, pregnant and postpartum women to use. Seventy-five percent of women (n=600) took oral FeS, 43.8% (n=569) used iron-containing MMNS at some stage of preconception, during pregnancy and postpartum, with 30.1% using both and 12% using neither. More women used oral iron-containing supplements with higher dosages during pregnancy than postpartum and preconception. The median (25^{th}, 75^{th}) daily dosage was 21.4 (4.6, 60.4) mg in preconception, 39.5 (7.0, 60.4) mg in the first trimester, 60.4 (18.6, 60.4) mg in the second trimester, 60.4 (29.8, 65) mg in the third trimester, and 20.9 (6.3, 60.4) mg in postpartum. Around half of women during pregnancy (42.9% in the first, 48.5% in the second and 50.5% in the third trimester), 34% in postpartum, and 38% in preconception used preventative dosage. The treatment dosage was mainly taken in the second (10.1%) and the third trimester (12.4%), and less than 1% reported high dosage intake (>200 mg). Almost all (90%) oral FeS used were prescribed, while all MMNS were self-purchased, predominately

(82%) based on women's general knowledge either alone (49.5%) or in combination with other reasons such as information from the internet, books or newspapers; or it was recommended by family or friends or a nutritionist (32.5%).

Conclusion: Oral iron-containing supplements were frequently used around pregnancy. Women took a wide range/array of brands of oral iron-containing supplements, which varied markedly in the amount of elemental iron they contained. The number of women who used oral iron-containing supplements and their dosage align with the increased iron requirement during pregnancy and decreased needs for postpartum. The Lead Maternity Carer (LMC) played an important role in influencing the decision to use and purchase oral FeS. However, most women who took an iron-containing MMNS did so independently of their LMC. This may have resulted in them selecting a supplement containing a level of elemental iron unsuitable for their requirements. Given that an increasing number of women are choosing to take an MMNS, more research is needed to explore what factors women consider when purchasing a supplement and if it even includes elemental iron content so that they can be better informed when it comes to selecting one that will help meet their iron needs and allow them to achieve optimal iron levels around pregnancy.

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List of Abbreviations and Symbols

Abbreviations or symbols	Definition
1st	First
2nd	Second
3rd	Third
et al.	And others
FBC	Full Blood Count
FeS	Iron Supplement
GUiNZ	Growing Up in New Zealand
Hb	Haemoglobin
ID	Iron Deficiency
IDA	Iron Deficiency Anaemia
LMC	Lead Maternity Carer
MMNS	Multiple Micronutrient Supplement
NA	Not Applicable
RDI	Recommended Daily Intake
SF	Serum Ferritin
mg	Milligram
µg	Microgram
L	Litre
mL	Millilitre
%	Percentage
≥	Equal to or greater than
≤	Equal to or less than
±	Plus-minus
&	And

Chapter 1: Introduction

1.1. Background

Iron is an essential mineral, playing a crucial role in many physiological functions, such as oxygen transport, energy production, brain development in early life, cognitive function, DNA synthesis, drug metabolism and immune health (Coad & Pedley, 2014; Michael & Georgieff, 2020; Thompson et al., 2013b; Wardlaw & Smith, 2013). When the storage of iron in the body cannot meet the physiological function demands due to increased requirement (such as during pregnancy), raised blood (iron) loss (such as heavy menstruation), insufficient diet intake or compromised absorption, iron deficiency (ID) results (Coad & Conlon, 2011; Pasricha et al., 2021; Pasricha et al., 2010). If iron storage is further depleted, iron deficient anaemia (IDA), the most severe stage of ID that impacts haemoglobin (Hb) and erythrocyte (red blood cell) production, eventually develops (Coad & Pedley, 2014). Whether or not the presence of IDA, ID can reduce cognitive functions and physical performance (Milman, 2011), while having IDA increases the vulnerability of haemodynamic instability, the need for a blood transfusion, morbidity and mortality rate (Pasricha et al., 2021). Clinically, serum ferritin (SF) is an effective indicator for assessing iron storage and, together with Hb levels, is widely used to evaluate iron levels and to diagnose ID/IDA (Lopez et al., 2016; Pasricha et al., 2021).

Pregnancy is a unique, vulnerable physiological period to ID, especially in the second and third trimesters, primarily due to significantly increased iron requirements (McMahon, 2010). The increased iron is used for the growth of the foetus, maternal blood volume expansion, and development of the placenta and umbilical cord (Bothwell, 2000; McMahon, 2010; Milman, 2011). As part of monitoring anaemia globally, it was estimated that amongst pregnant women (aged 15 to 49 years), the prevalence had decreased from 41% in 2000 to 36% in 2019 (Stevens et al., 2022). A World Health Organization report suggested that ID accounts for approximately 50% of all cases of anaemia among pregnant women (World Health Organization, 2017). This means that in 2019, globally, around 18% of pregnant women may have had IDA. In a New Zealand study in 2017, researchers reported that 7.9% of women in the first trimester, 65% in the second trimester, and 37.6% in the third trimester had ID, and 0.5%, 7.4%, and 5.8% had IDA over the three trimesters (Calje & Skinner, 2017). Further, in the 2014/15 New Zealand Health Survey (biochemical data), anaemia was found to be common amongst women of childbearing age, with 5.2% of women 15 to 24 years, 8.6% of women 25 to 34 years, 15.6% of women 35 to 44 years and 6.2% of women 45 to 54 years (Ministry of Health, 2020b), meaning some women may be entering pregnancy with poor iron status.

In contrast, once the baby is born, the maternal iron requirement is substantially lower than during pregnancy, largely because of expanded cell mass contracting back to the pre-pregnancy state, temporary menstrual cessation and limited iron secretion into breastmilk (Fransson & Lönnerdal, 1980; Means, 2020). Studies in New Zealand have reported low ID/IDA rates in postpartum (Jin et al., 2021; Savage, 2021).

ID and IDA are associated with a wide range of detrimental health impacts ranging from reduced cognition, fatigue, delayed wound healing, vulnerability to postpartum depression in the mother, an increased risk of pre-term labour, low birth weight, and mortality for the foetus, and neonatal anaemia, and delayed neurological development in infants (Derman & Patted, 2023; Means, 2020; Te Whatu Ora, 2022; Te Whatu Ora Lakes, 2024).

As a result, the recommended daily intake (RDI) of iron in New Zealand and Australia increases from 18 mg for a woman over 19 years of age pre-pregnancy to 27 mg during pregnancy and then reduces to 9 mg during lactation (Australian National Health and Medical Research Council & New Zealand Ministry of Health, 2017). However, the dramatically increased iron requirement during pregnancy is challenging to acquire through diet alone (Milman et al., 2016; Roy & Pavord, 2018), and pregnant women often require additional oral iron supplement (FeS) to prevent or treat ID/IDA. Oral FeS has a more than 90-year practical history in treating and preventing ID/IDA (Viteri, 2009), and compared to intravenous and intramuscular administration routes, the oral route of acquiring iron is simple and cost-effective, although its use is sometimes limited by adverse effects which can affect compliance (Macdougall, 1999). Many types of oral FeS are commercially available in New Zealand and can be prescribed or self-purchased (Chemist Warehouse, 2024a; Health 2000, 2023).

Worldwide, there is no consensus on whether oral FeS should be used universally by all pregnant women or selectively by those identified as requiring an oral FeS to prevent ID/IDA. The World Health Organisation recommends universal iron supplementation of 30-60 mg of elemental iron to pregnant women to prevent ID/IDA (World Health Organization, 2012) [The term “elemental iron” indicates the potentially absorbable iron quantity in these compounds (Elias, 2007)]. Similarly, the United States Centers for Disease Control and Prevention and Health Canada advise all pregnant women routinely take oral FeS once pregnancy is confirmed at 30 mg/day and 16-20 mg/day, respectively (Centers for Disease Control and Prevention, 1998; Health Canada, 2009; US Preventive Services Task Force, 2024). In contrast, the United Kingdom, Australia and New Zealand do not recommend routine oral iron supplementation. The oral FeS should be given based on the Hb and SF screening results (Frayne & Pinchon, 2019; Pavord et al., 2012; Te Whatu Ora, 2022; Te Whatu Ora Lakes, 2024; The Royal Australian and New Zealand College of Obstetricians and Gynaecologists,

2019).

In New Zealand, the Ministry of Health advises women to talk to their midwife, doctor or dietitian if they are concerned they may be at risk of ID due to following a vegetarian/vegan diet or have a previous history of ID/IDA (Ministry of Health, 2020; Ministry of Health, 2022). The local Health Boards have established separate guidelines for health professionals to screen and manage ID/IDA during pregnancy and postpartum. Along with dietary intervention strategies, oral FeS is the initial step in ID/IDA treatment during pregnancy (Te Whatu Ora, 2022; Te Whatu Ora Lakes, 2024). For screening, it is recommended that all women should tested for Full Blood Count (FBC), including Hb and SF, at their first antenatal visit (generally during the first trimester), at 28 weeks (the second trimester) or at other times if risk factors are identified (Te Whatu Ora, 2022; Te Whatu Ora Lakes, 2024). If ID is determined without being IDA (based on a low SF level but a normal Hb), an oral FeS containing 60-65 mg of elemental iron should be started (Te Whatu Ora, 2022; Te Whatu Ora Lakes, 2024). If IDA is diagnosed (based on a low SF and Hb), most countries, including New Zealand, agree on a treatment dosage of 100-200 mg of elemental iron per day (Frayne & Pinchon, 2019; Pavord et al., 2012; Siu & US Preventive Services Task Force, 2015; Te Whatu Ora, 2022; Te Whatu Ora Lakes, 2024; US Preventive Services Task Force, 2024; World Health Organization, 2012).

In addition to oral FeS, MMNS (defined in this analysis/study as multiple micronutrient supplement) has become more prevalent. In 2007, Elias identified five types of iron-containing MMNS targeting preconception, pregnancy, and lactation (Elias, 2007), But today, there is an increasing array of iron-containing MMNS designed for conceiving, pregnant, and lactating women available in the New Zealand market (Chemist Warehouse, 2024b). Few studies in New Zealand have reported the use of oral iron-containing supplements (an umbrella term for oral FeS and iron-containing MMNS) around pregnancy (Butts et al., 2018; Calje & Skinner, 2017; Morton et al., 2010; Savage, 2021), and usually the usage has been briefly summarised alongside other topics. The main study about oral iron-containing supplements usage, as reported by Growing Up in New Zealand (GUiNZ), was over a decade ago. None of these New Zealand studies have reported what preparations the women took, how much they took per day, and whether it was prescribed or self-purchased, suggesting the research gap in this topic.

1.2. Purpose of the study

This study is designed to investigate the usage of oral iron-containing supplements among postpartum women in New Zealand. This may provide insights into what, how many, and how much oral iron-containing supplements women were taking and whether the oral iron-containing supplements were prescribed or self-purchased in preconception (the three months

before pregnancy), three trimesters during pregnancy, and postpartum. Understanding current iron supplement usage may provide insights that could improve the management of ID and IDA in pregnant and postpartum women.

1.3. Study aim

This study aimed to investigate oral iron-containing supplements usage, including type, daily intake, and whether it was prescribed or self-purchased, in a group of postpartum New Zealand women in preconception, during the three trimesters of pregnancy and postpartum.

1.3.1. Objectives

1. To identify what iron-containing supplements were taken by New Zealand postpartum women during preconception (the three months before pregnancy), three trimesters in their pregnancy and postpartum period (first six weeks following childbirth).

2. To calculate the daily elemental iron intake from oral FeS and iron-containing MMNS across the preconception, three trimesters of pregnancy and postpartum period.

3. Explore the reasons for taking oral iron-containing supplements and whether it was prescribed or self-purchased.

1.4. Thesis structure

This thesis is structured into four chapters and appendices. **Chapter One** introduces the background, outlines the aim and objectives, provides the overall structure of the thesis, and lists the researchers' contributions. **Chapter Two** reviews the extended, contemporary literature that covers the general information on iron, especially around pregnancy, what happens when iron intake is insufficient (ID/IDA), oral iron-containing supplements and their guidelines, and studies that have reported oral iron-containing supplements usage. **Chapter Three** is a manuscript consisting of five parts: abstract, introduction, methodology, result, discussion and conclusion. The research manuscript is targeted for publication in the journal Nutrients. This is followed by **Chapter Four**, a concluding chapter summarising the study, reflecting on the strengths and limitations and providing recommendations for future studies and clinical practices. Finally, **The Appendices** include the study poster, information sheet, study information questionnaire and supplementary results.

1.5. Researchers' contributions

Table 1.1. Researcher's contributions to the study

Author	Contribution to thesis
Yuan. Dai MSc Nutrition and Dietetics Candidates	Primary author, literature review, data analysis, results interpretation, finalising and submission of thesis chapters
Dr Ying Jin Primary Supervisor Senior Lecturer School of Health Sciences	Research design, ethics application, recruiting participants, data collection, supporting data analysis, assisting with results interpretation, revised and approved the thesis chapters.
Dr Cheryl Gammon Co-Supervisor Lecture School of Health Sciences	Research design, ethics application, recruiting participants, data collection, supporting data analysis, assisting with results interpretation, revised and approved the thesis chapters.

Chapter 2: Literature Review

2.1. Introduction

The current knowledge of oral iron-containing supplements usage among women before, during, and after pregnancy is limited. The overarching purpose of this literature review is to answer the question of what is currently known about oral iron-containing supplements among this population. This chapter discusses iron and the increased requirements during pregnancy, the consequences of an inadequate intake (iron deficiency/iron deficiency anaemia (ID/IDA), oral iron-containing supplements [an umbrella term for oral iron supplement (FeS) and iron-containing multiple micronutrient supplement (MMNS)] and the guidelines around their use, and the studies on oral iron-containing supplements usage in New Zealand, and one study from Australia. Databases included Massey Discovery, Google Scholar, MEDLINE/PubMed, Scopus, and Science Direct. Ministry of Health websites were used to search for oral FeS guidelines and ID statistics. The research period was between November 2023 to December 2024. The search criteria were:

- Pregnant OR pregnancy OR gestation OR prenatal OR maternal OR breastfeeding OR postpartum OR lactating OR lactation
- Iron deficiency OR ID OR Anaemia OR IDA
- Iron guidelines OR pregnancy guidelines OR iron recommendations
- Supplement OR supplements OR supplementation OR multivitamin OR iron supplements OR single iron supplements OR iron in multivitamins
- Ferrous iron OR ferrous fumarate OR ferrous sulphate OR amino acid chelate iron OR iron glycinate OR iron bisglycinate OR ferrous glycinate
- New Zealand OR Aotearoa OR NZ OR Australia OR developed countries

2.2. Iron

Iron is a vital trace mineral for humans, crucial in various physiological functions. Many of its roles stem from its ability to switch between two valency states, the reduced ferrous form (Fe^{2+}) and the oxidised ferric form (Fe^{3+}), which enable iron to accept and donate a single electron performing oxidation-reduction reactions (Coad & Pedley, 2014; Scientific Advisory Committee on Nutrition, 2010). In adults, most of the iron in the body is present as haemoglobin (Hb) (60-70%) and myoglobin (10%) in erythrocytes (red blood cells) (Scientific Advisory Committee on Nutrition, 2010).

2.2.1. The importance of iron

The primary role of iron is oxygen transportation. Haemoglobin is responsible for transporting oxygen from the lungs to the body, and myoglobin, a structurally similar protein, transports and stores oxygen within muscles (Scientific Advisory Committee on Nutrition, 2010). Iron is also an irreplaceable component in the cytochrome and iron-sulphur proteins, involved in the electron transport chain and the tricarboxylic acid cycle for energy production (Scientific Advisory Committee on Nutrition, 2010; Thompson et al., 2013b). Beyond its roles in carrying oxygen and energy production, iron also contributes to cognitive function, steroid hormone production, DNA synthesis, drug metabolism, and immune health (Coad & Pedley, 2014; Thompson et al., 2013b). All these physiological roles underscore the importance of adequate iron intake to maintain overall health.

2.2.2. Iron in food sources

Iron-containing foods include animal sources such as meat, fish, and poultry, plant sources such as beans, lentils, and tofu, and some prepared foods such as iron-fortified breakfast cereals (Ministry of Health, 2020). There are two iron forms in diet: haem and non-haem iron. Haem iron, present as an iron complex in ferrous iron, is only available in animal products. When released from Hb or myoglobin during digestion, haem iron is readily absorbed in the small intestine. In contrast, non-haem iron primarily exists as ferric iron, found in both animal and plant foods, but is the sole type in plant foods and has a significantly lower absorption rate (Lopez et al., 2016; Piskin et al., 2022; Thompson et al., 2013b).

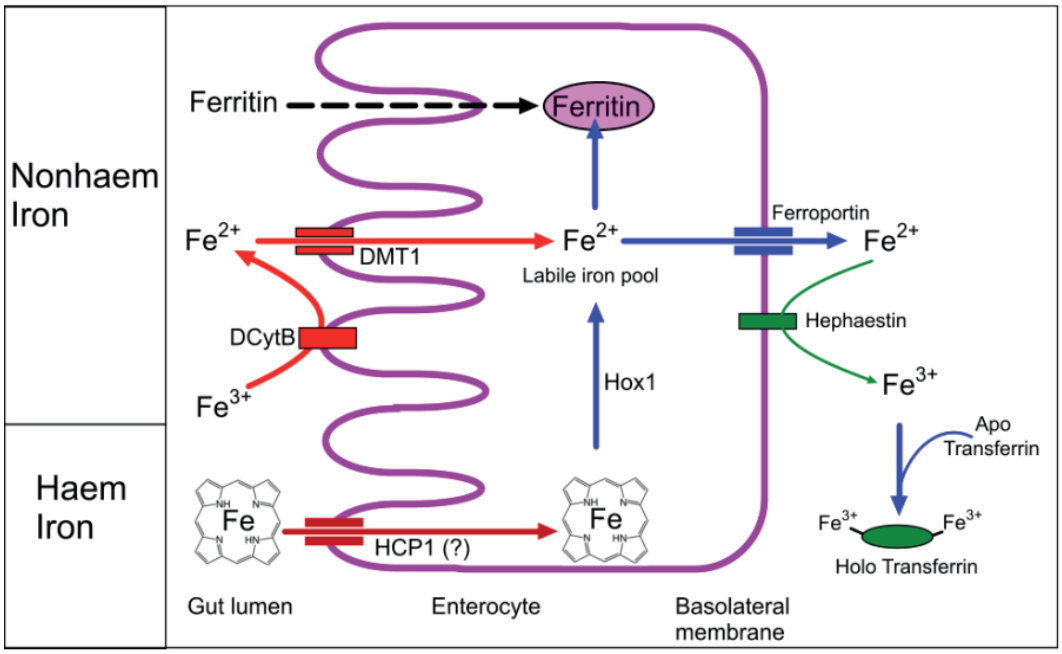
There are factors in some foods that can either enhance or impair non-haem iron absorption. The facilitators include vitamin C (which reduces ferric iron to ferrous iron) and meat factor protein, found in meat, fish and poultry. If animal food is eaten simultaneously with plant food, the meat factor protein can enhance non-haem iron absorption (Ministry of Health, 2020; Piskin et al., 2022; Thompson et al., 2013b). Inhibiting factors in plant-based foods include phytate, vegetable proteins, fibre, and polyphenols. These substances can bind with ferric iron and form an indigestible complex (Thompson et al., 2013b). Other divalent metals, such as calcium (rich in dairy products), can affect iron absorption from both haem and non-haem sources due to the complete absorption binding site with iron (Coad & Pedley, 2014; Thompson et al., 2013b).

2.2.3. Iron homeostasis

Although iron is an essential micronutrient that plays crucial roles in the body, consuming too much iron can be toxic, and the body has limited ways of eliminating excess iron. For these reasons, iron levels and homeostasis are tightly regulated (Coad & Pedley, 2014; Wardlaw & Smith, 2013).

One mechanism by which the body can regulate iron levels is through how much dietary iron is absorbed by enterocytes in the small intestine (Whitney et al., 2019). Once in the enterocyte, mucosal ferritin, the temporary iron storage protein, will hold onto the iron. If the body has sufficient iron, dietary iron will remain in enterocytes and be excreted with shed intestinal cells as faeces after their two to five-day cycle (Whitney et al., 2019). If the body needs more iron, more dietary iron is absorbed. Heme iron is transported from the lumen into the enterocyte by Heme Carrier Protein 1 (HCP-1), whose expression is upregulated in response to low iron levels. In contrast, non-heme iron, which as mentioned above, predominantly exists in the ferric form (Fe^{3+}), needs to be reduced to ferrous iron (Fe^{2+}) before it can be transported into the enterocyte by the divalent metal ion transporter 1 (DMT1). Once absorbed, the iron is either stored intracellularly as ferritin or transported across the basolateral membrane of the enterocyte by ferroportin, an iron-export protein. Once in the bloodstream, iron is bound to transferrin and delivered throughout the body (Figure 2.1) (Coad & Pedley, 2014).

Figure 2.1. ***Dietary Iron Absorption Crosses the Enterocyte***



DMT1: Divalent metal ion transporter 1; DCytB: Duodenal cytochrome B;
Hox1: Haem oxygenase-1; HCP1: Haem carrier protein 1
(Coad & Pedley, 2014:p.83)

The amount of iron entering the blood circulation is regulated by the secretion of hepcidin, a peptide hormone from the liver, which causes the sequestration of iron by the enterocytes and macrophages. For example, when too much iron is present in the body, hepcidin production rises to bind to ferroportin, which reduces the amount of iron that can be exported into the bloodstream. Conversely, when there is insufficient iron in the body, less hepcidin is made, which allows more ferroportin to be available to export iron into the blood circulation (Coad &

Pedley, 2014; Means, 2020).

Iron balance is also achieved by recycling iron from the breakdown of erythrocytes via macrophages into the circulating iron pool instead of consistently absorbing iron exogenously to make a new generation of erythrocytes every three months (Thompson et al., 2013b; Whitney et al., 2019). Combined with controlled dietary iron absorption, dietary requirements are generally low for those with low iron loss such as in men and non-menstruating women.

Any surplus iron is stored in ferritin, predominantly in hepatocytes (Whitney et al., 2019). A small amount is present in serum called serum ferritin (SF). Serum Ferritin is the source of ready-to-use iron when dietary intake is inadequate to meet the demand or iron loss is high (such as during pregnancy or heavy menstruation) (Thompson et al., 2013b; Whitney et al., 2019). It is easily detectable and acts as a good indicator for assessing iron storage without inflammation (Lopez et al., 2016; Pasricha et al., 2021).

2.2.4. Iron requirements in pregnancy and lactation

Pregnancy, a unique and vulnerable physiological period, is a time when women are particularly susceptible to ID primarily due to significantly increased iron requirements and the challenge of acquiring sufficient iron through diet alone. The iron requirement is not evenly distributed throughout the pregnancy (Bothwell, 2000). The first trimester does not require much more iron due to menstruation savings, but requirements are dramatically raised in the second and third trimesters of pregnancy to support blood volume expansion and foetus growth (Bothwell, 2000; McMahon, 2010). Extra iron is also needed to grow the placenta and umbilical cord and compensate for blood (iron) loss at delivery (Milman, 2011). Hence, the Recommended Daily Intake (RDI) during pregnancy is the highest compared to other life stages, at 27 mg/day (Australian National Health and Medical Research Council & New Zealand Ministry of Health, 2017) (Table 2.1).

During pregnancy, it can be challenging for many women to consume adequate iron via their diet alone. A 2,000 kcal/day Western diet typically provides about 12 mg of iron (Thompson et al., 2013b), significantly below the RDI of 27 mg. The challenge to have sufficient dietary iron intake could be even more notable in groups at increased risk of ID/IDA, such as those adopting a vegetarian diet, those with multiple pregnancies, adolescent pregnancies, low socioeconomic status and short pregnancy intervals (Te Whatu Ora, 2022). Moreover, although dietary strategies can boost iron status in pregnant women in some circumstances and iron absorption is enhanced in pregnancy (Wardlaw & Smith, 2013; Whitney et al., 2019), relying solely on diet strategies is not always ideal. They may not elevate iron indices as quickly

as required during pregnancy (Elias, 2007). Therefore, for those identified with ID/IDA during pregnancy, it is impractical to rely upon diet alone to restore and achieve a dramatically raised iron requirement, so iron supplementation is needed (Pavord et al., 2012; Roy & Pavord, 2018).

In contrast, once the baby is born, the maternal iron requirement is substantially lower than during pregnancy (Table 2.1). This is primarily due to the maternal blood volume returning to its pre-pregnancy level and expanded red cell mass contracting within one to six weeks after delivery (Means, 2020). Other physiological reasons also play a role. Firstly, several months into breastfeeding, women will likely save iron due to a temporary cessation of menstruation. Secondly, although iron is present in breast milk, which is viewed as an iron loss, only a low amount of iron is contained in breast milk (around 0.3 mg/L), and the form in breastmilk is highly bioavailable for the neonate/infant (Fransson & Lönnerdal, 1980). Due to the low requirement, acquiring sufficient iron through diet alone during this period is typically practical. Hence, iron supplement is generally not recommended for lactation mothers except for those who experienced significant haemorrhage or/and had ID during pregnancy (Te Whatu Ora, 2022).

The Upper Level of intake is set up for the highest daily intake to pose no risks of adverse health effects for most individuals. For adults, the upper level of iron intake is 45 mg/day in New Zealand, based on the estimate from a supplementation study and a median dietary intake of a population study. Due to limited available data for pregnancy and lactation, the upper level of intake of 45 mg/day was applied to these groups (Australian National Health and Medical Research Council & New Zealand Ministry of Health, 2017).

Table 2.1. Recommended Daily Intake (RDI) and Estimated Average Requirement (EAR) of elemental iron in childbearing-aged women

Age	Pregnancy (RDI)	Pregnancy (EAR)	Lactation (RDI)	Lactation (EAR)	Non-pregnant Adolescents and Women (RDI)	Non-pregnant Adolescents and Women (EAR)
14-18 years	27 mg/day	23 mg/day	10 mg/day	7 mg/day	15 mg/day	8 mg/day
19-30 years	27 mg/day	22 mg/day	9 mg/day	6.5 mg/day	18 mg/day	8 mg/day
31-50 years	27 mg/day	22 mg/day	9 mg/day	6.5 mg/day	18 mg/day	8 mg/day

(Australian National Health and Medical Research Council & New Zealand Ministry of Health, 2017)

2.3. Iron deficiency (ID) and iron deficiency anaemia (IDA)

As discussed, iron levels are closely controlled in the body, but a range of factors can disrupt iron homeostasis and lead to ID. These include excessive blood loss (heavy menstruation),

inadequate dietary intake and compromised absorption, and increased physiological demand in certain life stages, such as during pregnancy (Pasricha et al., 2021; Thompson et al., 2013b; Whitney et al., 2019). Iron deficiency can be categorised into three stages based on severity: iron depletion, marginal ID, and iron deficiency anaemia (IDA) (Coad & Conlon, 2011; Coad & Pedley, 2014).

2.3.1. Category of ID

Iron depletion, or mild ID, refers to decreasing iron storage without affecting iron-dependent protein production. At this stage, SF levels are reduced from normal (100±60 µg/L) to 20 µg/L (Coad & Conlon, 2011). Because iron-dependent proteins' production is unaffected, Hb level is maintained at the normal range of 120-160 g/L. This stage generally has no symptoms (Coad & Conlon, 2011; Coad & Pedley, 2014; Thompson et al., 2013b).

The second stage, marginal ID, also known as iron deficiency erythropoiesis, or ID, is manifested by the further exhaustion of SF level down to 10 µg/L and the reduction of transferrin saturation from a healthy level of 35%±15 to <15% (Coad & Conlon, 2011; Thompson et al., 2013b). Iron deficiency can be symptomatic, with common signs being fatigue, lethargy, reduced concentration, and dizziness (Coad & Pedley, 2014; Pasricha et al., 2021). Although Hb production remains normal at this stage, the production of other iron-dependent proteins, such as iron-dependent dehydrogenase involved in the electron transport chain, will be affected (Coad & Conlon, 2011; Coad & Pedley, 2014). This leads to low energy production, which results in low endurance, low energy efficiency, and muscle fatigue (Coad & Pedley, 2014). Conversely, physiological adaptation means some people can remain less symptomatic at this stage (Coad & Pedley, 2014).

The third and most severe stage of ID is IDA, which is one type of microcytic anaemia (Thompson et al., 2013b). At this stage, SF levels fall to <10 µg/L. Low iron in the body leads to impaired Hb in erythropoiesis production, resulting in low Hb levels (<120 g/L in non-pregnant women or <110 g/L in pregnant women) and microcytic (small) and hypochromic (pale) erythrocytes (Coad & Conlon, 2011; Coad & Pedley, 2014; World Health Organization, 2011). In IDA, healthy Hb and erythrocytes are too few to transport oxygen adequately or produce sufficient energy; these changes lead to classic symptoms of IDA including pallor, fatigue, and headache (Coad & Pedley, 2014; Lopez et al., 2016).

2.3.2. Maternal and foetus consequences of ID/IDA

Besides the range of troublesome symptoms such as fatigue, dizziness and breathlessness that may impact a person's quality of life, having ID/IDA in pregnancy can lead to an increased risk of maternal infections, placenta hypertrophy, caesarean delivery, postpartum

haemorrhage and even maternal mortality (Coad & Conlon, 2011; Drukker et al., 2015; Huang et al., 2001; Milman, 2011; Omotayo et al., 2021; Te Whatu Ora, 2022). For postpartum mothers, besides delayed wound healing and reduced cognition function (Beard et al., 2005; Te Whatu Ora, 2022), having ID/IDA can also negatively impact a woman's mental health status, with studies showing associations with increased rates of postpartum depression and impaired mother-child interactions and bonding (Beard et al., 2005; Murray-Kolb & Beard, 2009).

Evidence suggests there is a connection between maternal ID/IDA and poor pregnancy outcomes for the offspring, which include an elevated vulnerability to pre-term delivery, low birth weight, and even perinatal and neonatal mortality (Allen, 2000; Derman & Patted, 2023). Although the foetus is prioritised over the mother for receiving iron, moderate to severe maternal ID has been shown to affect the foetus's brain development and neonatal brain structure (Means, 2020; Michael & Georgieff, 2020). Maternal IDA can lead to decreased infant iron stores at birth, which, if not addressed, can increase the offspring's susceptibility to IDA within 12 months after birth (Allen, 2000; Te Whatu Ora, 2022).

2.3.3. Prevalence of ID/IDA amongst pregnant and lactation women in New Zealand

In the 2014/15 New Zealand Health Survey (which collected biochemical data), anaemia was found to be common amongst women of child-bearing age at 5.2% for 15-24 aged women, 8.6% for 25-34 aged women, 15.6% for 35-44 aged women, and 6.2% for 45-54 aged women, respectively (Ministry of Health, 2020b). The level of anaemia prevalence suggests that some New Zealand women may have low iron stores as they enter pregnancy.

A retrospective study in the Canterbury area in 2013, which investigated pre- and postnatal iron status among 189 women via 21 midwives' clinical management documents, indicated significant rates of ID (defined as SF <20 µg/L or SF <50 µg/L when C-reactive protein >5 mg) in the second trimester at 65% (n=123) and the third trimester during pregnancy at 37.6% (n=71) compared to 7.9% (n=15) for the first trimester (Calje & Skinner, 2017). The researchers further reported IDA (Hb <110 g/L in the first trimester and Hb <105 g/L in the second and the third trimester, with ID) rates of 0.5% (n=1), 7.4% (n=14), and 5.8% (n=11) for the three trimesters individually (Calje & Skinner, 2017).

In 2019, Brown et al., using an online questionnaire completed by 458 pregnant women across the country, revealed ID as the most common self-reported diagnosis (48%, n=219) during pregnancy (Brown et al., 2020). A slightly higher self-reported ID diagnosis rate during pregnancy was found at 57.1% (n=76) in another cross-sectional, observational study that

aimed to investigate the iron status of infants and their mothers (n=133 pairs) in Auckland before complementary feeding started (between 3 to 6 months postpartum) (Savage, 2021).

For postpartum, a New Zealand study (n=87), which aimed to investigate postpartum women's thyroid function, reported the ID (Hb ≥120 g/L and SF <12 μg/L) in six months postpartum women as 4.2% (n=3) with no IDA (Hb <120 g/L and SF <12 μg/L) cases (Jin et al., 2021). In Savage's study, a low ID (Hb ≥120 g/L and SF <15 μg/L) rate of 0.8% (n=1) and no IDA (Hb <120 g/L and SF <15 μg/L) was reported in three to six months postpartum women. Savage further reported 13 cases (9.8%) of mild ID (Hb ≥120 g/L and SF =15-29 μg/L) and ten (7.5%) cases of iron overload (SF ≥150 μg/L) (Savage, 2021).

2.3.4. New Zealand guidelines for screening ID/IDA of pregnant and postpartum women

In New Zealand, pregnant women are recommended to be screened for ID/IDA with a Full Blood Count (FBC), including Hb at the first antenatal appointment and 28 weeks (The Royal Australian and New Zealand College of Obstetricians and Gynaecologists, 2019). There is no set recommendation for SF level testing, but Te Toka Tumai Auckland recommends measuring SF levels together with FBC at booking, around 28 weeks, or at any point during pregnancy when additional risk factors are identified. These include the presence of red blood cell antibodies, refusal of a blood transfusion (for example, post-surgery or injury), or there is a history or a suspicion of ID/IDA due to factors such as the woman consuming a vegetarian/vegan diet, being an adolescent, having low socioeconomic status, a short pregnancy interval, or multiple pregnancies (Te Whatu Ora, 2022). The Lakes District Health Board suggests routine FBC and SF screening in the first and second trimesters and additional tests in the third trimester if ID/IDA is present earlier (Te Whatu Ora Lakes, 2024). Further, The Lakes District Health Board provides clear guidance for early postpartum women ID/IDA screening, suggesting a universal review of Hb and SF results with the latest blood result on labour admission and repeat FBC if the latest result showed Hb ≤104 g/L (Te Whatu Ora Lakes, 2024).

2.4. Oral iron-containing supplements

To compensate for the detrimental health effects caused by ID/IDA in pregnancy and postpartum, oral iron supplementation is often used for the prevention and treatment of ID/IDA. It is an effective and safe clinical strategy (Lopez et al., 2016; Pasricha et al., 2010; Pavord et al., 2012; Snook et al., 2021) and is reviewed as one of the first-line treatments during pregnancy in New Zealand (Te Whatu Ora, 2022; Te Whatu Ora Lakes, 2024). Compared to intravenous and intramuscular administration routes, the oral route of acquiring iron is simple

and cost-effective. However, its use can be limited by the adverse side effects associated with taking oral iron, which can also affect compliance (Macdougall, 1999).

2.4.1. The classification of oral iron-containing supplements

Oral iron-containing supplements include: 1) oral supplements where iron is the sole ingredient or the key ingredient, an oral iron supplement (FeS); or 2) iron is part of a multiple micronutrient supplement (MMNS), more commonly known as a multivitamin supplement. In addition to iron, oral FeS may also contain other nutrients, such as vitamin C to support iron absorption, vitamin B6 to support Hb production, folic acid, and vitamin B12 to prevent macrocytic and pernicious anaemia (Thompson et al., 2013b). The MMNS aim to supplement the micronutrients normally found in an individual's diet (New Zealand Medicines and Medical Devices Safety Authority, 2024).

Ferrous iron is generally considered more readily absorbed than ferric iron because ferric iron must first be reduced to the ferrous form (New Zealand Formulary, 2024). When making iron tablets/capsules, to stabilise ferrous iron, it is combined with other compounds, such as fumarate or sulphate, to form ferrous salts (Elias, 2007). Other iron preprations, including iron (ferric) polymaltose complex (Maltofer®) and amino chelated ferrous preparations (ferrous glycinate/bisglycinate), are also commonly seen in New Zealand. The term "elemental iron" indicates the potentially absorbable iron quantity in these compounds (Elias, 2007).

Oral iron-containing supplements can be further classified depending on how much elemental iron the supplements contain. Under the Medicines Regulations, if the supplement contains more than 24 mg of iron per recommended daily dose, it is classified as a pharmacy only medicine, meaning it can only be purchased from a pharmacy. Whereas, if it contains 24 mg or less, it is classified as general sales medicine, which means it can be purchased from other retail outlets and pharmacies, such as health shops and supermarkets, instore or online (New Zealand Government, 2024; New Zealand Medicines and Medical Devices Safety Authority, 2019). Practitioner only products refer to products that are required to be recommended by a qualified health professional, such as a naturopath or pharmacist, after a consultation (New Zealand Medicines and Medical Devices Safety Authority, 2020).

Table 2.2 shows the main pharmacy only oral FeS that can be prescribed or purchased by New Zealand pregnant and lactating women to prevent or treat ID/IDA. Except for Maltofer®, the other five preparations are included in the pharmacological schedule (The Pharmaceutical Management Agency, 2024). If oral FeS is prescribed, most preparations are fully funded, so the patient only needs to pay the $5 prescription tax unless their pharmacy has free prescriptions. However, Ferrograd C® and Maltofer® tablets are not funded in New Zealand and are a cost to the patient (Table 2.2). Besides pharmacy only oral FeS, a wide range of

general sales of oral FeS are commercially available from pharmacies, health stores, and online in New Zealand (Chemist Warehouse, 2024a; Health 2000, 2023).

Table 2.2. The main pharmacy only oral FeS which can be prescribed to or purchased by New Zealand pregnant and lactating women

Brand	Content	Type of iron	Dosing regime
Tablet Form			
Ferro-Tab®	Ferrous fumarate 200 mg equivalent to elemental iron 65 mg	Ferrous fumarate	Prophylaxis: Adult 1 tablet once or twice daily (equivalent to 65 mg or 130 mg of elemental iron)
			Treatment: Adult 1 tablet three times daily (equivalent to 195 mg of elemental iron)
Ferrograd®	Ferrous sulphate 325 mg equivalent to elemental iron 105 mg	Ferrous sulphate (modified release)	Adult 1 tablet once daily (equivalent to 105 mg of elemental iron)
Ferro-F Tab®	Ferrous fumarate 310 mg equivalent to elemental iron 100 mg Folic acid 350 µg	Ferrous fumarate	Adult 1 tablet once daily (equivalent to 100 mg of elemental iron)
Ferrograd C® **(Not funded on a prescription)**	Ferrous sulphate 325 mg equivalent to elemental iron 105 mg Sodium ascorbate 562.4 mg	Ferrous sulphate (modified release)	Adult 1 tablet once daily (equivalent to 105 mg of elemental iron)
Maltofer® **(Not funded on a prescription)**	Iron polymaltose 370mg equivalent to elemental iron 100 mg	Iron polymaltose	Prophylaxis of ID: if ferrous iron is not tolerated or is inappropriate, 1 tablet once daily (equivalent to 100 mg of elemental iron)
			Treatment of IDA: if ferrous iron is not tolerated or is inappropriate, 1-2 tablets once daily (equivalent to 100 mg or 200 mg of elemental iron)
liquid Form			
Ferodan®	Each mL oral solution contains 30 mg of Ferrous sulphate heptahydrate equivalent to elemental iron 6 mg	Ferrous sulphate heptahydrate	Adult 15-30 mL daily in three divided doses (equivalent to 90-180 mg of elemental iron)

(New Zealand Formulary, 2024; The Pharmaceutical Management Agency, 2024)

2.4.2. Using oral iron-containing supplements to prevent and treat ID/IDA

Clinically, oral FeS are used to prevent or treat ID/IDA (Lopez et al., 2016). The most used ferrous salts are ferrous fumarate and ferrous sulphate, with similar absorption rates, tolerance, and efficacy (New Zealand Formulary, 2024; Pasricha et al., 2010). Once oral FeS is given, Hb concentrations are expected to increase by 1-2 g/L per day or 20 g/L over three to four weeks (Lopez et al., 2016; New Zealand Formulary, 2024; Pasricha et al., 2010; Pavord et al., 2012). After two to three weeks, a follow-up Hb and SF screening test is recommended, and if the response is not within the range, iron infusion should be considered (Te Whatu Ora, 2022).

Worldwide, there is no consensus on whether oral FeS should be used universally (for every pregnant woman) or selectively for IDA prophylaxis. The World Health Organisation recommended universally supplementing 30-60 mg of oral FeS during pregnancy (World Health Organization, 2012). Similarly, the United States Centers for Disease Control and Prevention and Health Canada advise all pregnant women to routinely take oral FeS since pregnancy confirmed at 30 mg/day and 16-20 mg/day, respectively (Centers for Disease Control and Prevention, 1998; Health Canada, 2009; US Preventive Services Task Force, 2024). In contrast, the United Kingdom, Australia and New Zealand recommend the use of use oral FeS selectively based on Hb and SF screening results (Frayne & Pinchon, 2019; Pavord et al., 2012; Te Whatu Ora, 2022; Te Whatu Ora Lakes, 2024). If IDA is diagnosed, most countries agree on a treatment dosage of 100-200 mg per day (Frayne & Pinchon, 2019; Pavord et al., 2012; Siu & US Preventive Services Task Force, 2015; Te Whatu Ora, 2022; Te Whatu Ora Lakes, 2024; World Health Organization, 2012).

Iron-containing MMNS are not recommended for preventing or treating ID/IDA compared to oral FeS because most iron-containing MMNS contain low amounts of elemental iron (Pasricha et al., 2010). A randomised, double-blind Danish study in 2005 supplementing women with various dosages of ferrous fumarate from 18 weeks of pregnancy to eight weeks postpartum identified that the lowest effective daily elemental iron to prevent or treat ID and IDA is 40 mg (Milman et al., 2005), which the majority of iron-containing MMNS do not contain (Milman et al., 2016). This finding was later supported by a recent Canadian study (n=60), which gave pregnant women MMNS containing 27 mg of elemental iron (based on RDI) from 8 to 21 weeks for 16 weeks. This study found that 27 mg of elemental iron from MMNS was inadequate to meet the iron requirement for later pregnancy, with 81% had an SF <30 µg/L when measured between 24-38 weeks of gestation (Cochrane et al., 2022). Besides the low quantity, the competitive absorption interactions between iron and other divalent minerals such as calcium, magnesium, zinc, copper, manganese, and cobalt, which may also be present in MMNS, could lead to a low absorption rate of iron (Milman, 2012; Pasricha et al., 2010).

Although not recommended for preventing or treating ID/IDA, using MMNS is prevalent in New Zealand, with one study reporting that 62% of women were using an MMNS during pregnancy (Morton et al., 2010). MMNS can be purchased and used for multiple purposes. An Australian focus group study (n=40) found that most women took MMNS as a reassurance plan to meet their essential micronutrient requirements. Advice from health professionals such as general practitioners, midwives, or obstetricians, as well as the marketing of supplements by the manufacturers, were also factors identified as promoting MMNS use (Malek et al., 2018).

In MMNS marketing, the brands create an image that women require MMNS products to achieve optimum health, which is not always true. For example, the Elevit® breastfeeding multivitamins website states that their product contains Betacarotene (for baby's vision and eye health), Omega-3 (DHA) (promote baby's brain development and eyesight), Iodine (assists with baby's brain development); B Group vitamins & iron (assists with energy requirements Vitamin D to aid calcium absorption, and Zinc & Vitamin C (supports healthy immunity) (Bayer Pharmaceuticals, n.d.). It suggests to women that even when consuming a healthy diet, it can be difficult to meet the recommended micronutrients to support the health of both the mother and the growing infant (Bayer Pharmaceuticals, n.d.). The information provided by the website could potentially lead lactating women to become concerned that they might not have sufficient micronutrient intake through their diet and to be fearful of adverse health outcomes during the lactation period for themselves and their infant. However, as discussed in the case of iron, the requirement during the lactation period is the lowest at 9 mg per day (Australian National Health and Medical Research Council & New Zealand Ministry of Health, 2017). This is the amount of elemental iron provided per dose from Elevit breastfeeding multivitamins, but this amount of iron can also be acquired from diet alone. In a New Zealand observational study which reported the dietary intake of iron of a group of postpartum women (around 6 to 8 weeks), the mean intake was 16.1 mg per day for Asian women, 13.3 mg for Māori and Pasifika island women, and 14.8 mg for New Zealand European women (Butts et al., 2018).

2.4.3. Adverse effects and safety of oral iron-containing supplements

Adverse effects of oral FeS are commonly reported when the intake level is approximately 40-50 mg/day (Brown & Wright, 2020). The most common adverse effects associated with oral FeS (ferrous sulphate) are constipation (12%), nausea (11%) and diarrhoea (8%) (Tolkien et al., 2015). Nausea is dosage-related, but how iron dosage affects bowel habits remains unclear (New Zealand Formulary, 2024; Pavord et al., 2012). The gastrointestinal symptoms can reduce the compliance rate with the therapy, negatively impacting the adequacy and effectiveness of the treatment (Pasricha et al., 2021). The modified-release preparations release iron gradually along the gastrointestinal tract. These preparations tend to have fewer

adverse effects, but this may be because overall, they are less well absorbed, with not all of the iron being available in the first part of the duodenum where maximum iron absorption occurs (New Zealand Formulary, 2024; Pasricha et al., 2021). The iron-containing MMNS usually contains a low dosage of iron (<30 mg), associated with fewer adverse effects.

Acute toxicity is defined as orally ingesting more than 30 mg/kg of elemental iron, and the lethal dosage is 180-300 mg/kg of elemental iron (New Zealand Medicines and Medical Devices Safety Authority, n.d.). The body regulates iron levels by altering the absorption rate via the hepcidin hormone and stores the extra iron in ferritin. Hence, oral FeS has a low risk of causing toxicity in adults (Brown & Wright, 2020; Elias, 2007). Additionally, many women who experience adverse effects are less likely to reach toxic levels as they have passively reduced the consumption of iron-containing supplements. However, some emerging evidence suggests that too much elemental iron from oral FeS may negatively impact iron-sufficient women (Pavord et al., 2012). The detrimental effects include interfering with other essential divalent cations absorption and oxidative stress generated by non-absorbed elemental iron, which can damage the intestinal epithelium, placenta and other organs (Coad & Pedley, 2014; Pavord et al., 2012). In 2022, a narrative review of 14 clinical trials, case-control or cohort studies suggested that oral iron-containing supplements may increase vulnerability to gestational diabetes in pregnant women, possibly due to oxidative stress-related insulin resistance and insufficient insulin secretion (Petry, 2022). Further, raised Hb levels from excessive oral FeS, when above 130 g/L, were shown to be associated with adverse pregnancy outcomes, including increased rate of preterm birth, low birth weight, and raised infant mortality (McMahon, 2010; Pavord et al., 2012).

The exception to iron toxicity is a genetic condition called haemochromatosis, where iron levels slowly build up in the body over many years to cause iron overload. If untreated, severe health consequences can result, including damage to the heart, liver, kidneys, and central nervous system and death (Thompson et al., 2013b).

Regarding MMNS safety, a German study based on nine international clinical trials during pregnancy concluded that no adverse effects were reported and that using MMNS from preconception to delivery was safe when the dosage of the ingredients was within the RDI recommendations (Biesalski & Tinz, 2017). Nevertheless, the effects of high dosages in some MMNS (above the RDI recommendation) and the use of these products during pregnancy are not yet clear (De Boer et al., 2018). For example, while it is recognised that for some nutrients, such as vitamin A, taking a supplement that increases a woman's intake to three to four times over the RDI can lead to toxicity symptoms and even cause severe birth defects and spontaneous abortion (Thompson et al., 2013a). For other micronutrients the effects are still

to be fully investigated. In the case of iron, although elemental iron contained in iron-containing MMNS is generally low, the frequent use of both iron-containing MMNS and oral FeS could lead to the safety threshold of 300 mg/day (or 4.2 mg/kg/day for a 70 kg person) being exceeded (McEvoy, 1998 as cited in New Zealand Medicines and Medical Devices Safety Authority, n.d.).

2.5. Oral iron-containing supplements in pregnancy and lactation in New Zealand

In New Zealand, in addition to the general national iron supplement guideline from the Royal Australian and New Zealand College of Obstetricians and Gynaecologists, more detailed guidelines have been developed by local Health Boards to guide health professionals in prescribing oral FeS and managing ID/IDA in pregnancy and postpartum. Ministry of Health provides guidance on MMNS usage.

2.5.1. Oral iron-containing supplements guidelines in New Zealand

In New Zealand, the Ministry of Health does not recommend the routine use of dietary supplements (single nutrient form or MMNS) during pregnancy or lactation other than folic acid and iodine unless clinically indicated. It is recognised that most women consuming a balanced diet should be able to meet any additional nutrient requirements (Ministry of Health, 2022). However, if a specific need is identified, which, in the case of iron, includes those who adopt restrictive diets (vegetarian/vegan) leading to low iron intake or who have been diagnosed with ID/IDA, then oral FeS is recommended, with the supplement containing at least 60 mg of elemental iron daily (The Royal Australian and New Zealand College of Obstetricians and Gynaecologists, 2019). Beyond this general recommendation, different Health Boards around the country have developed their own clinical guideline for health professionals prescribing oral FeS in pregnancy or postpartum, covering what investigations should be undertaken to establish iron status and treatment protocols based on the patient's iron status.

In the case of Te Whatu Ora Te Toka Tumai Auckland, this includes two flowcharts for oral FeS covering the second and the third trimesters. For women diagnosed with ID (Hb >110 g/L, SF <15 µg/L) in the second trimester, a low dose oral FeS (one Ferro-Tab® tablet daily containing 65 mg of elemental iron) should be started. For IDA (Hb <110 g/L, SF <15 µg/L), a high dose oral FeS (one Ferrograd® tablet (105 mg of elemental iron) or two Ferro-Tab® tablets daily (provide a total of 130 mg elemental iron) should be prescribed. In some situations, for example, if a woman is unresponsive to oral FeS, has a limited time frame for oral FeS to be effective (such as diagnosis is too close to the delivery), or has severe anaemia, an iron infusion should be given (Te Whatu Ora, 2022).

The Lakes District Health Board shares the same iron management principles as Te Toka Tumai Auckland but with a few differences. These include different cut-offs used for ID/IDA diagnosis. Haemoglobin diagnosis value is based on trimesters, with Hb <110 g/L in the first trimester but <105 g/L in the second and third, which considers the haemodilution effect (Pavord et al., 2012). Serum Ferritin's cut-off is higher at 30 µg/L instead of 15 µg/L in Te Toka Tumai Auckland. They include a flow chart covering each trimester, and the treatment iron dosages are slightly different, with the sole focus on dose (rather than options by brand) recommending a low dose of 60 mg and a broader high dosage range of 100-200 mg. It includes the recommendation that oral FeS should not be given to those with Hb >130 g/L (even if ID) due to possible adverse pregnancy effects such as low birth weight and smallness for gestational age. It also suggests strategies such as taking oral FeS on alternative days or reducing the daily dosage to a minimum of 60 mg if the supplement is causing adverse effects. Dietary advice encouraging the consumption of an iron-rich diet is recommended as a key part of any treatment plan (Te Whatu Ora Lakes, 2024).

For postpartum management, a referral should be made to the obstetric team if anaemia is detected (Hb ≤99 g/L). For those who are not anaemic (Hb >100 g/L) after labour but had an ID diagnosed during pregnancy, the advice is to continue oral FeS for at least six weeks and follow up with the midwife or general practitioner (Te Whatu Ora Lakes, 2024). In Te Toka Tumai Auckland guideline, oral FeS may still be prescribed postpartum, but an iron infusion is recommended for women who have experienced postpartum haemorrhage or have a previously diagnosed ID (Te Whatu Ora, 2022). An iron infusion is also recommended post-surgery, where the inflammatory response can affect the absorption of iron taken orally for two to three weeks, making oral iron therapy less suitable (Te Whatu Ora, 2022).

Currently, different Health Boards have separate guidelines. It would be ideal to establish a detailed, comprehensive national guideline covering all clinical recommendations around oral FeS other than the current general one from the Royal Australian and New Zealand College of Obstetricians and Gynaecologists. For example, it would be suitable for all Health Boards to include diet strategies to boost iron absorption in the iron deficiency management plan and include recommendations if adverse effects occur.

2.5.2. Oral iron-containing supplements intake in New Zealand amongst pregnant and lactating women

In 2007, a New Zealand College of Midwives practice article listed 13 types of oral iron-containing supplements available in the New Zealand market (Elias, 2007). Further, several studies reported prenatal and postnatal oral iron-containing supplements usage. The Growing Up in New Zealand (GUiNZ) study, the most extensive ongoing longitudinal study examining

child development in New Zealand, asked about supplement use in mothers' antenatal questionnaire three months before and during pregnancy (n=6158). Researchers found that 22.8% (n=1403) took oral iron-containing supplements (oral FeS and/or iron-containing MMNS) before pregnancy. During pregnancy, another 48% (n=2956) added taking oral iron-containing supplements (oral FeS and/or iron-containing MMNS) (Morton et al., 2010). The researchers noted that the consumption of oral iron-containing supplements increased after the first trimester. It was also found that health practitioners, family, and friends were the most trusted information providers when choosing supplements (Morton et al., 2010).

The Savage (2021) study in New Zealand aimed to examine iron status from a cohort of 133 mother and baby as well as explored maternal iron-containing supplement usage during pregnancy. However, only 98 participants (a low response rate of 74%) completed iron questionnaire and reported 88.8% (n=87) of women took oral iron-containing supplements during pregnancy (Savage, 2021). In 2019, Brown et al.'s maternal dietary choice study on supplementation via online questionnaire among pregnant and breastfeeding women recruited (n=458), reported 70% of "other supplements" usage during pregnancy. The "other supplements" was a combined category of supplements, including iron, calcium, magnesium, fish oil, selenium, zinc, vitamin C, vitamin B, probiotics, and vitamin D (Brown et al., 2020), thus the maternal use of the iron-containing supplements could not be identified.

In the Calje and Skinner (2017) study, for those women who had an ID/IDA diagnosis, 11.1% in the first trimester, 65.6% in the second trimester, and 34.4% in the third trimester reported the use of oral iron-containing supplements, considering either prescribed or recommended for self-purchase by their midwife (Calje & Skinner, 2017). Although two-thirds of women were prescribed or recommended oral iron-containing supplements in the second trimester, 47.1% still had a low iron status when checked before birth(Calje & Skinner, 2017). Interestingly, dietary advice was only given to 10.1 % of women in early pregnancy and 3.2 % in later pregnancy (Calje & Skinner, 2017). Unfortunately, this study lacks information on prescription details such as preparations, dosages, and the intention to prescribe or recommend self-purchase oral iron-containing supplements.

For postpartum oral iron-containing supplements usage, Cajie and Skinner indicated low iron status check and prescription rates in the early postpartum period (72 hours after birth). Only 43 out of 189 women tested Hb. Among them, 21 (48.8%) out of 43 were anaemic (Hb <100 g/L), but only 7 (33.3%) were prescribed an oral FeS or had it noted that they should continue taking oral FeS (Calje & Skinner, 2017).

The Savage (2021) study reported that 49% (n=48) of participants in postpartum (between

three to six months) took iron-containing supplements (Savage, 2021). A small New Zealand study (n=78) that analysed breastmilk composition also reported supplementation via a three-day food diary in early postpartum (6-8 weeks postpartum) (Butts et al., 2018). Researchers found that MMNS, oral FeS, and iodine were the most popular supplements. Among those who used supplements in early postpartum (n=50), 42% (n=21) used oral FeS, with the highest intake rates seen among the New Zealand European participants (n=13) (Butts et al., 2018). MMNS were also popular, with 28% (n=14) reporting taking an MMNS. Again New Zealand European participants had the highest use of MMNS (n=8) (Butts et al., 2018), but it was not clear whether the MMNS were iron-containing.

None of the above NZ studies examined the detailed levels of intake dosage. In 2014, a cross-sectional study in Sydney, Australia, detailed the pattern of oral iron-containing supplement usage during pregnancy (Chatterjee et al., 2016). Of 589 participants, 88% used oral iron-containing supplements, with 70.1% taking iron-containing MMNS only, 7.2% using oral FeS only, and 22.2% consuming both (Chatterjee et al., 2016). In terms of intake dosages (total number=432), around one-third (36.8%, n=159) of participants had low-dosage elemental iron intake (<30 mg) daily, 39.6% (n=171) used preventative dose (30-65 mg) daily, 5.6% (n=24) used intermediate dose (66-99 mg) daily, 15.1% (n=65) had treatment dosage (100-200 mg) daily, and a few women 3% (n=13) reported >200 mg/day elemental iron intake (Chatterjee et al., 2016). These categories will be used in this secondary analysis of this thesis.

2.6. Concluding statement

The literature suggests that compared to postpartum, pregnancy is a life stage where women can be more vulnerable to ID/IDA, and many women will need to take an oral FeS. Although oral iron-containing supplements are generally safe, too little or too much iron causes detrimental health effects in pregnancy and postpartum. From a safety perspective, knowing how much iron New Zealand pre- and postnatal women consume from both oral FeS and iron-containing MMNS is essential. It is also worth knowing what oral iron-containing supplements are used and the reasons for taking them. Moreover, literature shows that oral FeS and MMNS usage are common among pregnant and postpartum women but lack detailed consumption information. Most New Zealand studies briefly summarised the usage alongside other topics, for example, in the maternal diet choice study, iron-containing supplements were reported in conjunction with other supplements including calcium, magnesium, fish oil, selenium, zinc, vitamin C, vitamin B, probiotics, and vitamin D. Some of the literature in New Zealand about oral iron-containing supplement usage, including the GUiNZ study, is now over ten years old. They all indicate the research gap in this topic. The results of this research will add value to what is already known about the use of oral iron-containing supplements before, during and

after pregnancy in New Zealand.

Chapter 3: Oral iron-containing supplement use from preconception to six weeks postpartum: a secondary data analysis from a cross-sectional survey among postpartum women in New Zealand

3.1. Abstract

Background/Objectives: Oral iron-containing supplements are often needed during pregnancy due to increased iron requirements. Limited studies have examined the use of oral iron supplement (FeS) in New Zealand. This study aims to investigate oral iron-containing supplements usage before, during, and after pregnancy among a cohort of postpartum women in New Zealand.

Methods: This secondary data analysis used data from an online questionnaire, which included questions on FeS and multiple micronutrient supplement (MMNS) use. The daily elemental iron intake from oral FeS and iron-containing MMNS was calculated and categorised into five dose levels: low (<30 mg/day), preventative (30-65 mg/day), intermediary (66-99 mg/day), treatment (100-200 mg/day), and high (>200 mg/day). Descriptive statistics was used to describe the data.

Results: Six hundred women were included in this analysis. Seventeen brands of oral FeS and 30 of iron-containing MMNS were reported taken (elemental iron dosage between 5-105 mg). Overall, 75.2% of women took oral FeS (n=600), while 43.8% (n=569) took iron-containing MMNS at some stage around pregnancy. Increased usage was seen in the second and third trimesters. While low and preventative dosages were most used, about 10% of women in the second and 12% in the third trimesters took the treatment dose. Almost all (90%) oral FeS was prescribed, while all iron-containing MMNS was self-purchased, predominantly (82%) based on their own general knowledge alone or in combination with another reason.

Conclusion: Oral iron-containing supplements were commonly used around pregnancy. Women consumed varied brands and doses. The increased usage and dosage taken during pregnancy aligned with what would be expected. However, while the Lead Maternity Carer plays an important role in using oral FeS, this was not the case for MMNS. More research is needed to explore what factors women consider when purchasing an MMNS to be better supported in selecting supplements to meet their nutritional requirements.

Keywords: iron, iron deficiency, iron supplement, multivitamin, preconception, pregnancy, postpartum, New Zealand

3.2. Introduction

Iron is an essential micronutrient that plays a crucial role in a range of physiological functions (Coad & Pedley, 2014; Scientific Advisory Committee on Nutrition, 2010). During pregnancy, iron requirements significantly increase as the pregnancy proceeds, driven by the increased requirements of the growing foetus, maternal blood volume expansion, and growth of the placenta and umbilical cord (Bothwell, 2000; McMahon, 2010; Michael & Georgieff, 2020; Milman, 2011). This puts pregnant women at increased risk of iron deficiency/iron deficiency anaemia (ID/IDA), which in mothers can lead to a reduction in cognitive function, delay wound healing, and make them vulnerable to postpartum depression, together with an increased risk of having a low birth weight baby, and causing neonatal anaemia, and delayed neurological development in infants (Derman & Patted, 2023; Means, 2020; Pasricha et al., 2021; Te Whatu Ora, 2022; Te Whatu Ora Lakes, 2024). During lactation, unless there has been significant blood (iron) loss at delivery, iron requirements generally fall primarily due to the expanded cell mass contracting back to the pre-pregnancy state, temporary menstrual cessation and limited iron secretion into the breast milk (Fransson & Lönnerdal, 1980; Means, 2020).

As a result of these changes, the recommended daily intake (RDI) in New Zealand and Australia, for women over 19 years of age increases from 18 mg pre-pregnancy to 27 mg during pregnancy and then reduces to 9 mg during lactation (Australian National Health and Medical Research Council & New Zealand Ministry of Health, 2017). Thus, it may be challenging for most pregnant women to meet their iron requirements through diet alone (Milman et al., 2016; Pavord et al., 2012; Roy & Pavord, 2018). Plus, the reported prevalence of anaemia amongst women of child-bearing age suggests some women are likely starting their pregnancy already with low iron stores (Ministry of Health, 2020b).

Worldwide, there is no consensus on whether oral iron supplement (FeS) should be used universally by all pregnant women or selectively by those identified as requiring an oral FeS to prevent ID/IDA. The World Health Organisation recommends universal oral iron supplementation of 30-60 mg of elemental iron to women during pregnancy to prevent ID (World Health Organization, 2012). Similarly, the Centers for Disease Control and Prevention of the United States and Health Canada advise all pregnant women to routinely take oral FeS once pregnancy is confirmed at 30 mg/day and 16-20 mg/day, respectively (Centers for Disease Control and Prevention, 1998; Health Canada, 2009; US Preventive Services Task Force, 2024). In contrast, the United Kingdom, Australia and New Zealand do not recommend routine oral iron supplementation. In New Zealand, the Ministry of Health advises women to talk to their midwife, doctor or dietitian if they are concerned they may be at risk of ID, for example, if they are following a vegetarian/vegan diet or have a history of ID/IDA (Ministry of

Health, 2020; Ministry of Health, 2022). Although different regional Health Boards in New Zealand have their own guidelines for screening and managing iron status in pregnant and postpartum women, in general, it is recommended that all women are screened [Full Blood Count (FBC) including haemoglobin (Hb), and Serum Ferritin (SF)] as part of their first antenatal visit (generally in the first trimester), at 28 weeks (the second trimester) or at other times if risk factors are identified (Te Whatu Ora, 2022; Te Whatu Ora Lakes, 2024).

If ID is identified without being IDA (based on a low SF level but a normal Hb), an oral FeS containing 60-65 mg of elemental iron should be started (Frayne & Pinchon, 2019; Pavord et al., 2012; Te Whatu Ora, 2022; Te Whatu Ora Lakes, 2024). If IDA is diagnosed (based on a low Hb and SF), most countries agree on a treatment dosage of 100-200 mg of elemental iron per day (Frayne & Pinchon, 2019; Pavord et al., 2012; Siu & US Preventive Services Task Force, 2015; Te Whatu Ora, 2022; Te Whatu Ora Lakes, 2024; US Preventive Services Task Force, 2024; World Health Organization, 2012).

In addition to oral FeS, multiple micronutrient supplement (MMNS) has become more prevalent. In 2007, Elias identified five types of iron-containing MMNS targeting preconception, pregnancy, and lactation (Elias, 2007), but today, there is an increasing array of self-funded MMNS designed for conceiving, pregnant, and lactating women available in the New Zealand market (Chemist Warehouse, 2024b). Few studies in New Zealand have reported the use of oral iron-containing supplements (an umbrella term for oral FeS and iron-containing MMNS) around pregnancy (Butts et al., 2018; Calje & Skinner, 2017; Morton et al., 2010; Savage, 2021). None of these New Zealand studies have reported what preparations of these iron-containing supplements women took, how much they took per day, and whether it was prescribed or self-purchased. This study aimed to determine oral iron-containing supplements usage, including type, the dose taken daily, and whether it was prescribed or self-purchased in preconception (the three months before pregnancy), three trimesters during pregnancy, and postpartum (six weeks postpartum). This analysis is needed to better understand the current usage patterns of oral iron-containing supplements among New Zealand women during these important time periods.

3.3. Method

This secondary analysis used data from an anonymous, specifically designed online questionnaire to retrospectively investigate supplementation usage among a cohort of postpartum women in New Zealand before, during, and after pregnancy. Ethical approval was submitted to the Massey University Human Ethics Committee. This study was assessed as low risk (Ethical application approval no. 4000025351).

3.3.1. Participants and recruitment

To be included in the original study, women must be 18 years or older, have given birth between February and mid-August 2022, be less than or equal to three months postpartum, reside in New Zealand, and be proficient in English. Exclusion criteria included individuals who had used assisted reproductive technologies to become pregnant (for example, in-vitro fertilisation) because of the increased care level from specialists (Hunter, 2023).

Social media, posters (Appendix A), professional associations, word of mouth, and personal contact were used in recruiting participants (Hunter, 2023). All participants interested in participating in the study were provided with summarised study information, including estimated completion time, researcher contact details, data confidentiality, and a link to a full version of the “study information sheet” (Appendix B). Women were offered the opportunity to ask questions, and informed consent was gained by getting participants to tick “Yes, I consent to my responses to this survey being included in the research”. Participants were then invited to complete the eligibility questions before starting the online questionnaire if they met the eligibility criteria.

3.3.2. Questionnaire

The research team developed the questionnaire at the beginning of 2022, adapting questions from the “Antenatal questionnaire” from the Growing Up in New Zealand (GUiNZ) study (Morton et al., 2009) and the maternal dietary choice study in New Zealand (Brown et al., 2020). Before release, it was peer-reviewed by colleagues at Massey University and then pre-tested by some childbearing-aged women for the questions' logical flow, readability, and appropriate understanding level.

The questionnaire was delivered using the online software Qualtrics XM (July 2022) and required about 15 minutes to complete. It was self-directed, including tick-box and open-ended questions to add extra information (Appendix C). The questionnaire had three sections: eligibility, maternal information, and supplement use. Eligibility questions included if participants were over 18 years old and living in New Zealand, the month the baby was due and born, and whether a fertility clinic was involved in becoming pregnant. The maternal information section contained questions about maternal age, ethnicity (women were asked to select the main ethnic group that they identify with most), highest qualification, and total household income. This was followed by questions relating to her pregnancy, including parity, whether the pregnancy was planned, whether she was breastfeeding, who her Lead Maternity Carer (LMC) was, her general health and supplement usage before pregnancy, and if she had any medical diagnosis during her pregnancy (Hunter, 2023). The supplement use section

included five subsections with questions on different types of supplements [1. Folic acid-only supplements, 2. Iodine-only supplements, 3. Iron-only supplements (FeS), 4. Multivitamin supplements (MMNS), 5. Other supplements] (Hunter, 2023). This secondary analysis utilised questions from the demographic and maternal information section and the FeS and MMNS sections.

The FeS and MMNS subsections included the common questions as follows: 1. Did the participants take the supplement(s)? 2. What type/brand of the supplement(s) did the participants take? 3. Were their LMC aware they were taking the supplement(s)? 4. How many times a day did the participants take the supplement(s), and How often did they take the supplement(s) during the following five periods, defined as three months preconception, three trimesters during pregnancy, and six weeks postpartum? (Hunter, 2023). As specific MMNS is aimed to support the breastfeeding period, participants were also asked if they took a different MMNS during the postpartum period.

Within each supplement section, a few specific questions were asked. For example, in the FeS section, whether the FeS were prescribed or purchased and, if purchased, the reason (participants could indicate more than one reason) and location for purchasing was asked. In the MMNS subsection, the reason for taking an MMNS and where it was obtained was asked. If the participants took MMNS based on a health professional's advice, the specific health professional was asked. If the participants used MMNS based on self-purchase, the reason(s) for the decision were asked, and participants were allowed to choose more than one answer.

3.3.3. Statistical analysis

All collected data from the online questionnaire was downloaded into Microsoft Excel before being imported into an SPSS file. Statistical analysis was performed using IBM SPSS Statistics software (Version 27). For categorical data, descriptive statistics were used, including frequencies and percentages. The continuous variables were tested for normality using the Shapiro-Wilk tests and normality plots. As several variables were significantly skewed, the continuous variables were reported as medians (25th, 75th percentiles), with the minimum and maximum values included to show the range. The formulation for the reported oral FeS and iron-containing MMNS was sourced from online pharmacies such as Chemist Warehouse, Pharmacy Direct, Beta Health, and/or the company's website, as shown in Appendix D and Appendix E.

The elemental iron quantity contained in each self-reported brand of oral FeS and iron-containing MMNS was used to calculate the total weekly elemental iron intake by multiplying the elemental iron quantity by the number of times taken per day and the average number of

days per week (Table 3.1). If an oral FeS or iron-containing MMNS was not used, the intake was recorded as zero. For example, if a participant reported taking only oral FeS as Ferro-Tab® (twice daily, three to five times a week) without using any iron-containing MMNS, her weekly elemental iron intake will be 65 mg * 2 * 4 [(3+5)/2] + 0 = 520 mg/week. This calculation was done for both oral FeS and iron-containing MMNS in each period. The average daily elemental iron intake was then calculated using the total weekly elemental iron intake divided by seven. For this participant, her average daily elemental iron intake was 520 mg / 7 = 74.3 mg.

Table 3.1. Responses from the frequency question used in calculating weekly intake of elemental iron

On average, how often did you take xxx supplement	The average number of days per week
Most days of the week (6 to 7 days per week)	6.5
Some days of the week (3 to 5 days per week)	4
A few days of the week (1 to 2 days per week)	1.5
Sporadically (less than once a week)	0.5
Not taken/ do not know/ cannot remember	0

(Hunter, 2023)

To compare the average daily elemental iron intake from oral iron-containing supplements with the recommended dose from New Zealand and other developed countries guidelines, it categorised into five dose levels: low dose (<30 mg/day), preventative dose (30-65 mg/day), intermediary dose (66-99 mg/day), treatment dose (100-200 mg/day), and high dose (>200 mg/day) (Chatterjee et al., 2016).

3.4. Results

3.4.1. Participant characteristics

Of the 863 responses, 600 were included in the final analysis. Of the remainder (n=263), 77 completed the eligibility screening questions but were excluded due to still being pregnant at the time of study completion, having given birth over six months or having used assisted reproductive technologies to become pregnant; 146 had incomplete answers to the maternal information questions; 40 responses did not include answers to any questions for the oral FeS and/or MMNS sections.

Nearly half of the participants were in the 31 to 35-year-old age group (45.7%). Most participants were New Zealand-born (82.5%), and New Zealand European/Pakeha was the dominant ethnicity group (87%). Three-quarters of participants held a bachelor's degree or higher. Over three-quarters (76.8%) reported a yearly household income of $100,000 or over, exceeding the median household income of $96,001 in 2022 (StatsNZ, 2023) (Table 3.2).

Table 3.2. Sociodemographic characteristics (n=600)

		Total n (%)
Age	18-25 years	47 (7.8)
	26-30 years	200 (33.3)
	31-35 years	274 (45.7)
	36-40 years	73 (12.2)
	>40 years	6 (1.0)
Ethnicity (n=599)	New Zealand European/Pakeha	521 (87.0)
	New Zealand Māori	29 (4.8)
	Pacific Island	8 (1.3)
	Asian	9 (1.5)
	Other[1]	32 (5.3)
New Zealand born	Yes	495 (82.5)
Highest qualification achieved (n=599)	Bachelor's Degree or higher	453 (75.6)
	Diploma/Polytechnic qualification/Trade certificate	85 (14.2)
	Secondary school	59 (9.8)
	No qualifications	2 (0.3)
Total annual household income	Less than $100,000	126 (21.0)
	$100,000 or over	461 (76.8)
	Do not know or prefer not to answer	13 (2.2)

[1]Includes South African, Russian, other European, Latin American, Canadian, American Jewish, and Filipino Americans.

Almost half (49.7%) of the women stated that this was their first pregnancy, and a significant portion (83.5%) were planned. Before this pregnancy, most women had excellent/very good or good health (93%), and about one-third (30.7%) indicated regularly taking general supplements before this pregnancy. Having a midwife as their LMC was documented by over four-fifths of women (88.3%). Iron deficiency was the most common self-reported diagnosed medical condition during this pregnancy, with six out of ten women (60.9%) reporting being diagnosed with ID alone or alongside other medical conditions. Almost all women (97.8%) had breastfed at some stage after the baby was born (Table 3.3).

Table 3.3. Maternal characteristics (n=600)

		Total n (%)
First pregnancy	Yes	298 (49.7)
Number of other children	One	196 (32.7)
	Two or more	106 (17.6)
Planned pregnancy	Planned	501 (83.5)
	Unplanned	96 (16.0)
	Choose not to say	3 (0.5)
Maternal health before this pregnancy	Excellent/very good	394 (65.7)
	Good	164 (27.3)
	Fair or poor	42 (7.0)
Frequency of general supplements use prior to this pregnancy	Regularly	184 (30.7)
	Occasionally	228 (38.0)
	Never	188 (31.3)
Lead maternity carer (n=599)	Midwife	529 (88.3)
	Obstetrician (Specialist)	58 (9.7)
	Doctor (General Practitioner)	2 (0.3)
	Combination of Midwife/Obstetrician	10 (1.7)
Reported medical conditions during pregnancy (n=578)	Iron deficiency[1]	332 (57.4)
	Anaemia[1]	5 (0.9)
	Iron deficiency and Anaemia[1]	20 (3.5)
	Other[2]	107 (18.5)
	No conditions reported	114 (19.7)
Breastfed (at some point after childbirth, expressing included)	Yes	587 (97.8)

[1]Includes participants who reported had been diagnosed with iron deficiency, anaemia or both alone or alongside other medical conditions.
[2]Includes participants who reported had been diagnosed with medical conditions but did not include iron deficiency or anaemia. Other medical conditions included, but were not limited to, hypertension, gestational diabetes, hyperemesis gravidarum, and heartburn.

3.4.2. Identified oral iron-containing supplements

In total, 17 different types of oral FeS were identified. Seven contained iron as the sole ingredient, while the remainder included other nutrient ingredients such as vitamin C to support iron absorption and B group vitamins to support Hb production and to prevent macrocytic and pernicious anaemia (Thompson et al., 2013b). Of these 17 identified oral FeS, four were classified as being pharmacy only, including Ferro-Tab®, Ferrograd®, and Maltofer®, which contained between 65-105 mg elemental iron per tablet, and Ferodan® contains 6 mg elemental iron per millilitre (mL). Of the rest, ten were classified as general sales, while three were considered practitioner only (products that are required to be recommended by a qualified health professional such as a naturopath or pharmacist after following a consultation) (New Zealand Medicines and Medical Devices Safety Authority, 2020). All solid dose supplements contained between 4.95-24 mg of elemental iron per tablet/capsule (Table 3.4, full detail of brand information refer to Appendix D).

Of the 30 reported iron-containing MMNS, 24 were specifically formulated to target preconception, pregnancy, and/or lactation. Along with iron, these supplements included a

range of multiple vitamins and minerals, such as B group vitamins, vitamin C, vitamin D, vitamin E, calcium, magnesium, iodine, and zinc. Only Elevit with Iodine® was categorised as a pharmacy only MMNS because it contained 60 mg of elemental iron per tablet. Of the rest, 24 types were classified as general sales, and five were practitioner only. Most iron-containing MMNS had <10 mg of elemental iron. Compared to oral FeS, where a range of iron salt forms was noted, only two iron salt forms, iron amino acid chelate and ferrous fumarate, were identified in iron-containing MMNS (Table 3.4, full detail of brand information refer to Appendix E).

Table 3.4. Oral iron-containing supplements characteristics

	Categories	Oral FeS (n=17)	Iron-containing MMNS (n=30)
Formulation type	Iron as the sole ingredient	7	NA[1]
	Iron combined with other vitamins and/or minerals	10	30
The intention of the product	Designed for preconception, pregnancy, and/or lactation	NA[1]	24
Classification	Pharmacy only	4	1
	General sales	10	24
	Practitioner only	3	5
Elemental iron quantity per tablet/capsule	Equal or over 60 mg	4	1
	24 mg	8	1
	10-23 mg	1	6
	4.95-9 mg	4	22
Supplement iron salt form	Iron amino acid chelate (Ferrous bisglycinate, glycinate)	7	13
	Ferrous fumarate	4	14
	Ferrous sulphate	2	0
	Iron polymaltose	1	0
	Carbonyl iron	1	0
	Not specified	2	3

[1] Not applicable

3.4.3. Use of oral iron-containing supplements

Three-quarters of participants reported taking oral FeS (75.2%, n=451) at some stage of preconception, during pregnancy, or postpartum, with the majority being prescribed (90%, n=406). Ferro-Tab® was the dominant brand (70.5%, n=318), followed by Ferrograd® (11.8%, n=53) (Table 3.5; for full details of usage, refer to Appendix D). Four women reported receiving an iron infusion, and 42 women did not know what brand of oral FeS they were prescribed or purchased but provided usage information.

Only a small number of participants (10.0%, n=45) self-purchased oral FeS, with most bought from their local pharmacy (72.7%, n=32), followed by online (18.2%, n=8). Almost all (93%) women reported that their LMC knew they had purchased oral FeS (Table 3.5). When looking at the reasons participants had purchased oral FeS, most (82.2%, n=37) did so based on

doctors'/midwives'/specialists' advice either alone (62.2%, n=28) or their doctors'/midwives'/specialists' advice combined with other self-directed reasons such as their own general knowledge or information from the internet (20%, n=9).

For the usage of iron-containing MMNS, data was available for 569 women, with 31 being excluded because they provided insufficient information, or it was not possible to confirm if the MMNS they took contained iron. Of these women, 43.8% (n=249) reported taking an iron-containing MMNS at some stage of preconception, during pregnancy, or postpartum, with the most popular brand taken being Elevit with Iodine® (40.2%, n=100), followed by Blackmores Pregnancy & Breastfeeding Gold (20.9%, n=52) and Eagle Tresos Natal (6.4%, n=16) (Table 3.5; for full details of usage, refer to Appendix E).

Participants reported taking an MMNS either because they had been advised to purchase by a health professional (including a general practitioner, midwife, specialist, pharmacist, naturopath, dietitian/nutritionist) (20.5%, n=51) or they had independently self-purchased and used the MMNS (78.3%, n=195). Two participants reported receiving the MMNS as a gift, and one chose not to answer (Appendix F). Over half (61%, n=150) of the MMNS were purchased from a local pharmacy, with another quarter (25.6%, n=63) purchased online. Fewer participants (84.9%) reported that their LMC knew they had purchased an iron-containing MMNS, with remainder either not informing their LMC (8.6%) or they could not remember (6.5%) (Table 3.5). When looking at the reasons participants had self-purchased an MMNS, most (82%, n=159) did so based on their own general knowledge (Appendix F), either alone (49.5%, n=96) or in combination with other reasons such as information from the internet, books or newspapers; or it was recommended by family or friends or a nutritionist (32.5%, n=63).

In addition, the usable data of the 569 participants for both oral FeS and iron-containing MMNS showed that 30.1% of participants (n=171) took both oral FeS and iron-containing MMNS at some stage of preconception, during pregnancy, and postpartum, 44.3% used oral FeS only (n=252), 13.7% used iron-containing MMNS only (n=78), and 12% took neither (n=68).

Table 3.5. The reported use of oral iron-containing supplements

Oral FeS (n=451) n (%)		**Iron-containing MMNS (n=249) n (%)**
The reported top three brands		
318 (70.5) - Ferro-Tab®[1]		100 (40.2) - Elevit with Iodine®
53 (11.8) - Ferrograd®[1]		52 (20.9) - Blackmores Pregnancy & Breastfeeding Gold
10 (2.2) -Maltofer®		16 (6.4) - Eagle Tresos Natal
Self-purchased or received as a gift		
45 (10.0)		249 (100.0)
Location obtained		
	n=44	**n=246**
Local pharmacy	32 (72.7)	150 (61.0)
Online	8 (18.2)	63 (25.6)
Supermarket/health store dispensary	4 (9.1)	20 (8.1)
Other[2]	0 (0.0)	10 (4.1)
Both[3]	0 (0.0)	3 (1.2)
The LMC is aware if self-purchased		
	n=43	**n=185**
Yes	40 (93.0)	157 (84.9)
No	0 (0.0)	16 (8.6)
Can't remember	3 (7.0)	12 (6.5)

[1]Include participants who took both Ferro-Tab® and Ferrograd® (n=3).
[2]Include options for obtaining iron-containing MMNS from a health professional clinic, such as a naturopath or nutritionist (n=9), or receiving it as a gift from a Usana representative (n=1).
[3]Include getting iron-containing MMNS from two places: a supermarket or pharmacy (n=2), a general practitioner and online (n=1).

3.4.4. Usage and intake dosage of oral iron-containing supplements

After excluding 147 from the calculation due to insufficient information on determining which supplement was used or did not use any of oral FeS and/or iron-containing MMNS, 453 participants were included in the dosage calculation. A higher number of women used oral FeS during the second (n=272) and the third trimesters (n=346) of pregnancy than postpartum (n=170), while the use in preconception was considerably lower (n=53). During pregnancy, the most consumed elemental iron dosage from oral FeS was at a preventative dosage (30-65 mg/day). In postpartum, 44.7% of participants (n=76) took low doses and 42.9% took preventative doses (n=73) (Table 3.6).

Table 3.6. Reported oral FeS elemental iron intake dosage in mg/day

Stages	Median (25^{th}, 75^{th}) (Min, Max)	Low dose (<30 mg/day) n (%)	Preventative dose (30-65 mg/day) n (%)	Intermediary dose (66-99 mg/day) n (%)	Treatment dose (100-200 mg/day) n (%)	High dose (>200 mg/day) n (%)
Preconception (n=53)	37.1 (12.6, 60.4) (2.3, 278.6)	22 (41.5)	23 (43.4)	6 (11.3)	1 (1.9)	1 (1.9)
1st trimester (n=112)	60.4 (18.6, 60.4) (2.3, 278.6)	34 (30.4)	61 (54.5)	11 (9.8)	5 (4.5)	1 (0.9)
2nd trimester (n=272)	60.4 (30.0, 60.4) (2.8, 278.6)	61 (22.4)	164 (60.3)	28 (10.3)	18 (6.6)	1 (0.4)
3rd trimester (n=346)	60.4 (37.1, 60.4) (2.3, 278.6)	72 (20.8)	208 (60.1)	36 (10.4)	29 (8.4)	1 (0.3)
Postpartum (n=170)	37.1 (13.9, 60.4) (2.3, 278.6)	76 (44.7)	73 (42.9)	15 (8.8)	5 (2.9)	1 (0.6)

A relatively stable proportion of women took iron-containing MMNS across the five stages (Table 3.7). Despite one participant in the second trimester and one in the third trimester who consumed >65 mg/day, all women took low and preventative dosages. The most widely use MMNS dosage was low dose, <30 mg/day of elemental iron from MMNS. None reported high dose intake.

Table 3.7. Reported iron-containing MMNS elemental iron intake dosage in mg/day

Stages	Median (25^{th},75^{th}) (Min, Max)	Low dose (<30 mg/day) n (%)	Preventative dose (30-65 mg/day) n (%)	Intermediary dose (66-99 mg/day) n (%)	Treatment dose (100-200 mg/day) n (%)	High dose (>200 mg/day) n (%)
Preconception (n=146)	7.0 (4.6, 60.4) (0.4, 60.4)	89 (61.0)	57 (39.0)	0 (0.0)	0 (0.0)	0 (0.0)
1st trimester (n=187)	9.3 (4.6, 60.4) (0.4, 60.4)	114 (61.0)	73 (39.0)	0 (0.0)	0 (0.0)	0 (0.0)
2nd trimester (n=173)	7.0 (4.6, 60.4) (0.4, 74.3)	115 (66.5)	57 (32.9)	1 (0.6)	0 (0.0)	0 (0.0)
3rd trimester (n=166)	7.0 (4.6, 60.4) (0.4, 120.7)	109 (65.7)	56 (33.7)	0 (0.0)	1 (0.6)	0 (0.0)
Postpartum (n=138)	5.7 (4.6, 9.8) (0.5, 60.4)	113 (81.9)	25 (18.1)	0 (0.0)	0 (0.0)	0 (0.0)

When considering the average daily amount of elemental iron consumed from both oral FeS and iron-containing MMNS (Table 3.8), more women took low or preventive doses than the

ones for other doses, despite the different stages. A treatment dose was taken more during the second (10.1%, n=37) and the third trimesters (12.4%, n=51). Less than one percent of women reported high doses of >200 mg/day intake during these time periods.

Table 3.8. Reported total elemental iron intake dosage in mg/day (oral FeS and/or iron-containing MMNS)

Stages	Median (25^{th},75^{th}) (Min, Max)	Low dose (<30 mg/day) n (%)	Preventative dose (30-65 mg/day) n (%)	Intermediary dose (66-99 mg/day) n (%)	Treatment dose (100-200 mg/day) n (%)	High dose (>200 mg/day) n (%)
Preconception (n=179)	21.4 (4.6, 60.4) (0.4, 283.2)	96 (53.6)	68 (38.0)	10 (5.6)	4 (2.2)	1 (0.6)
1^{st} trimester (n=252)	39.5 (7.0, 60.4) (0.4, 283.2)	112 (44.4)	108 (42.9)	16 (6.3)	15 (6.0)	1 (0.4)
2^{nd} trimester (n=367)	60.4 (18.6, 60.4) (0.4, 283.2)	114 (31.1)	178 (48.5)	36 (9.8)	37 (10.1)	2 (0.5)
3^{rd} trimester (n=410)	60.4 (29.8, 65) (0.4, 283.2)	102 (24.9)	207 (50.5)	48 (11.7)	51 (12.4)	2 (0.5)
Postpartum (n=262)	20.9 (6.3, 60.4) (0.5, 283.2)	145 (55.3)	89 (34.0)	18 (6.9)	9 (3.4)	1 (0.4)

3.5. Discussion

To the author's knowledge, this was the first study in New Zealand to explore beyond whether a woman took oral iron-containing supplements during preconception, pregnancy, and/or postpartum, and examine what supplement they took, when and how much elemental iron they took and whether it was prescribed or self-purchased. Most participants in this study were highly educated New Zealand-born Europeans/Pakeha with high household incomes. Most of them had excellent/very good or good general health before pregnancy (93%), which is very close to a previous New Zealand study that investigated maternal diet choices at 94% (Brown et al., 2020) and slightly higher than that reported by the GUiNZ study at 89.7% (Morton et al., 2010). The slight difference may be due to the difference in data collection with GUiNZ using a face-to-face interview rather than an online questionnaire (as used by this and the Brown study). In addition, ID was the most common self-reported diagnosed medical condition (60.9%, n=352) during this pregnancy, higher than previous New Zealand studies at 48% (Brown et al., 2020) and 57.1% (Savage, 2021) but slightly lower than that reported at 65% by an Australian oral iron-containing supplements focused study among pregnant women (Chatterjee et al., 2016).

3.5.1. Oral iron-containing supplements preparations

In this study, women took a wide range of oral iron-containing supplements,17 types of oral FeS and 30 types of iron-containing MMNS, of which 24 types of iron-containing MMNS were marketed as suitable for women to use before, during pregnancy and lactation. Notably, six types of iron-containing MMNS focused on general health were reported to have been used by participants. These may include insufficient folic acid and iodine and/or contained herbal ingredients that are not recommended to be taken by pre- or postnatal women. In 2007, a New Zealand College of Midwives practice article provided a table showing 13 types of oral iron-containing supplements (both oral FeS and iron-containing MMNS) available in New Zealand (Elias, 2007). This study found noticeably more oral iron-containing supplements, likely due to the general increase in the use and range of available supplements to date. It could be expected that it would be challenging for the LMC to keep across all available oral iron-containing supplements and the dose each provides.

The oral iron-containing supplements' dosages in this study ranged broadly from 5-105 mg per tablet/capsule. Of the 47 types of oral iron-containing supplements identified, only five of them (Ferro-Tab®, Ferrograd®, Ferodan®, Maltofer®, and Elevit with Iodine®) contain enough elemental iron (>60 mg) that they are recognised as being suitable to prevent or treat ID/IDA based on New Zealand guidelines (Te Whatu Ora, 2022; Te Whatu Ora Lakes, 2024; The Royal Australian and New Zealand College of Obstetricians and Gynaecologists, 2019). The elemental iron content in the top three frequently used oral FeS (65 mg, 105 mg, 100 mg) and iron-containing MMNS (60 mg, 5 mg, 7.5 mg) in this study closely resembled Chatterjee et al.'s study at 105 mg, 87.4 mg and 100 mg for oral FeS and 60 mg, 5 mg and 5 mg for iron-containing MMNS individually (Chatterjee et al., 2016). Further, among participants in this study, 40.2% took the most popular iron-containing MMNS brand that contained 60mg (Elevit with Iodine®), similar to what was reported by Chatterjee et al. (44.5%) (Chatterjee et al., 2016). The high similarity of the elemental iron content and the percentage of using the most popular iron-containing MMNS brand in both studies may be attributed to the comparable oral FeS and MMNS available in both countries (Elias, 2007; Frayne & Pinchon, 2019; Kidson- Gerber & Zheng, 2016; Pasricha et al., 2010), and the similar guidelines for managing ID/IDA during pregnancy (Frayne & Pinchon, 2019; Te Whatu Ora, 2022; Te Whatu Ora Lakes, 2024; The Royal Australian and New Zealand College of Obstetricians and Gynaecologists, 2019).

3.5.2. The prevalence of oral iron-containing supplements

Oral iron-containing supplements were widely used in this study, with the high rate of self-reported ID during pregnancy likely contributing to this. Three-quarters of participants took oral FeS, and just over 40% took iron-containing MMNS at some stage of preconception, during

pregnancy, and postpartum. For those (n=569) usable data, a third of the participants took oral FeS and iron-containing MMNS.

The overall findings from this study were not directly comparable to other studies because of differences in the time periods examined and how the results were reported. However, because this study reported the number of usages in individual time periods, the data were comparable in some time periods. This study found 39.5% of women used oral iron-containing supplements in preconception, significantly higher than that reported in the GUiNZ study (n=6158) at 22.8% (n=1403) before pregnancy (Morton et al., 2010). One explanation could be that participants in this study are more affluent, whereas GUiNZ participants are more representative of the New Zealand population, and those with lower incomes are less likely to purchase MMN supplements. During pregnancy, GUiNZ reported that on top of those who already used oral iron-containing supplements (oral FeS and iron-containing MMNS) before pregnancy, another 48% (n=2956) added taking oral iron-containing supplements (oral FeS and/or iron-containing MMNS) (Morton et al., 2010). In another New Zealand study (n=133), frequent usage of oral iron-containing supplements (oral FeS and/or iron-containing MMNS) during pregnancy (88.8%, n=87) was reported (Savage, 2021). In 2013, Calje and Skinner, using data gathered from midwives documents, noted that the prescription/recommended self-purchase rate of oral iron-containing supplements (oral FeS, iron-containing MMNS, and/or herbal preparations) amongst their patients during pregnancy was 11.1% at first, 65.6% at the second and 34.4% at the third trimester (Calje & Skinner, 2017). In postpartum, Savage reported using oral iron-containing supplements (oral FeS and/or iron-containing MMNS) between three to six months postpartum reduced from during pregnancy to 49% (n=48) (Savage, 2021). A small New Zealand study (n=78) reported that among those who used supplements in early postpartum (6-8 weeks postpartum) (n=50), 42% (n=21) used oral FeS (Butts et al., 2018). This finding was similar to what this study found at 37.5% in postpartum. Although there is no literature that the author is aware of, one explanation that could explain the high percentage of women who were still taking oral FeS in postpartum could be that women continued to finish the supplements that they had.

Beyond New Zealand studies, an Australian survey of pregnant women (n=589) also found a high consumption rate of oral iron-containing supplements (88%) during pregnancy (Chatterjee et al., 2016). Interestingly, in Chatterjee et al.'s study, vastly more women acquired iron from iron-containing MMNS (70.1%) than oral FeS (7.2%) alone, with a further 22.2% reporting taking both during their pregnancy. In this study, oral FeS was used more widely (44.3%) than iron-containing MMNS (13.7%), and a higher number reported taking both (30%). Acknowledging our results does not just include pregnancy. One explanation may be that the

study by Chatterjee et al. included all types of MMNS used by each participant, with two-fifths of women reporting taking more than one type of MMNS. In contrast, only the most frequently used MMNS was asked in this study, which may have led to an underreporting of the preparations if women used more than one type of MMNS, hence the lower usage rate. In both studies, 12% of participants reported taking no supplement. This is of interest, as it is recognised that diet alone can be challenging to meet the increased iron requirements of pregnancy. Are these women achieving acceptable iron levels with their diet, or are they sub-optimal as they have chosen not to take a supplement, for example, as they had previously experienced adverse effects from an iron supplement (Pasricha et al., 2021).

3.5.3. The use of oral iron-containing supplements across five periods

The use of oral iron-containing supplements before pregnancy was low (n=179), with most being taken as part of an iron-containing MMNS (n=146). This likely reflects that for most women, iron may not be a concern at this stage, but they are taking an iron-containing MMNS to give their baby the ‘best start’ or to meet the additional micronutrient requirements for other micronutrients such as folic acid and iodine (De Boer et al., 2018).

During pregnancy, as the pregnancy trimester progressed, more women used oral FeS, the usage number significantly increased from 112 in the first trimester to 346 in the third trimester. Similarly, with the intake dosage, fewer women used low doses (<30 mg/day), and more women used preventative (30-65 mg) and treatment doses (100-200mg) with the trimester progression, indicating the rise in elemental iron intake. The trend was in line with what would be expected, with iron requirements increasing, particularly in the second and the third trimesters and women having their routine iron levels screened by their LMC. If their Hb or SF level were low, an oral FeS could be prescribed. When compared to the daily elemental iron dosage intake, Chatterjee et al.'s study showed a similar but slightly higher dosage consumption as fewer women used preventative dosage during pregnancy (39.6%) but more used treatment dosage (15.1%) and high dose (3%) (Chatterjee et al., 2016). As explained earlier, one possible reason could be that Chatterjee et al.'s study included all types of MMNS used. Compared to this study, only the most used MMNS was asked. More types of MMNS contributed to higher elemental iron dosage intake; therefore, a slightly higher dosage intake was observed in Chatterjee et al.'s study.

In postpartum, the number of women who used oral iron-containing supplements (n=262) decreased from the numbers reported during pregnancy. The oral FeS usage was reduced to 170, while the number taking iron-containing MMNS was similar to pregnancy at 138. The stability of iron-containing MMNS usage may be related to women using MMNS to acquire other essential nutrients, such as iodine, as recommended by the Ministry of Health (Ministry

of Health, 2020). The falling number of women who used oral iron-containing supplements and reduced daily dosage of elemental iron intake in our study is expected due to a significant reduction of iron requirements in lactation. It was expected that most women could acquire enough iron from diet alone unless there was severe blood loss via childbirth (for example, haemorrhage).

In a previous New Zealand study (n=133), Savage reported that 7.5% (n=10) of postpartum women had iron overload (defined as SF ≥150 μg/L) (Savage, 2021). Excessive iron may also be an issue apart from ID/IDA. When applied to oral iron-containing supplements, the high iron overload cases highlighted the importance of screening Hb and SF levels before taking oral iron-containing supplements postpartum. More studies to investigate the ID/IDA screening rate and whether the LMC was involved when taking oral iron-containing supplements postnatally are recommended in the future.

3.5.4. The reason for using oral iron-containing supplements and self-purchase

Our study found that most women (90%) took oral FeS based on prescription, and the LMCs' advice was the most significant influencing factor (82.2%) for self-purchasing an oral FeS. This also aligns with almost all women (93%) who reported that their LMC knew they had purchased oral FeS. This finding was consistent with previous studies that found the LMC to be the most common and trusted information provider for supplement use among pregnant women (Chatterjee et al., 2016; Morton et al., 2010). In our study, the health profession's (including the LMC) advice was the primary determinant of oral FeS usage, echoed by an earlier New Zealand study (Brown et al., 2020). However, the results could not be directly compared because oral iron-containing supplements were combined with other supplements, such as calcium, fish oil and vitamin D, to form a bigger category in Brown's studies. The LMC is professionally trained, knowledgeable about the relevant prenatal care guidelines and well-positioned to provide advice on women's iron-rich diet, iron-fortified food and oral FeS if required. Notably, achieving optimal iron status around pregnancy needs is a holistic approach; with oral FeS, dietary advice is also recommended as a first-line strategy, such as encouraging the consumption of iron-rich foods or dietary patterns (Ministry of Health, 2020; Pavord et al., 2012; Te Whatu Ora Lakes, 2024). Although our study did not collect any dietary-related information, such as whether the LMC offered dietary advice about iron, a previous New Zealand study reported that only 10% of women in early pregnancy and 3.2% in later pregnancy were given dietary advice by their midwife (Calje & Skinner, 2017). These findings indicate that many women may not receive sufficient dietary advice for antenatal care in New Zealand. Lacking guidance on dietary advice may result in women being unaware of the simple,

practical ways to boost their iron levels and potentially increase their risk of ID.

On the contrary, iron-containing MMNS was mostly self-purchased, and the use was primarily based on their own general knowledge, either alone or in combination with other reasons such as information from the internet, books or newspapers, or family or friends or a nutritionist recommended it. Fewer (84.9%) women indicated they had let their LMC know they were taking an MMNS, with this figure potentially being higher as a significant number of women chose not to answer this question. Similarly, a qualitative Australian study (n=40) investigating the motivation for using MMNS during pregnancy also reported that most women took MMNS based on self-belief to gain reassurance that the nutrients required had been definitely met (Malek et al., 2018). In New Zealand, except for folic acid and iodine, the Ministry of Health does not recommend any supplement usage in pregnancy and lactation unless clinically indicated (Ministry of Health, 2022). Self-purchasing based on one's own general knowledge may be problematic because 1. Women may have an insufficient understanding of the different requirements of iron intake during preconception (18mg), pregnancy (27 mg), and lactation (9 mg) (Australian National Health and Medical Research Council & New Zealand Ministry of Health, 2017). 2. They may not be aware that the nutrient levels MMNS contain vary so much by the brand. For example, the elemental iron quantity in the most popular iron-containing MMNS brand (Elevit with Iodine®, 60 mg per capsule) differs greatly from the second most popular brand (Blackmores Pregnancy & Breastfeeding Gold, 5 mg per capsule). 3. Women may lack the knowledge to check how much iron is in a product before purchasing it. For example, women may be confused about the concept of "elemental iron" or some preparations labelled elemental iron as daily servings instead of per tablet/capsule, which requires following the manufacturer's instructions (For example, three capsules per day) to achieve adequate elemental iron. To support women with appropriate decision-making, effective communication from their LMC on different iron requirements and advice on what to look for when self-purchasing oral iron-containing supplements based on their needs would be helpful (Chatterjee et al., 2016). In addition, given the variety of preparations, dosage differences in today's oral iron-containing supplements market, and widespread consumption, empowering the LMC's knowledge about oral iron-containing supplements is crucial.

3.5.5. Strengths and limitations

The strengths of this study were the large cohort size and the detailed coverage of oral FeS and iron-containing MMNS usage as oral iron-containing supplements across preconception, pregnancy and postpartum. However, most women in this study were highly educated, healthy New Zealand-born Europeans/Pakeha with high household incomes, limiting the generalisability of results to the whole New Zealand population. Further, due to the online

questionnaire and data collected retrospectively, opportunities to clarify the exact usage were missed. Participants may have forgotten or inaccurately remembered the reported details. This likely also contributed to the high number of missing or incomplete responses, resulting in high exclusion rates for some data analyses.

3.6. Conclusion

To conclude, oral iron-containing supplements were commonly used around pregnancy. Women took a wide range/array of brands, which varied markedly in the elemental iron they contained. The number of women who used oral iron-containing supplements and their corresponding dosage align with the increased iron requirement during pregnancy and decreased postpartum. The LMC played an important role in influencing the maternal decision to use and purchase oral FeS. However, iron-containing MMNS were mostly self-purchased and may have been with or without understanding the formulation of the MMNS and how much iron they contained. This may have resulted in participants choosing an iron-containing MMNS that does not contain sufficient iron for their needs. More research is needed to explore the growing trend of the use of MMNS around pregnancy so that if a woman chooses to take an iron-containing MMNS, they and their LMC are in a better position to tailor the choices of iron-containing supplements that will help meet maternal iron needs.

Chapter 4: Conclusions and Future Recommendations

4.1. Study summary and achievements of aim and objectives

This study was a secondary analysis, which used data collected from an anonymous self-administered online questionnaire for a cross-sectional observational study of postpartum women in New Zealand between February and mid-August 2022. The primary aim of this study was to investigate the usage of oral iron-containing supplements [an umbrella term for oral iron supplement (FeS) and iron-containing multiple micronutrient supplement (MMNS)] across preconception, three trimesters of pregnancy, and postpartum periods. Three objectives helped achieve this, including identifying the preparations of the oral iron-containing supplements women took, the daily quantity of elemental iron from iron-containing supplements taken, and whether the oral iron-containing supplements were prescribed or self-purchased.

For the first objective, 47 types of oral iron-containing supplements were reported being taken by the women. This included 17 types of FeS and 30 types of iron-containing MMNS, providing elemental iron dosages ranging between 5 to 105 mg per tablet/capsule. The most popular oral FeS taken was Ferro-Tab®, followed by Ferrograd®. In addition to the five FeS (Ferro-Tab®, Ferrograd®, Ferodan®, Ferro-F Tab®, and Ferrograd C®) that are included in the New Zealand pharmaceutical schedule, which a Lead Maternity Carer (LMC) can prescribe, women reported taking a wide selection of other oral iron-containing supplements. The most widely used iron-containing MMNS was Elevit with Iodine®. Six types of iron-containing MMNS reported taken were marketed for general health and, therefore, potentially unsuitable to be taken by women in preconception, during pregnancy and postpartum.

Based on New Zealand guidelines (Te Whatu Ora, 2022; Te Whatu Ora Lakes, 2024; The Royal Australian and New Zealand College of Obstetricians and Gynaecologists, 2019), to prevent or treat iron deficiency/ iron deficiency anaemia (ID/IDA), oral iron-containing supplements should be higher than 60 mg per tablet/capsule. In this study, only five preparations (Ferro-Tab®, Ferrograd®, Ferodan®, Maltofer®, and Elevit with Iodine®) contained the required level of elemental iron. The remaining 42 types of oral iron-containing supplements (13 FeS and 29 iron-containing MMNS), including the five practitioner only brands, comprised much less elemental iron, at 24 mg per tablet/capsule or less, with the majority (22 out of 30 types) of iron-containing MMNS containing negligible amounts of (<10 mg) elemental iron per tablet/capsule. This study provided some insights into the wide range of preparations that contain varying amounts of elemental iron that New Zealand women might be taking. Notably, the common ones prescribed are on the pharmaceutical schedule, and information is

readily available for the LMC to access, including the New Zealand Formulary (New Zealand Formulary, 2024). It would be challenging for the LMC to keep across all available oral iron-containing supplements and the dosage they provide. Addressing knowledge gaps in the LMCs' knowledge of oral iron-containing supplements is essential so that they can provide updated and reliable information as part of antenatal care.

The second objective was achieved by calculating the average daily elemental iron intake by dividing the total weekly elemental iron intake (combined from oral FeS and iron-containing MMNS) by seven. The median (25^{th}, 75^{th}) daily dosage was 21.4 (4.6, 60.4) mg in preconception, 39.5 (7.0, 60.4) mg in the first trimester, 60.4 (18.6, 60.4) mg in the second trimester, 60.4 (29.8, 65) mg in the third trimester, and 20.9 (6.3, 60.4) mg in postpartum. This study found that more women used oral iron-containing supplements in the second and third trimesters, mainly contributed by using oral FeS. Higher elemental iron daily intake was found in the second and third trimesters. Around half of the women used a preventative dosage (30-65) mg during pregnancy as recommended by New Zealand, Australia, and the United Kingdom guidelines to prevent IDA (Te Whatu Ora, 2022; Te Whatu Ora Lakes, 2024), with an increasing number reporting taking a treatment dosage (100-200 mg) in the second (10.1%) and third trimesters (12.4%). As could be expected, based on the increased iron intake required during pregnancy, women should have visited their LMC, and their Haemoglobin (Hb) and Serum Ferritin (SF) levels should have been checked. If low iron status was detected, an oral FeS was prescribed. In contrast, iron-containing MMNS use remained similar with a low dosage intake. This is expected; women may take MMNS to acquire other essential micronutrients beyond iron, such as folic acid or iodine, as the Ministry of Health recommended (Ministry of Health, 2022). The low dosage could be due to the negligible amounts of (<10 mg) elemental iron per tablet/capsule most iron-containing MMNS contains. The results provided insights that the number of women who used oral iron-containing supplements and the corresponding dosage aligned with the increased iron requirement during pregnancy and decreased needs for postpartum.

The third objective was fulfilled by examining whether the oral FeS was prescribed and, if not, the reason for the self-purchase, and the intake reason for MMNS. Almost all women who reported oral FeS usage had been prescribed (90%). For the few women who purchased their supplement, their LMC played an important role in influencing their decision to use and purchase oral FeS. In contrast, iron-containing MMNS were mostly self-purchased, predominantly (82%) based on women’s own general knowledge either alone or in combination with another reason, with limited advice (20.5%) input from their LMC and/or health professionals. Women seem to be generally well supported in oral FeS usage by their LMC.

The active involvement of the LMC was anticipated and aligned with the Ministry of Health guideline, which advised women to talk to their midwife, doctors, and dietician if they are concerned about ID. Oral FeS should only be used once clinically indicated based on their Full Blood Count (FBC) test results where their LMC is routinely prescribed during antenatal visits (Ministry of Health, 2020; Te Whatu Ora, 2022; Te Whatu Ora Lakes, 2024; The Royal Australian and New Zealand College of Obstetricians and Gynaecologists, 2019). In contrast, iron-containing MMNS usage mainly relies on self-knowledge with or without understanding the content of those MMNS, which may lead to choosing an iron-containing MMNS that does not contain sufficient iron for their need. When self-purchasing oral iron-containing supplements, women may not be aware of their iron requirement, may not pay attention to the formulation of nutrients and the dosages they contain, and/or may lack the knowledge to check how much iron is in a product. Given the variety of preparation and dosage differences in today's oral FeS and MMNS market, actively asking about oral iron-containing supplements usage around pregnancy by the LMC would be beneficial. To support women with appropriate decision-making to use oral iron-containing supplements, effective communication from their LMC is necessary about whether women need oral iron-containing supplements based on their FBC results and, if required, what type of oral iron-containing supplements and how much elemental iron it should contain.

4.2. Impact

Despite knowing that oral iron-containing supplements are commonly used during pregnancy and postpartum, there is little contemporary information about what oral iron-containing supplements and what doses of elemental iron women are taking. This study is valuable in providing more information about what women are taking and how much. Although the data cannot represent the general New Zealand population, it does reflect oral iron-containing supplements usage in a cohort of highly educated, healthy and high household income women. This study identified the broad range of oral iron-containing supplements, particularly iron-containing MMNS, that the LMC may not be familiar with, so any additional knowledge gap could be bridged to the LMC and women in pregnancy and lactation. This study highlighted that the active discussion about iron-containing MMNS usage around pregnancy could be beneficial. It serves as a pilot study for future qualitative research to explore why women choose to take these supplements, including whether one of the factors is to increase their iron intake and whether marketing strategies influence their decision. To better support women in achieving their optimal iron levels during pregnancy, it may be useful to provide a guideline on how much iron they should look to see if a product contains.

4.3. Strengths

To the author's knowledge, this was the first study in New Zealand to investigate oral iron-containing supplements beyond the simple question of "whether women used oral iron-containing supplements around pregnancy." A key strength of this study is that it provides more up-to-date data, including what preparations women were taking, their daily dosage intake, and whether the usage was prescribed or self-purchased. Beyond the traditional image of iron supplement, in which iron is the sole or key ingredient, this study comprehensively included information on iron-containing MMNS usage. Because the data covered preconception, pregnancy and postpartum, the use and daily elemental iron intake of iron-containing supplements could be compared, which was a unique angle from which to interpret maternal supplement usage.

Another strength of this study is the practical and flexible questionnaire design, allowing the collection of a wide range of data while respecting and reducing participants' burdens. A similar, repetitive layout and question style in the different supplement sections was adopted to make the questionnaire easier to understand and quicker to complete. In the MMNS section, given the variety of MMNS brands women might take, the image of popular MMNS brands was provided as visual clues to facilitate women identifying the preparation they had used. Moreover, the mixture of open and closed-ended questions, the place for additional information, and the option to skip irreverent questions improved the flexibility of participants when completing the questionnaire.

4.4. Limitations

Despite the large sample size, this study's participants were predominantly highly educated (bachelor's degree or higher) New Zealand-born Europeans/Pakeha with high household incomes and self-reported good health statuses. Demographics showed limited generalisability in representing the New Zealand population. Therefore, the results and conclusion from this study should be treated with caution. Moreover, the nature of collecting data online and retrospectively means that opportunities to clarify the exact usage were missed. Participants may have forgotten or inaccurately remembered the reported details, leading to incomplete or conflicting data, which results in high exclusion rates from specific analyses.

The other limitation of this study was that being a secondary analysis meant there were other questions in addition to the oral iron-containing supplements usage that it would have been useful to have information on but were not gathered. These included dietary information, such as whether the participants adopted a vegan/vegetarian diet or the frequency of consuming iron-rich food like red meat or iron-fortified cereals and what advice they had been given by

their LMC. If they had a history of ID/IDA in a previous pregnancy, how they took their oral FeS (whether it was on an empty stomach, taken with a vitamin C-rich source, and foods rich in calcium such as milk were avoided), and if they had any adverse effects, which could have affected their compliance. The inclusion of some open-ended questions around the reasons women took supplements would have given a greater insight into the reasons why women chose to take the supplements they did. Although we asked which MMNS they took 'the most throughout their pregnancy', this may not have fully captured if they took different MMNs at different stages (for example, an MMNS that contained more elemental iron during the third trimester). Finally, we did not have access to participants' blood results for Hb and SF levels, which meant participants could not be categorised into groups based on these results and matched with their iron intake, and to confirm whether oral iron supplementation was clinically required.

4.5. Recommendation for future research

1. Future studies could include a wider socioeconomic group and diverse ethnicities, including Māori, Pacific Islanders, Asians, and other minority populations, to gather more comprehensive data to present the general population in New Zealand. Low socioeconomic status is recognised as a maternal ID/IDA risk factor. Statistics from lower socioeconomic groups would contribute more data and indicate the usage of iron-containing supplements among the more vulnerable population to ID/IDA.
2. It is recommended that qualitative research, for example, semi-structured interviews, be developed to explore the self-purchase rationale of iron-containing MMNS. Priority should be given to what pregnant and postpartum women know and believe about MMNS and to what extent and how the marketing strategies influenced the decision.
3. In the future, in-depth investigations of how adverse effects were managed when using oral iron-containing supplements around pregnancy are suggested. With the evolving view to support intermediate dosage (30-60 mg elemental iron) and intermittent dosing (second daily to week) in mild IDA treatment (especially for those who experience adverse effects) (Kaundal et al., 2020; Kumar et al., 2022; Stoffel et al., 2020), future research focus could involve the compliance rate and how adverse effects are managed during IDA treatment in pregnant and postpartum women. A study from both the LMC's and pregnant women's perspectives on intermediate dosage and intermittent dosing is worth exploring.
4. It could be beneficial to investigate the ID/IDA screening rate and whether the LMC is involved in advising oral iron-containing supplements during postpartum to develop an understanding of whether women who take these supplements meet the iron requirement during lactation.

4.6. Recommendation for clinical practice

Develop an education sheet/handout about using oral iron-containing supplements around pregnancy. This sheet should illustrate the different iron requirements and needs for oral FeS in preconception, during pregnancy, and postpartum, explain the concept of “elemental iron,” the disparities of dosage and iron forms among different brands of iron-containing supplements, and demonstrate where to look for or how to calculate elemental iron quantity contained in a serving size in oral iron-containing supplements. During routine antenatal visits, the LMC could actively ask women if they took iron-containing supplements, remind them of the dosage of iron and if it suits their condition, and provide dietary strategies to enhance iron absorption and ensure oral FeS is correctly consumed.

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Appendices

Appendix A: Study posters

Appendix B: Study information sheet

Dietary supplement use before, during and after pregnancy

Invitation to Participate in the Research Study

My name is Brianna Hunter, and I am a postgraduate student undertaking a thesis project to complete a Master of Science degree in Nutrition and Dietetics at Massey University. I am under the supervision of Dr Cheryl Gammon and Dr Ying Jin from the School of Health Sciences at Massey University.

Please read this Information Sheet carefully before deciding whether you wish to take part in our study. You are under no obligation to participate in this study. Feel free to discuss with your family, whānau, and friends.

Project Description

Pregnancy and breastfeeding places additional nutrient demand on a woman's body. Most women will receive advice from their lead maternity carer (LMC) on diet and possible use of dietary supplements (including preparations such as folic acid, iodine and iron) during the different stages of pregnancy or after childbirth. The LMC can prescribe these individual dietary supplements, with the prescription then filled by a Pharmacy. In addition, there is an increasing number of mainly multivitamin dietary supplements aimed at pregnant and breastfeeding women, which are available online and in a range of shops. At the same time, women are being exposed to a wider range of sources of information than ever before, such as the internet (health websites, Facebook), TV and other media (radio, newspapers, magazines), other health professionals such as Pharmacists, and friends and family.

The study will involve an online questionnaire for mothers with newborns to explore what supplements they took before becoming pregnant, during the three trimesters of pregnancy, and the period following the birth of their child.

Participant Identification and Recruitment

We aim to recruit 300 participants for this study.

To participate in this study, you must:

- be female
- ≥ 18 years old
- reside in New Zealand
- be in the later stages of your pregnancy or have given birth within the last 3 months
- not have used any assisted reproductive technologies (such as *in-vitro* Fertilisation) to become pregnant due to increased specialist advice
- be proficient in English and able to complete an online questionnaire

What does the study involve?

Prospective participants will be invited to take part in the online survey via an anonymous link. There will be the opportunity to read the description of the study including a section on data confidentiality, before completing several screening questions to confirm their eligibility to take part in the study. If eligible, participants will need to acknowledge that by agreeing to continue, they are consenting to be included in this part of the research and be directed to start the survey. Once the survey is completed, participants will receive an automated message of survey completion and be provided with details as to where they will be able to find a summary of the results.

The online questionnaire will take approximately 15 minutes.

What are the benefits of taking part in this study?

This study will help to fill the knowledge gap on what dietary supplements are currently being taken by women before and during pregnancy and the post-childbirth period, and where women are receiving information on supplement use.

Data Management

All data collected will be anonymous and will be used only for this study. Participants will be identified only by a unique study identification code (not your name).

The questionnaire data will be stored on computers, which are protected by passwords, using only the unique study identification code and will be accessible only to the researchers. The project data will be stored as outlined above for 5 years.

Outcomes from this project may be published in scientific journals or presented at relevant conferences. These outcomes will be summary data only and not identify individual participant data.

Participant's Rights

You are under no obligation to accept this invitation. If you decide to participate, you have the right to:

- decline to answer any particular question;
- withdraw from the study at any time;
- ask any questions about the study at any time during participation;
- provide information on the understanding that all data collected will be done anonymously and any contact details given will only be used for the purpose of the study
- be given access to a summary of the project findings when it is concluded.

Project contacts

Ms Brianna Hunter (School of Sport, Exercise and Nutrition, Massey University),

Email: b.hunter@massey.ac.nz

Dr Cheryl Gammon (School of Health Sciences, Massey University),

Email: c.gammon@massey.ac.nz

Dr Ying Jin (School of Health Sciences, Massey University),

Email y.jin@massey.ac.nz

Committee Approval Statements

This project has been evaluated by peer review and judged to be low risk. Consequently, it has not been reviewed by one of the University's Human Ethics Committees. The researcher(s) named in this document are responsible for the ethical conduct of this research.

If you have any concerns about the conduct of this research that you want to raise with someone other than the researcher(s), please contact Professor Craig Johnson, Director (Research Ethics), email humanethics@massey.ac.nz.

Thank you for considering participating in this study

Appendix C: Study information questionnaire

Block: Information Sheet (2 Questions)

Branch: New Branch
If
If Do you wish to continue? By agreeing to continue, you are consenting to be included in this part... No, I do not wish to be included in the research Is Selected

EndSurvey: Advanced

Standard: Eligibility Questions (4 Questions)

Branch: New Branch
If
If What month was your baby born? (in 2022) My baby was born in 2021 Is Selected

Block: Born in 2021 (1 Question)

EndSurvey:

Branch: New Branch
If
If Unfortunately you are not eligible to partake in this study as we are looking for participants li... Is Displayed

EndSurvey:

Branch: New Branch
If
If What month is your baby due? March Is Selected
Or What month is your baby due? April Is Selected
Or What month is your baby due? May Is Selected
Or What month is your baby due? June Is Selected
Or What month is your baby due? July Is Selected
Or What month is your baby due? August Is Selected
Or What month is your baby due? September Is Selected
Or What month is your baby due? October Is Selected

Block: Still Pregnant (1 Question)

Branch: New Branch
If
If Unfortunately at this time you are unable to complete the survey as we are looking for participan... I would like to receive an email reminder when I am eligible (enter email address below) Is Selected
Or Unfortunately at this time you are unable to complete the survey as we are looking for participan... No thank you Is Selected

EndSurvey:

Standard: Still Pregnant (1 Question)
Standard: Born in 2021 (1 Question)
Standard: Given birth (3 Questions)
Block: About you (7 Questions)

Block: Your pregnancy (9 Questions)
Block: Supplement use (10 Questions)
Block: Supplement use (10 Questions)
Block: Supplement use (10 Questions)
Block: Supplement use (14 Questions)
Block: Supplement use (7 Questions)

Page Break

Start of Block: Information Sheet

Q3 **Dietary supplement use before, during and after pregnancy**

My name is Brianna Hunter, and I am a postgraduate student undertaking a thesis project to complete a Master of Science degree in Nutrition and Dietetics at Massey University. I am under the supervision of Dr Cheryl Gammon and Dr Ying Jin from the School of Health Sciences at Massey University.

This study aims to explore what dietary supplements were taken by New Zealand women who have recently given birth, before they got pregnant, during the three trimesters of pregnancy and the period following the birth of their child. This study involves completing a short online survey.

Who are we looking for?

- women aged ≥ 18 years who reside in New Zealand,
- and have given birth in 2022,
- but have not used any assisted reproductive technologies (such as in-vitro fertilisation) to become pregnant due to increased specialist advice,
- and are able to complete the survey online in English

Please read the Full Information Sheet (a copy can be found here) before deciding whether you wish to take part in our study. You are under no obligation to participate in this study. Feel free to discuss with your family, whānau, and friends.

All data collected will be anonymous and will be used only for this study. Participants will be identified only by a unique study identification code (not your name).

The questionnaire will take 10-15 minutes to complete.

For further information please contact:
Ms Brianna Hunter (School of Sport, Exercise and Nutrition, Massey University), Email: b.hunter@massey.ac.nz

Page Break

Do you wish to continue? By agreeing to continue, you are consenting to be included in this part of the research.

- Yes, I consent to my responses to this survey being included in the research (1)
- No, I do not wish to be included in the research (2)

End of Block: Information Sheet

Start of Block: Eligibility Questions

Q1 Please select one of the following statements best describe you at this moment.

- I am living in New Zealand and aged over 18 years old and **currently pregnant** (1)
- I am living in New Zealand and aged over 18 years old and have **recently given birth** to my new baby (2)
- I am living outside of New Zealand or younger than 18 years old (3)

Display This Question:
If Please select one of the following statements best describe you at this moment. = I am living outside of New Zealand or younger than 18 years old

Q80 Unfortunately you are not eligible to partake in this study as we are looking for participants living in New Zealand and/or over the age of 18.

Display This Question:
If Please select one of the following statements best describe you at this moment. = I am living in New Zealand and aged over 18 years old and currently pregnant

Q2 What month is your baby due?

- March (7)
- April (8)
- May (9)
- June (10)
- July (11)
- August (12)
- September (13)
- October (14)

Display This Question:
If Please select one of the following statements best describe you at this moment. = I am living in New Zealand and aged over 18 years old and have recently given birth to my new baby

Q3 What month was your baby born? (in 2022)

- January (4)
- February (5)
- March (6)
- April (7)
- May (8)

- June (10)
- July (11)
- August (12)
- My baby was born in 2021 (9)

End of Block: Eligibility Questions

Start of Block: Born in 2021

Display This Question:
If What month was your baby born? (in 2022) = My baby was born in 2021

Q77 Unfortunately you are not eligible to partake in this research as we are looking for mums that have given birth within the last three months. If you know anyone that fits this criteria please send them the link to this study.

End of Block: Born in 2021

Start of Block: Still Pregnant

Display This Question:
If What month is your baby due? = March
Or What month is your baby due? = April
Or What month is your baby due? = May
Or What month is your baby due? = June
Or What month is your baby due? = July
Or What month is your baby due? = August
Or What month is your baby due? = September
Or What month is your baby due? = October

Q76 Unfortunately at this time you are unable to complete the survey as we are looking for participants who have given birth. If you would like to complete the survey once you have given birth, please provide your email address below and we will send you the link to the survey and a reminder at this time.

- I would like to receive an email reminder when I am eligible (enter email address below) (4)

_____

- No thank you (7)

Skip To: End of Survey If Unfortunately at this time you are unable to complete the survey as we are looking for participan... = I would like to receive an email reminder when I am eligible (enter email address below)
Skip To: End of Survey If Unfortunately at this time you are unable to complete the survey as we are looking for participan... = No thank you

End of Block: Still Pregnant

Start of Block: Given birth

Display This Question:
If What month was your baby born? (in 2022) = January
Or What month was your baby born? (in 2022) = February
Or What month was your baby born? (in 2022) = March
Or What month was your baby born? (in 2022) = April
Or What month was your baby born? (in 2022) = May
Or What month was your baby born? (in 2022) = July
Or What month was your baby born? (in 2022) = June

Q4 Did you need help from a fertility clinic to get pregnant?

- Yes (1)
- No (2)
- Not sure - please contact Brianna at b.hunter@massey.ac.nz for any queries regarding this question (3)

Skip To: End of Block If Did you need help from a fertility clinic to get pregnant? = No

Page Break

Display This Question:
If Did you need help from a fertility clinic to get pregnant? = Yes

Q78 Unfortunately you are not eligible to partake in this research due to the increased specialist guidance you may have received.

Skip To: End of Survey If Unfortunately you are not eligible to partake in this research due to the increased specialist gu... Is Displayed

Page Break

Display This Question:
If Did you need help from a fertility clinic to get pregnant? = Not sure - please contact Brianna at b.hunter@massey.ac.nz for any queries regarding this question

Q79 Brianna will be in contact regarding your query, so you are able to best respond to this question. For the time being, if you know anyone who is currently pregnant or has recently given birth, please invite them to take this survey.

Skip To: End of Survey If Brianna will be in contact regarding your query, so you are able to best respond to this question... Is Displayed

End of Block: Given birth

Start of Block: About you

Q81 The following questions are about you.

Page Break

Q1 What is your age?

- 18-25 years (4)
- 26-30 years (5)
- 31-35 years (6)
- 36-40 years (7)
- >40 years (8)

Page Break

Q2 Which is the main ethnic group that you identify with most. Please select one.

- NZ European/Pakeha (1)
- New Zealand Māori (2)
- Cook Island Māori (6)
- Fijian (3)
- Samoan (7)
- Tongan (8)
- Other Pacific Island (9)
- Other European (10)
- Chinese (11)
- South East Asian (12)
- Other Asian (4)
- Prefer not to answer (13)
- Other (Please specify) (5)

_____

Page Break

Q3 Were you born in New Zealand?

- Yes (1)
- No (2)
- Prefer not to answer (3)

Page Break

Q4 What is your highest qualification? Please select one.

- NCEA level 1/School certificate or NCEA level 2/6th form certificate or NCEA level 3 (1)
- Polytechnic qualification or Trade Certificate (2)
- Bachelors degree or higher (3)
- None/No qualifications (4)
- Other (please specify) (5)

_____

Page Break

Q5 5. What is your current postcode? Please write the four-digit number in the box below.

If you do not know your postcode, please click here .

Please note: your postcode is for the area you live in, not your house. This is so we cannot identify who you are from your postcode.

_____

Page Break

Q6 What was the total income from all sources for your household (before tax) over the last 12 months?

- Under $40,000 (1)
- $40,000 but less than $70,000 (2)
- $70,000 but less than $100,000 (3)
- $100,000 but less than $120,000 (4)
- 120,000 but less than $150,000 (5)
- $150,000 or more (6)
- I don't know (7)
- Prefer not to answer (8)

End of Block: About you

Start of Block: Your pregnancy

Q82 The following questions are about your pregnancy.

Page Break

Q1 Is this your first pregnancy?

- Yes (1)
- No (2)

Skip To: Q3 If Is this your first pregnancy? = Yes
Skip To: Q2 If Is this your first pregnancy? = No

Page Break

Q2 How many other children do you have?

- 1 (1)
- 2 or more (2)
- Other (7)

Page Break

Q3 Was this pregnancy...

- Planned (1)
- Unplanned (2)
- Choose not to answer (3)

Page Break

Q4 Since your baby was born, have you breastfed your baby, this includes expressing milk?

- Yes (1)
- No (2)

Page Break

Q7 Before your pregnancy was your health

- Poor (1)
- Fair (2)
- Good (3)
- Very good (4)
- Excellent (5)
- Do not know (6)

Page Break

Q8 Please select which best applies to how often you took dietary supplements (this includes vitamins and minerals) before you got pregnant.

- I regularly took dietary supplements (1)
- I occasionally took dietary supplements (2)
- I never took dietary supplements (3)

Page Break

Q9 Were you diagnosed with any medical conditions during your pregnancy? (please select all that apply)

- Iron deficiency (1)
- Anaemia (2)
- Hypertension (high blood pressure) (3)
- Gestational Diabetes (4)
- Hyperemesis Gravidarum/Morning Sickness (5)
- Heartburn (6)
- Other (please specify) (7)

_____

- Non-applicable (8)

Page Break

Q10 During your pregnancy, who was your lead maternity carer (primary maternity care provider)?

- Midwife (1)

- Doctor (GP: General Practitioner) (2)
- Obstetrician (Specialist) (3)
- Other (please specify) (4)

_____

- Did not have one (5)
- Choose not to answer (6)

End of Block: Your pregnancy

Start of Block: Supplement use

Q27 Folic Acid

The following questions are about your use of folic acid supplements before, during and after your pregnancy.

NOTE: These questions are about folic acid tablets on their own, not as part of a multivitamin preparation.

Page Break

Q1
Did you take 0.8mg or 5mg folic acid-**only** supplements?

- 0.8mg Folic Acid-only tablet (1)
- 5mg Folic Acid- only tablet (please specify why) (2)

_____

- Neither (3)

Skip To: Q2 If Did you take 0.8mg or 5mg folic acid-only supplements? = Neither
Skip To: Q3 If Did you take 0.8mg or 5mg folic acid-only supplements? = 0.8mg Folic Acid-only tablet
Skip To: Q3 If Did you take 0.8mg or 5mg folic acid-only supplements? = 5mg Folic Acid- only tablet (please specify why)

Page Break

Q2 Please indicate your reason(s) for not taking a folic acid-**only** tablet at any stage of your pregnancy.

- I was taking a multivitamin preparation that contained folic acid (1)
- I didn't receive any advice to take a folic acid supplement by my doctor/nurse/midwife (2)
- I could not tolerate them due to nausea or other side effects of pregnancy (3)
- Folic acid supplements were too expensive (4)
- I did not feel the need to as my health is good (5)

- I prefer to get all my nutrients from my diet (6)
- I cannot remember if I took them or not (7)
- Other (please specify) (8)

Skip To: Q6 If Please indicate your reason(s) for not taking a folic acid-only tablet at any stage of your pregn... = I was taking a multivitamin preparation that contained folic acid
Skip To: Q6 If Please indicate your reason(s) for not taking a folic acid-only tablet at any stage of your pregn... = I didn't receive any advice to take a folic acid supplement by my doctor/nurse/midwife
Skip To: Q6 If Please indicate your reason(s) for not taking a folic acid-only tablet at any stage of your pregn... = I could not tolerate them due to nausea or other side effects of pregnancy
Skip To: Q6 If Please indicate your reason(s) for not taking a folic acid-only tablet at any stage of your pregn... = Folic acid supplements were too expensive
Skip To: Q6 If Please indicate your reason(s) for not taking a folic acid-only tablet at any stage of your pregn... = I did not feel the need to as my health is good
Skip To: Q6 If Please indicate your reason(s) for not taking a folic acid-only tablet at any stage of your pregn... = I prefer to get all my nutrients from my diet
Skip To: Q6 If Please indicate your reason(s) for not taking a folic acid-only tablet at any stage of your pregn... = I cannot remember if I took them or not
Skip To: Q6 If Please indicate your reason(s) for not taking a folic acid-only tablet at any stage of your pregn... = Other (please specify)

Page Break

Q3 On average how often did you take folic acid-**only** tablets during the following periods

	Most days of the week (6 to 7 days per week) (1)	**Some days of the week (3 to 5 days per week)** (2)	**A few days of the week (1 to 2 days per week)** (3)	**Sporadically (less than once a week)** (4)	**Not taken** (5)	**Do not know/cannot remember** (6)
In the 3 months before you were pregnant? (1)						
In the first 3 months (trimester) of pregnancy? (2)						
In the second 3 months						

(trimester) of pregnancy? (3)
In the last 3 months (trimester) of pregnancy? (4)
In the 6 weeks following birth? (5)

Page Break

Q4 Why did you take a folic acid-**only** supplement?

- o I was prescribed a folic acid-only supplement by my lead maternity carer (1)
- o I was advised to purchase a folic acid-only supplement by a health professional (GP, Midwife, Nurse, Obstetrician/Specialist, Pharmacist) (2)
- o I self-purchased and took a folic acid-only supplement (3)
- o Choose not to answer (4)
- o Other (please specify) (5)

_____

Skip To: Q4a If Why did you take a folic acid-only supplement? = I was advised to purchase a folic acid-only supplement by a health professional (GP, Midwife, Nurse, Obstetrician/Specialist, Pharmacist)
Skip To: Q4a If Why did you take a folic acid-only supplement? = I self-purchased and took a folic acid-only supplement
Skip To: Q5 If Why did you take a folic acid-only supplement? = Choose not to answer
Skip To: Q5 If Why did you take a folic acid-only supplement? = Other (please specify)
Skip To: Q5 If Why did you take a folic acid-only supplement? = I was prescribed a folic acid-only supplement by my lead maternity carer

Page Break

Q4a Please specify which

- o Doctor/GP (general practitioner) (1)
- o Midwife (2)

- Nurse (3)
- Obstetrician/Specialist (4)
- Pharmacist (5)
- Other (please specify) (6)

_____

Skip To: Q5 If Please specify which = Doctor/GP (general practitioner)
Skip To: Q5 If Please specify which = Midwife
Skip To: Q5 If Please specify which = Nurse
Skip To: Q5 If Please specify which = Obstetrician/Specialist
Skip To: Q5 If Please specify which = Pharmacist
Skip To: Q5 If Please specify which = Other (please specify)

Page Break

Q4a I did this based on (please select all that apply).

- My own general knowledge (1)
- It was recommended by family member (whanau/hākuikui) or friends (2)
- Information found on the internet (3)
- Information found in a book, newspaper, or magazine (4)
- Do not know (5)
- Choose not to answer (6)
- Other (please specify) (7)

_____

Page Break

Q4b Was your lead maternity carer aware that you were taking it?

- Yes (1)
- No (2)
- I cannot remember/do not know (3)

Page Break

Q5 Where did you obtain your folic acid-**only** supplement?

- Local pharmacy (1)
- Online (2)
- Other (please specify) (3)

_____

- I cannot remember/do not know (4)

Page Break

Q6 Do you know what health issues are associated with inadequate intake of folic acid?

(please select all that apply).

- Neural tube defects (1)
- Goitre (2)
- Birth defects (3)
- Weak bones and teeth (4)
- Mental retardation (5)
- Impaired physical development during childhood (6)
- Blindness (7)
- Do not know (8)

End of Block: Supplement use

Start of Block: Supplement use

Q38 Iodine

The following questions are about your use of Iodine supplements before, during and after your pregnancy.

NOTE: These questions are about iodine tablets on their own, not as part of a multivitamin preparation.

Page Break

Q3 Did you take a 150µg iodine-**only** tablet?

- Yes (1)
- No (2)

Skip To: Q4 If Did you take a 150µg iodine-only tablet? = Yes
Skip To: Q4 If Did you take a 150µg iodine-only tablet? = No

Page Break

Q4 Please indicate your reason(s) for not taking an iodine-**only** tablet at any stage of your pregnancy.

- I was taking a multivitamin preparation that contained iodine (1)
- I didn't receive any advice to take a supplement by my doctor/nurse/midwife (7)
- I could not tolerate them due to nausea or other side effects of pregnancy (2)
- Iodine supplements were too expensive (3)
- I did not feel the need to as my health is good (4)
- I prefer to get all my nutrients from my diet (5)
- I cannot remember if I took them or not (8)

- Other (please specify) (6)

_____

Skip To: Q89 If Please indicate your reason(s) for not taking an iodine-only tablet at any stage of your pregnancy. = I was taking a multivitamin preparation that contained iodine
Skip To: Q89 If Please indicate your reason(s) for not taking an iodine-only tablet at any stage of your pregnancy. = I could not tolerate them due to nausea or other side effects of pregnancy
Skip To: Q89 If Please indicate your reason(s) for not taking an iodine-only tablet at any stage of your pregnancy. = Iodine supplements were too expensive
Skip To: Q89 If Please indicate your reason(s) for not taking an iodine-only tablet at any stage of your pregnancy. = I did not feel the need to as my health is good
Skip To: Q89 If Please indicate your reason(s) for not taking an iodine-only tablet at any stage of your pregnancy. = I prefer to get all my nutrients from my diet
Skip To: Q89 If Please indicate your reason(s) for not taking an iodine-only tablet at any stage of your pregnancy. = Other (please specify)
Skip To: Q89 If Please indicate your reason(s) for not taking an iodine-only tablet at any stage of your pregnancy. = I didn't receive any advice to take a supplement by my doctor/nurse/midwife
Skip To: Q89 If Please indicate your reason(s) for not taking an iodine-only tablet at any stage of your pregnancy. = I cannot remember if I took them or not

Page Break

Q4 On average how often did you take iodine-**only** tablets during the following periods

	Most days of the week (6 to 7 days per week) (1)	**Some days of the week (3 to 5 days per week)** (2)	**A few days of the week (1 to 2 days per week)** (3)	**Sporadically (less than once a week)** (4)	**Not taken** (5)	**Do not know** (6)
In the 3 months before you were pregnant? (1)						
In the first 3 months (trimester) of pregnancy? (2)						
In the second 3 months (trimes						

ter) of pregnancy? (3) **In the last 3 months (trimester) of pregnancy?** (4) **In the 6 weeks following birth?** (5)	

Page Break

Q5 Why did you take an iodine-**only** supplement?

- I was prescribed an iodine supplement by my lead maternity carer (1)
- I was advised to purchase an iodine supplement by a health professional (GP, Midwife, Nurse, Obstetrician/Specialist, Pharmacist) (2)
- I self-purchased and took an iodine supplement (3)
- Choose not to answer (4)
- Other (please specify) (5)

_____

Skip To: Q5a If Why did you take an iodine-only supplement? = I was advised to purchase an iodine supplement by a health professional (GP, Midwife, Nurse, Obstetrician/Specialist, Pharmacist)
Skip To: Q6 If Why did you take an iodine-only supplement? = I was prescribed an iodine supplement by my lead maternity carer
Skip To: Q5a If Why did you take an iodine-only supplement? = I self-purchased and took an iodine supplement
Skip To: Q6 If Why did you take an iodine-only supplement? = Choose not to answer
Skip To: Q6 If Why did you take an iodine-only supplement? = Other (please specify)

Page Break

Q5a Please specify which

- Doctor/GP (general practitioner) (1)
- Midwife (2)
- Nurse (3)
- Obstetrician/Specialist (4)

- Pharmacist (5)
- Other (please specify) (6)

_____

Skip To: Q6 If Please specify which = Doctor/GP (general practitioner)
Skip To: Q6 If Please specify which = Midwife
Skip To: Q6 If Please specify which = Nurse
Skip To: Q6 If Please specify which = Obstetrician/Specialist
Skip To: Q6 If Please specify which = Pharmacist
Skip To: Q6 If Please specify which = Other (please specify)

Page Break

Q5a I did this based on (please select all that apply).

- My own general knowledge (1)
- It was recommended by family member (whanau/hākuikui) or friends (2)
- Information found on the internet (3)
- Information found in a book, newspaper, or magazine (4)
- Do not know (5)
- Choose not to answer (6)
- Other (please specify) (7)

_____

Page Break

Q5b Was your lead maternity carer aware that you were taking it?

- Yes (1)
- No (2)
- I cannot remember/do not know (3)

Page Break

Q6 Where did you obtain your iodine supplement?

- Local pharmacy (1)
- Online (2)
- Other (please specify) (3)

_____

Page Break

Q89 Do you know what health issues are associated with inadequate intake of iodine? (please select all that apply).

- Neural tube defects (1)
- Goitre (2)

- Birth defects (3)
- Weak bones and teeth (4)
- Mental retardation (5)
- Impaired physical development during childhood (6)
- Blindness (7)
- Do not know (8)

End of Block: Supplement use

Start of Block: Supplement use

Q49 Iron

The following questions are about your use of iron supplements before, during and after your pregnancy.

NOTE: These questions are about iron tablets on their own, not as part of a multivitamin preparation.

Page Break

Q1 Did you take an iron-**only** supplement?

- Yes (1)
- No (2)

Skip To: End of Block If Did you take an iron-only supplement? = No

Page Break

Q2 Was the iron supplement you took...

- Prescribed by your midwife/doctor/specialist (1)
- Purchased (2)
- I cannot remember/do not know (3)

Skip To: Q93 If Was the iron supplement you took... = I cannot remember/do not know
Skip To: Q90 If Was the iron supplement you took... = Prescribed by your midwife/doctor/specialist
Skip To: Q91 If Was the iron supplement you took... = Purchased

Page Break

Q90 What type/brand of iron tablets did you have prescribed?

- Ferro-Gradumet (ferrous sulphate) (1)
- Ferro-Tab (ferrous fumerate) (2)
- Do not know (3)

- Other (please specify) (4)

_____

Skip To: Q93 If What type/brand of iron tablets did you have prescribed? = Ferro-Gradumet (ferrous sulphate)
Skip To: Q93 If What type/brand of iron tablets did you have prescribed? = Ferro-Tab (ferrous fumerate)
Skip To: Q93 If What type/brand of iron tablets did you have prescribed? = Do not know
Skip To: Q93 If What type/brand of iron tablets did you have prescribed? = Other (please specify)

Page Break

Q91 What type/brand of iron tablets did you purchase?

- Ferro-Gradumet (ferrous sulphate) (1)
- Ferro-Tab (ferrous fumerate) (2)
- Other e.g. Clinicians, Red Seal, Healtheries (please specify) (3)

_____

- Do not know (4)

Page Break

Q92 I purchased the iron tablets based on (please select all that apply)

- Advice from my doctor/midwife/specialist (1)
- My own general knowledge (2)
- It was recommended by family member (whanau/hākuikui) or friends (3)
- Information found on the internet (4)
- Information found in a book, newspaper, or magazine (5)
- Not sure (6)
- Other (please specify) (7)

_____

Page Break

Q5 Was your lead maternity carer aware that you were taking it?

- Yes (1)
- No (2)
- I cannot remember/do not know (3)

Page Break

Q6 Where did you obtain your iron supplement?

- Local pharmacy (1)
- Online (2)
- Other (please specify) (3)

_____

- I cannot remember/do not know (4)

Page Break

Q93 On average how many times a day did you take your iron tablets

- Once a day (1)
- Twice a day (2)
- Three times a day (3)
- Other (please specify) (4) _____
- I cannot remember/do not know (5)

Page Break

Q3 On average how often did you take iron-**only** tablets during the following periods

	Most days of the week (6 to 7 days per week) (1)	**Some days of the week (3 to 5 days per week)** (2)	**A few days of the week (1 to 2 days per week)** (3)	**Sporadically (less than once a week)** (4)	**Not taken** (5)	**Do not know** (6)
In the 3 months before you were pregnant? (1)						
In the first 3 months (trimester) of pregnancy? (2)						
In the second 3 months (trimester) of pregnancy? (3)						
In the						

last 3 months (trimester) of pregnancy? (4) **In the 6 weeks following birth?** (5)

End of Block: Supplement use

Start of Block: Supplement use

Q58
Multivitamins

The following questions are about your use of multivitamin supplements before, during and after your pregnancy.

Page Break

Q94 Did you take a multivitamin at any stage before, during or after your pregnancy?

- Yes (1)
- No (2)

Skip To: End of Block If Did you take a multivitamin at any stage before, during or after your pregnancy? = No

Page Break

Q1 Below are images of multivitamins available on the market in New Zealand. You may have taken more than one but select the one that you took the most throughout your pregnancy (Before you have given birth).

- Blackmores Conceive Well Gold Capsules + Tablets (1)
- Elevit with Iodine (2)
- Forever Mum –Preconception + Pregnancy Multi (3)
- Healtheries Pregnancy and Breastfeeding Multi (4)
- Radiance Preconception and Pregnancy Multi (5)
- Solgar Prenatal Nutrients (6)
- Swisse Ultinatal Preconception and Pregnancy multivitamin (7)
- Blackmores Pregnancy and Breastfeeding Gold (8)

- Vitawomenz Conception and Pregnancy Support (9)
- Elevit Breastfeeding (10)
- GO Healthy GO Pregnancy and Breastfeeding Advance (11)
- Microgenics pregnancy support multivitamin (12)
- BePure Mum's One (13)
- Fabfol tablets (14)
- BePure Folate Restore (17)
- Other (please specify) (15)

_____

Page Break

Q95 Did you take a multivitamin after you had given birth?

- Yes (1)
- No (2)
- I cannot remember/do not know (4)

Skip To: Q98 If Did you take a multivitamin after you had given birth? = No
Skip To: Q98 If Did you take a multivitamin after you had given birth? = I cannot remember/do not know

Page Break

Q96 Was it the same multivitamin that you took during your pregnancy?

- Yes (1)
- No (2)

Skip To: Q98 If Was it the same multivitamin that you took during your pregnancy? = Yes

Page Break

Q97 From the images below select the one that you took the most in the 6 weeks after you had given birth.

- Blackmores Conceive Well Gold Capsules + Tablets (1)
- Elevitwith Iodine (2)
- Forever Mum –Preconception + Pregnancy Multi (3)
- Healtheries Pregnancy and Breastfeeding Multi (4)
- Radiance Preconception and Pregnancy Multi (5)
- Solgar Prenatal Nutrients (6)
- Swisse Ultinatal Preconception and Pregnancy multivitamin (7)
- Blackmores Pregnancy and Breastfeeding Gold (8)
- Vitawomenz Conception and Pregnancy Support (9)
- Elevit Breastfeeding (10)
- GO Healthy GO Pregnancy and Breastfeeding Advance (11)
- Microgenics pregnancy support multivitamin (12)
- BePure Mum's One (13)
- Fabfol tablets (14)
- BePure Folate Restore (17)

- Other (please specify) (15)

_____

Page Break

Q98 On average how many times a day did you take a multivitamin tablet

- Once a day (1)
- Twice a day (2)
- Three times a day (3)
- Other (please specify) (4)
- I cannot remember/do not know (5)

Page Break

Q99 On average how often did you take a multivitamin tablet during the following periods

	Most days of the week (6 to 7 days per week) (1)	**Some days of the week (3 to 5 days per week)** (2)	**A few days of the week (1 to 2 days per week)** (3)	**Sporadically (less than once a week)** (4)	**Not taken** (5)	**Do not know** (6)
In the 3 months before you were pregnant? (1)						
In the first 3 months (trimester) of pregnancy? (2)						
In the second 3 months (trimester) of pregnancy? (3)						

In the last 3 months (trimester) of pregnancy? (4)	
In the 6 weeks following birth? (5)	

Page Break

Q2 Why did you take a multivitamin supplement?

- I was advised to purchase a multivitamin supplement by a health professional (GP, Midwife, Nurse, Obstetrician/Specialist, Pharmacist) (2)
- I self-purchased and took a multivitamin supplement (3)
- Choose not to answer (4)
- Other (please specify) (5)

_____

Skip To: Q2a If Why did you take a multivitamin supplement? = I was advised to purchase a multivitamin supplement by a health professional (GP, Midwife, Nurse, Obstetrician/Specialist, Pharmacist)
Skip To: Q2a If Why did you take a multivitamin supplement? = I self-purchased and took a multivitamin supplement
Skip To: Q3 If Why did you take a multivitamin supplement? = Choose not to answer
Skip To: Q3 If Why did you take a multivitamin supplement? = Other (please specify)

Page Break

Q2a Please specify which

- GP (general practitioner) (1)
- Midwife (2)
- Nurse (3)
- Obstetrician/Specialist (4)
- Pharmacist (5)
- Other (please specify) (6)

_____

Skip To: Q3 If Please specify which = GP (general practitioner)
Skip To: Q3 If Please specify which = Midwife
Skip To: Q3 If Please specify which = Nurse

Skip To: Q3 If Please specify which = Obstetrician/Specialist
Skip To: Q3 If Please specify which = Pharmacist
Skip To: Q3 If Please specify which = Other (please specify)

Page Break

Q2a I did this based on (please select all that apply)

- My own general knowledge (1)
- It was recommended by family member (whanau/hākuikui) or friends (2)
- Information found on the internet (3)
- Information found in a book, newspaper, or magazine (4)
- Do not know (5)
- Choose not to answer (6)
- Other (please specify) (7)

_____

Page Break

Q2b Was your lead maternity carer aware that you were taking it?

- Yes (1)
- No (2)
- I cannot remember/do not know (3)

Page Break

Q3 Where did you obtain your multivitamin supplement(s)?

- Local pharmacy (1)
- Online (2)
- Other (please specify) (3)

_____

- I cannot remember/do not know (4)

Page Break

Q100 If you took more than one brand of multivitamin supplement **before or during** your pregnancy, can you please tell us here a bit more about that - what other brands you took, how many a day and how often you took them and during what periods of your pregnancy.

_____
_____
_____
_____
_____

End of Block: Supplement use

Start of Block: Supplement use

Q77 Other supplements and final questions

The following questions are about your use of other supplements (including other vitamin and mineral products, herbal products, traditional medicine products) before, during and after your pregnancy.

Page Break

Q1 Before, during or after your pregnancy, did you take any other supplements? These may include any other vitamin and mineral products, herbal products and traditional medicine products.

- Yes (1)
- No (2)

Skip To: Q4 If Before, during or after your pregnancy, did you take any other supplements? These may include any... = No

Page Break

Q2 Can you tell us a bit more about what supplements you took and why you took them? (e.g. Omega-3 capsules – A friend told you need extra of these during your pregnancy; Probiotics – I had read these could reduce the risk of the baby having allergies)

- Before pregnancy (1)

_____

- During Pregnancy (2)

_____

- After pregnancy (3)

_____

Page Break

Q3b If you did take other supplements during your pregnancy, was your lead maternity carer aware that you were taking them?

- Yes (1)
- No (2)
- I cannot remember/do not know (3)

Page Break

Q4 During your pregnancy, was your access to healthcare affected due to COVID-19?

- Yes (please specify) (1)

_____

- No (2)

Page Break

Q101 During your pregnancy, do you think your supplement use was affected by COVID-19?

- Yes (please specify) (1)

_____

- No (2)

Page Break

Q102 Is there anything else that you would like to tell us about any of your supplement use before, during or in the 6 weeks following birth.

_____
_____
_____
_____
_____

End of Block: Supplement use

Appendix D: Description of reported oral iron supplements (FeS) that were taken (n=451)[1,2]

Iron supplements that have iron as a sole ingredient				
Brand	**Iron salt and the content of elemental iron per tablet**	**Other ingredients per tablet or capsule**	**Recommended dosing regime for adults**	**Usage Number**
Ferro-Tab (Pharmacy only)	Ferrous fumarate 200 mg equivalent to elemental iron **65mg**	NA	Prophylaxis: Take 1 tablet once or twice daily Treatment: Take 1 tablet three times daily	315
Ferrograd (Pharmacy only)	Ferrous sulphate 325 mg (modified release) equivalent to elemental iron **105 mg**	NA	Take 1 tablet once daily	50
Maltofer Tablets (Pharmacy only)	Iron polymaltose 370mg equivalent to elemental iron **100 mg**	NA	Take 1-2 tablets once daily	10
Solgar Gentle Iron (General sales)	Ferrous bisglycinate equivalent to elemental iron **20 mg**	NA	Take 1 capsule once daily	2
Spatone Liquid Iron (General sales)	Each sachet contains Trefriw Wells mineral water 25mL equivalent to elemental iron **5 mg**	NA	Take 1 sachet once daily Pregnant women: Take 2 sachets daily	2

Blackmores Women's Premium Iron (General sales)	Iron (II) glycinate 87.7 mg equivalent to elemental iron **24 mg**	NA	Take 1 tablet once daily	1
Ferodan (Pharmacy only)	Each mL oral solution contains ferrous sulfate heptahydrate 30 mg equivalent to elemental iron **6 mg**	NA	Take 15 mL-30 mL three times daily	1
Iron supplements that have iron as a key ingredient				
Brand	**Iron salt and the content of elemental iron**	**Other supplement ingredients**	**Recommended dosing regime for adults**	**Usage Number**
Bepure Iron Restore (General sales)	Iron bisglycinate equivalent to elemental iron **24 mg**	Vitamin C 500 mg Vitamin B9 300 mcg Vitamin B12 50 mcg Vitamin B6 12.5 mg	Take 1 capsule once daily	3
Thompson's Organic Iron (General sales)	Iron amino acid chelate 120 mg equivalent to elemental iron **24 mg**	Vitamin C 30 mg Folic Acid 100 mcg Vitamin B12 2 mcg	Take 1 tablet once daily	3
Floradix Iron Tablets (General sales)	Iron form not specified equivalent to elemental iron **7mg**	Vitamin B1 0.55mg Vitamin B2 0.7mg Niacin 8 mg Vitamin B6 0.7mg Folic Acid 100 mcg Vitamin B12 1.25 mcg Vitamin C 15mg	Take 1 tablet twice daily	3

Sanderson Superior Organic Iron (General sales)	Ferrous fumarate 73mg equivalent to elemental iron **24 mg**	Vitamin C 30mg Folic Acid 100mcg Vitamin B6 3mg Vitamin B12 2mcg Pumpkin Seed (Cucurbita Pepo) 25mg	Take 1 tablet once daily	2
BioMedica BioHeme (practitioner only)	Iron (II) glycinate 88.3mg equivalent to elemental iron **24 mg**	Lactoferrin 100 mg Vitamin C 100 mg	Take 1 capsule once daily	1
Clinicians Iron Boost (General sales)	Carbonyl iron equivalent to elemental iron **24 mg**	Vitamin C 50 mg Vitamin B12 50 mg Folic acid 300 mcg	Take 1 capsule once daily	1
Eagle Haemo-Red Plus (practitioner only)	Iron bisglycinate 120 mg equivalent to elemental iron **24 mg**	Vitamin C 200 mg Vitamin B2 20 mg Vitamin B6 12.8 mg Vitamin B1 10 mg Levomefolic acid (5-MTHF) 400 mcg Vitamin B12 400 mcg	Take 1 tablet once daily	1
Metagenics Hemagenics Iron Advanced (practitioner only)	Iron amino acid chelate (Meta Fe® – Iron bisglycinate) 120 mg equivalent to elemental iron **24 mg**	Ascorbic acid 80 mg Vitamin B12 500 mcg Vitamin B6 5 mg Levomefolic acid 200 mcg	Take 1 capsule once daily	1
Red Seal Iron Plus Vitamin C 100 (General sales)	Ferrous fumarate equivalent to elemental iron **7 mg**	Vitamin C 12mg Yeast (S.cervisiae) 120mg	Take 1-3 tablets once daily	1

Iron Melts (General sales)	Ferrous fumarate 25.4 mg equivalent to elemental iron **5 mg**	Vitamin C 50 mg Folic Acid 250 mcg Vitamin B12 10 mcg	Chew or suck 1 tablet once daily	1

[1]The number includes iron infusion (n=4), not knowing the prescribed oral iron supplement (FeS) name (n=37), and missing data on the name of the purchased oral FeS (n=5).
[2]The number includes those who took two types of oral FeS, which were those who prescribed both Ferro-Tab® and Ferrograd® (n=3) and purchased two types of oral FeS (n=4) (Thompson + Sanderson, Maltofer + Bepure, Ferrograd + Thompson, and Metagenics +Spatone).

Appendix E: Description of reported iron-containing multiple micronutrient supplements (MMNS) that were taken (n=249)[1]

Brand	Iron salt and the content of elemental iron per tablet or capsule	Other ingredients per tablet or capsule	Recommended dosing regime for adults	Usage number (before/during pregnancy)	Usage number (postpartum)
Elevit with Iodine (Pharmacy only)	Ferrous fumarate 183 mg equivalent to elemental iron **60 mg**	Vitamin B1 1.55 mg Vitamin B2 1.8 mg Vitamin B3 19 mg Vitamin B5 10 mg Vitamin B6 2.6 mg Vitamin B12 4.0 mcg Vitamin C 100 mg Vitamin D3 12.5 mcg Vitamin E 15 mg Vitamin H 200 mcg Folic Acid 800 mcg Calcium 125mg Magnesium 100 mg Phosphorus 125 mg Cooper 1 mg Manganese 1 mg Zinc 7.5 mg Iodine 250 mcg	Take 1 tablet daily	100	30
Blackmores Pregnancy & Breastfeeding Gold (General sales)	Iron glycinate 18.5 mg equivalent to elemental iron **5 mg**	Folic acid 250 mcg Iodine 75 mcg Concentrated omega-3 triglycerides fish 250 mg, containing omega-3 marine triglycerides 150 mg as: Docosahexaenoic acid (DHA) 125 mg Eicosapentaenoice acid (EPA) 25 mg Vitamin D 360 IU 9 mcg Nicotinamide 9 mg Vitamin C 30mg Calcium 50 mg Biotin 15 mcg	Take 2 capsules daily	52	51

		Zinc 5.5 mg Magnesium 35 mg Selenium 32.5 mcg Chromium 15 mcg Vitamin B1 700 mcg Vitamin B2 700 mcg Vitamin B5 2.5 mg Vitamin B6 950 mcg Vitamin B12 1.3 mcg Vitamin E 5.22 IU Betacarotene 2.5 mg			
Eagle Tresos Natal (Practitioner only)	Iron amino acid chelate equivalent to elemental iron **7.5 mg**	Vitamin B1 30 mg Vitamin B2 30 mg Vitamin B3 (Nicotinamide) 30 mg Vitamin B3 (Nicotinic acid) 5 mg Vitamin B5 30 mg Vitamin B6 (Pyridoxal-5-phosphate) 10 mg Vitamin B6 (Pyridoxine hydrochloride) 40 mg Vitamin B12 700 mcg Folinic acid 250 mcg Levomefolate calcium (5-MTHF) 270.7 mcg equiv. levomefolic acid 250 mcg Choline bitartrate 300 mg Inositol 40 mg Biotin 500 mcg Betacarotene 3 mg Vitamin C 50 mg Natural Vitamin E 75 IU Vitamin D3 1000 IU Vitamin K1 100 mcg Boron 250 mcg Chromium 50 mcg Copper 50 mcg Calcium 50 mg Magnesium 20 mg Manganese 2 mg Molybdenum 50 mcg	Take 1 tablet daily	16	11

		Iodine 270 mcg Selenium 50 mcg Zinc 15 mg			
Bepure Mum's One (General sales)	Iron bisglycinate equivalent to elemental iron **6.7 mg**	Vitamin A as Beta-Carotene 333.3 IU RE Vitamin A as Retinyl Acetate 333.3 IU RE Vitamin D-3 333.3 IU Vitamin E 25 mg (37 IU) Vitamin K-2 40 mcg Vitamin C 50 mg Vitamin B1 6.7 mg Vitamin B2 6.7 mg Vitamin B3 10 mg Vitamin B5 13.3 mg Vitamin B6 Pyridoxine HCL 6.7 mg Vitamin B6 as Pyridoxal 5'-phosphate 6.7 mg Vitamin B7 as Biotin 100 mcg Vitamin B9 100 mcg Vitamin B12 16.7 mcg Betaine Anhydrous 50 mg Chromium 9.7 mcg Calcium 16.7 mg Iodine 50 mcg Kelp trace elements 50 mcg Magnesium 33.3 mg Zinc 5 mg Selenium 50 mcg Silica 1.7 mg Boron 0.33 mg Copper 0.67 mg Choline 150 mg Molybdenum 16.7 mcg Manganese 0.67 mg Vanadium 25 mcg Additional ingredients: Hypromellose (capsule); Microcrystalline Cellulose; Vegetable Stearate; Silicon Dioxide	Take 3 capsules daily	15	12

Healtheries Pregnancy & Breastfeeding Multi (General sales)	Iron form not specified equivalent to elemental iron **10mg**	Vitamin B1 2mg Vitamin B2 2mg Vitamin B3 22mg Vitamin B5 12mg Vitamin B6 4mg Folic Acid 300mcg Vitamin B12 50mcg Biotin 100mcg Betacaratene 3mg Vitamin C 60mg Vitamin D3 700IU 17.5mcg Vitamin E 12IU 10mg Calcium 40mg Choline 10mg Chromium 30mcg Copper 1mg Manganese 500mcg Zinc 10mg Potassium 2mg Iodine 250mcg Selenium 65mcg Magnesium 100mg	Take 1 capsule daily	11	4
Swisse Ultinatal Pre-conception and Pregnancy Multivitamin (General sales)	Iron glycinate equivalent to elemental iron **5 mg**	Folic acid 250 mcg Choline 22.62 mg Concentrated fish Omega-3 triglycerides 250mg Containing: Eicosapentaenoic acid (EPA) 37.5 mg Docosahexaenoic acid (DHA) 125 mg Biotin 15 mcg Vitamin B1 700 mcg Vitamin B2 700 mcg Nicotinamide 9 mg Vitamin B5 2.5 mg Vitamin B6 950 mcg Mecobalamin 1.31 mcg Vitamin C 30 mg Vitamin D3 12.5 mcg	Take 2 capsules daily	9	2

		Vitamin E 3.5 mg Calcium 25 mg Iodine 110 mcg Magnesium 25 mg Selenium 32.5 mcg Zinc 5.50 mg			
Orthoplex Pure Natal (Practitioner only)	Iron bisglycinate 35.4mg equivalent to elemental iron **8 mg**	Levomefolate calcium 325 mcg Folic acid 200 mcg Vitamin C (Magnesium ascorbate monohydrate) 151 mg (Calcium ascorbate dihydrate) 150 mg Betacarotene 3 mg Vitamin D 1000 IU Mecobalamin 400 mcg Thiamine nitrate 30 mg Riboflavin sodium phosphate 20 mg Nicotinamide 35 mg Calcium pantothenate 40 mg Pyridoxine hydrochloride 30 mg Pyridoxal 5-phosphate 11 mg Biotin 300 mcg Choline bitartrate 100 mg Inositol 50 mg Iodine 270 mcg Chromium 25 mcg Chromium 25 mcg Vitamin K1 70 mcg Vitamin K2 20 mcg Calcium 1.47 mg Manganese 1 mg Molybdenum 50 mcg Silicon 4.67mg Selenium 60 mcg Zinc 12.3mg	Take 1 capsule daily	4	3
Healtheries Women's Multi + Probiotics	Iron form not specified equivalent to elemental	Vitamin B1 30mg Vitamin B2 30mg Nicotinamide 30mg	Take 1 tablet daily	4	4

(General sales)	iron **6mg**	Pantothenic acid 43mg Vitamin B6 45mg Vitamin B12 40mcg Calcium 27mg Folic acid 200mcg Magnesium 13mg Boron 500mcg Zinc 10mg Selenium 50mcg Iodine 150mcg Chromium 200mcg Beta-carotene 1mg Biotin 50mcg Vitamin C 50mg Vitamin D3 (200 IU) 5mcg Vitamin E (27 IU) 20mg Siberian ginseng root ext. equiv. dry 900mg Grape seed ext. equiv. dry 2500mg Bacillus Coagulans 500million			
Forever Mum Preconception + Pregnancy Multi (General sales)	Iron glycinate equivalent to elemental iron **5 mg**	Folic acid 400 mcg Iodine 150 mcg Vitamin B2 1.4mg Vitamin B3 18mg Vitamin B3 2.50mg Vitamin B6 1.0mg Vitamin B12 1.3mcg Biotin (Vitamin B7) 30 mcg Vitamin C 60mg Vitamin K2 30 mcg Choline 50mg Vitamin E 5.3IU 4.38mg Vitamin D3 200 IU 5 mcg Betacarotene 2.4mg Calcium 50mg Chromium 30 mcg Manganese 800 mcg	Take 1 capsule daily	4	1

		Selenium 16.25 mcg Zinc 5mg Molybedum 33.3 mcg Vitamin B1 700 mcg			
GO Healthy GO Pregnancy and Breast feeding Advance (General sales)	Ferrous fumarate 16.25mg equivalent to elemental iron **5 mg**	Concentrated Fish Omega-3 triglycerides 600mg (equiv. Eicosapentaenoic acid (EPA) 60mg Docosahexaenoic acid (DHA) 300mg Beta-carotene 3mg Vitamin B1 4mg Vitamin B2 4mg Vitamin B3 9mg Vitamin B5 3.7mg Vitamin B6 3.2mg Vitamin B12 1.5mcg Folic Acid 250mcg Biotin 15mcg Vitamin C 45mg Vitamin D3 500IU 12.5mcg Vitamin E 30IU 20mg Calcium 50mg Chromium 15.5mcg Copper 168mcg Magnesium 35mg Iodine 84mcg Selenium 75mcg Zinc 10mg	Take 2 capsules daily	4	1
Blackmores Conceive Well Gold Capsules + Tablets (General sales)	Ferrous fumarate 75.4 mg equivalent to elemental iron **24 mg**	Iodine 150 mg Folic acid 500 mg Copper 1.3 mg Vitamin B2 1.5 mg Vitamin B1 1.2 mg Manganese 5 mg Zinc 15 mg Nicotinamide 20 mg Vitamin B6 41.2mg Vitamin B12 50 mg	Take 1 capsule and 1 tablet daily	3	1

		Magnesium 200 mg Ascorbic acid 200 mg Vitamin C 300 mg Selenium 65 mg Biotin 100 mg Vitamin B5 4.6 mg Fish oil- natural 500 mg, containing omega-3 triglycerides 150 mg as: docosahexaenoic acid (DHA) 125 mg eicosapentaenoic acid (EPA) 25mg natural vitamin E 200 IU 147 mg Ubidecarenone(CoQ10) 60 mg vitamin D 400 IU 10 mg Betacarotene 1.5 mg			
Metagenics Pregnancy Care Advanced (Practitioner only)	Iron bisglycinate 60 mg equivalent to elemental iron **12 mg**	Choline 69 mg Lutein 1 mg Vitamin C 50 mg Betacarotene 3 mg Vitamin K2 15 mcg Vitamin D3 12.5 mcg Vitamin B1 12.5 mg Vitamin B2 12.5 mg Vitamin B3 15 mg Vitamin B5 12.5 mg Vitamin B6 (Pyridoxal 5-phosphate monohydrate) 12.5 mg (Pyridoxine hydrochloride) 12.5 mg Folic Acid 200 mcg Levomefolic acid (5-MTHF) (as Levomefolate glucosamine 89 micrograms) 50 mcg Vitamin B12 250 mcg Biotin 35 mcg Zinc 10 mg Manganese 1.3 mg	Take 2 tablets daily	3	1

		Iodine 149.5 mcg Chromium 25 mcg Molybdenum 25 mcg Selenium 25 mcg			
Solgar Prenatal Nutrients (General sales)	Iron bisglycinate equivalent to elemental iron **7 mg**	Calcium 326 mg Magnesium 113.5 mg Soya Protein Isolate/Amino Acid Blend (L-glutamic acid, L-aspartic acid, L-leucine, L-arginine, L-lysine, L-phenylalanine, L-serine, L-proline, L-valine, L-isoleucine, L-alanine, glycine, L-threonine, L-tyrosine, L-histidine, L-tryptophan, L-cysteine, L-methionine) 40 mg Vitamin C 25 mg Vitamin E 5 mg Zinc 3.75 mg Vitamin B3 5 mg Glycine 5 mg L-Aspartic Acid 5 mg Copper 500 mcg Pantothenic Acid 2.5 mg Inositol 2.5 mg Choline 1 mg Manganese 0.25 mg Natural Source Beta-carotene 0.9 mg Vitamin B6 0.625 mg Carotenoid Mix 2.4 mcg Vitamin B1 0.425 mg Vitamin B2 0.5 mg Folic Acid 200 mcg D-biotin 75 mcg Chromium 6.25 mcg Iodine 37.5 mcg Selenium 6.25 mcg Vitamin D2 2.5 mcg Vitamin B12 2 mcg	Take 1 tablet daily	3	4
Radiance	Ferrous bisglycinate	Total folate derivatives 250mcg	Take 2 capsules daily	3	1

Preconception and pregnancy Multi (General sales)	18.26mg equivalent to elemental iron **5 mg**	equiv. levomefolic acid 75mcg equiv. folic acid 175mcg Omega-3 261mg equiv. DHA 104mg equiv. EPA 157mg Choline 10mg Vitamin B1 7.5mg Vitamin B2 7.5mg Vitamin B3 7.5mg Vitamin B5 7.5mg Vitamin B6 7.5mg Vitamin B12 25µg Vitamin C 30mg Vitamin D3 250IU Vitamin E 25IU Vitamin K2 25mcg Biotin 25mcg Inositol 5mg Boron 250mcg Calcium 10mg Chromium 12.5mcg Copper 500mcg Iodine 50mcg Magnesium 10mg Manganese 1mg Potassium 5mg Selenium 10mcg Zinc 5mg			
Thorne Basic Prenatal (Practitioner only)	Ferrous bisglycinate equivalent to elemental iron **15 mg**	Biotin 16.7 mcg Boron 0.3 mg Calcium 30 mg Calcium 30 mg Chromium 33.3 mcg Copper 0.67 mg Folate 0.57 mg Iodine 50 mcg Magnesium (Citrate) 15 mg	Take 3 capsules daily	2	2

		Magnesium (Malate) 15 mg Manganese 1.67 mg Selenium 16.7 mcg Vitamin A (Beta carotene) 150mcg Vitamin A (Palmitate) 200mcg Vitamin B1 1.67 mg Vitamin B12 66.7 mcg Vitamin B2 1.67 mg Vitamin B3 10mg Vitamin B5 6 mg Vitamin B6 4 mg Vitamin C 50 mg Vitamin D3 8.3 mcg Vitamin E 11.2 mg Vitamin K1 33.3 mcg Zinc 8.3 mg			
Elevit Breastfeeding (General sales)	Ferrous fumarate equivalent to elemental iron **9 mg**	Lutein 250mcg Concentrated Omega-3 Triglycerides-fish: 425.6mg, equiv. to Docosahexaenoic acid (DHA) 200mg Eicosapentaenoic acid (EPA) 21mg Betacarotene 6.5mg Folic Acid 500mcg Iodine 225mcg Vitamin B1 1.4mg Vitamin B2 1.6mg Vitamin B3 17mg Vitamin B5 7mg Vitamin B6 2mg Vitamin B12 2.8mcg Vitamin C 60mg Vitamin D3 600 IU 15mcg Vitamin E 10mg Vitamin H (Biotin) 35mcg Calcium 120mg Zinc 10mg Selenium 55mcg	Take 1 capsule daily	2	13

Radiance Mineral Power (General sales)	Iron bisglycinate equivalent to elemental iron **15 mg**	Calcium 254mg Magnesium 125mg Silica 50mg Zinc 5mg Manganese 2.5mg Boron 1mg Vitamin D3 500IU Copper 500mcg Vitamin K 50mcg Iodine 50mcg Chromium 50mcg Selenium 50mcg Molybdenum 25mcg	Take 1-2 capsules daily	1	0
Naturobest Prenatal Trimester 2 & 3 Plus Breastfeeding (General sales)	Ferrous glycinate 88.8 mg equivalent to elemental iron **12 mg**	Betacarotene 1 mg Lutein 1 mg Vitamin B1 0.7 mg Vitamin B2 0.8 mg Vitamin B3 9 mg Vitamin B5 3 mg Vitamin B6) 1 mg Levomefolic acid (active folate) 150 mcg equivalent folinic acid (activated folate) 100 mcg Total folate per daily dose 250mcg Vitamin B12 14 mcg Choline 200 mg Biotin 17.5 mcg Vitamin C 30mg Vitamin D3 1000IU 12.5 mcg Chromium 22.5 mcg Iodine 135 mcg Manganese 0.5 mg Molybdenum 25 mcg Selenium 32.5 mcg Silica 6 mg Zinc 10 mg	Take 2 capsules daily	1	2
Full Circle	Ferrous fumarate	Vitamin A 400 mcg	Take 3 tables daily	1	0

Prenatal (General sales)	equivalent to elemental iron **9 mg**	Vitamin C 23.3 mg Vitamin D 4.1 mcg Vitamin E 6.7 mg Thiamin 0.6 mg Riboflavin 0.6 mg Niacin 6.7 mg Vitamin B6 0.83 mg Folate 266.7 mcg Vitamin B12 2.6 mcg Biotin 100 mcg Pantothenic acid 3.3 mg Choline 50 mg Calcium 116 mg Phosphours 80 mg Iodine 50 mcg Magnesium 50 mg Zinc 5 mg Selenium 3.3 mcg Copper 0.6 mg Manganese 0.6 mg Chromium 3.3 mcg DHA (Docosahexaenoic acid) 16.6 mcg Lemon Bioflavonoid Complex 8.3 mg			
Vitabiotics Pregnacare Max (General sales)	Ferrous fumarate equivalent to elemental iron **8.5 mg**	N-Acetyl Cysteine 25 mg L-Arginine 50 mg Inositol 50 mg Betacarotene 1 mg Vitamin D 5 mcg Vitamin E 2 mg Vitamin K 35 mcg Vitamin C 40 mg Vitamin B1 2.5 mg Vitamin B2 1 mg Vitamin B3 10 mg Vitamin B6 5 mg Folic Acid 200 mcg L-Methylfolate 100 mcg	Take 2 tablets daily	1	0

		Pteroylmonoglutamic Acid 100 mcg Vitamin B12 4.5 mcg Biotin 75 mcg Pantothenic Acid 3 mg Calcium 250 mg Magnesium 75 mg Zinc 7.5 mg Copper 500 mcg Manganese 0.25 mg Selenium 27.5 mcg Iodine 75 mcg			
Vitabiotics Pregnacare Breast-feeding (General sales)	Ferrous fumarate equivalent to elemental iron **8 mg**	Vitamin D 5 mcg Vitamin E 10 mg Vitamin K 35 mcg Vitamin C 35 mcg Vitamin B1 2.5 mg Vitamin B2 1 mg Vitamin B3 10 mg Vitamin B6 5 mg Folic Acid 200 mcg Vitamin B12 3 mcg Biotin 75 mcg Pantothenic Acid 3 mg Calcium 350 mg Magnesium 75 mg Zinc 7.5 mg Copper 500 mcg Selenium 15 mcg Iodine 75 mcg Betacarotene 1 mg	Take 2 tablets daily	0	1
USANA Cellsentials Prenatal (General sales)	Ferrous fumarate equivalent to elemental iron **7 mg**	Calcium 67.5 mg Iodine 75 mcg Magnesium 75 mg Zinc 5 mg Copper 0.5 mg Vitamin A 3750 IU Vitamin C 325 mg	Take 4 tablets daily	1	1

		Vitamin D3 450 IU Vitamin E 100 IU Vitamin B1 6.75 mg Vitamin B2 6.75 mg Niacin 10 mg Vitamin B6 8 mg Folate 250 mcg Vitamin B12 50 mcg Biotin 75 mcg Pantothenic acid 22.5 mg			
Centrum For Women (General sales)	Ferrous fumarate equivalent to elemental iron **6.8 mg**	Retinol acetate (vitamin A) 300 mcg Betacarotene 600 mcg Vitamin D3 20 mcg Vitamin K1 20 mcg Calcium 11.9 mg Vitamin B1 4.2 mg Nicotinamide 14 mg Vitamin B2 3.85 mg Vitamin B6 6 mg Vitamin B12 21.6 mcg Biotin (vitamin H) 45 mcg Folic acid 300 mcg Vitamin E 28 mg Vitamin C 150 mg Calcium (394 mg as calcium carbonate and 6 mg as calcium hydrogen phosphate) 400 mg Magnesium 64 mg Zinc 8 mg Manganese 5 mg Chromium 25 mcg Selenium 55 mcg Copper 900 mcg Iodine 150 mcg	Take 1 tablet daily	1	1
Pure Synergy PureNatal Multivitamin For Mom & Baby	Iron form is not specified elemental iron **6.75 mg**	Vitamin A 325 mcg Vitamin C 37.5 mg Vitamin D3 6.25 mcg Vitamin E 7.25 mg	Take 4 tablets daily	1	0

(General sales)		Vitamin K1 22.5 mcg Thiamin (B1) 1.75 mg Riboflavin (B2) 2 mg Niacin 9 mg Vitamin 2 mg Folate 200 mcg Vitamin B12 10.5 mcg Biotin 17.5 mcg Pantothenic Acid 3.5 mg Choline 35 mg Iodine 72.5 mcg Zinc 3.25 mg Selenium 17.5 mcg Copper 0.33 mg Manganese 0.65 mg Chromium GTF 11 mcg Molybdenum 12.5 mcg Vitamin K2 5 mcg Organic Red Raspberry Leaf Extract 12.5 mg Organic Sprout Blend Fresh freeze-dried Sprouts: Broccoli, Upland Cress, Daikon, Red Radish, Cabbage, Arugula, Cauliflower 62.5 mg Organic Berry Blend Cold Temperature-Dried: Black Currant, Bilberry, Aronia, Pomegranate, Lingonberry, Concord Grape, Wild Blueberry, Sour Cherry, Elderberry, Cranberry, Red Raspberry, Black Raspberry 62.5 mg			
Blackmores Multivitamin for Women (General sales)	Ferrous fumarate 15.7 mg equivalent to elemental iron **5 mg**	Vitamin C 45 mg Biotin (Vitamin H) 15 mcg Calcium 100 mg Vitamin B5 4 mg Chromium 50 mcg Vitamin D3 5 mcg Copper 600 mcg Vitamin B12 2.4 mcg	Take 1 tablet daily	1	1

		Vitamin E 10.4 IU 8.6 mg Vitamin B9 400 mcg Magnesium 80 mg Manganese 3.5 mg Nicotinamide 14 mg Vitamin K1 35 mcg Iodide 150 mcg Vitamin B6 1.3 mg Betacarotene 1.2 mg Vitamin B2 1.1 mg Selenium 60 mcg Vitamin B1 1.1 mg Zinc 8 mg Choline bitartrate 60 mg Eleutherococcus senticosus (Siberian ginseng) extract dry conc. equiv. dry root 1 g 66.7 mg			
Me Today Women's Daily (General sales)	Ferrous fumarate 15.21mg equivalent to elemental iron **5 mg**	Betacarotene 5mg Vitamin B1 50mg Vitamin B2 25mg Vitamin B3 50mg Vitamin B5 50mg Vitamin B6 10mg Folic Acid 300mg Vitamin B12 50mcg Vitamin C 100mg Vitamin D3 12.5mg Vitamin E (25IU) 20.66mg Biotin 600mcg Choline Bitartrate 10mg Inositol 10mg Calcium 24.6mg Chromium 25mcg Copper 1500mcg Iodine 50mcg Manganese 1.8mg Magnesium 75mg	Take 1 capsule daily	0	1

		Selenium 55mcg Zinc 5mg Citrus Bioflavonoids Extract 10mg Co-Enzyme Q10 2mg Cranberry (Vaccinium Macrocarpon) ext. equiv. to Fresh Fruit 1500mg Grape Seed (Vitis vinifera) ext. equiv. to dry seed 1000mg Ginseng (Eleutherococcus Seticosus) ext. equiv. to dry root 400mg			
Microgenics Pregnancy Support Multivitamin (General sales)	Ferrous fumarate equivalent to elemental iron **5 mg**	Concentrated fish Omega-3 trigylcerides 500mg Equiv. to Docosahexaenoic acid (DHA) 120mg Eicosapentaenoic acid (EPA) 180mg Betacarotene 5mg Thiamine hydrochloride 5mg Vitamin B2 5mg Nicotinamide 20mg Calcium pantothenate 10mg Vitamin B6 41.13mg Folic Acid 500mcg Vitamin C 62mg Vitamin D3 200IU 5mcg Calcium 20mg Chromium 2.5mcg Magnesium 10mg Manganese 1mg Iodine 250mcg Selenium 16.25mcg Silicon 4.67mg Zinc 12mg	Take 1 capsule a day	1	0
Health By Habit Women's Multi (General sales)	Ferrous fumarate equivalent to elemental iron **4.95 mg**	Vitamin E 6.43mg Copper 0.49mg Iodine 68.9mcg Potassium 21.3mcg Vitamin D3 10mcg Vitamin B1 9.27mg	Take 1 capsule daily	1	0

		Vitamin B12 42.2mcg Biotin 146mcg Folic acid 237mcg Vitamin B2 9.5mg Vitamin B6 9.79mg Calcium 53.4mg Phosphorus 50.7mg Vitamin B5 47.5mg Bioflavonoid 5.25mg Vitamin B3 39.4mg Betacarotene 1000mcg Choline 14.9mg Molybdenum 0.02mcg Selenium 15mcg Magnesium 14.9mg Zinc 5mg Manganese 2mg Boron 1mg Inositol 29mg Ananas sativus fruit extract 25mg (equiv. to Ananas sativus dry fruit 1000mg) Vitamin C 119mg Vitamin K 13mcg Papain 10mg			
BioMedica Natal Care (Practitioner only)	Iron amino acid chelate equivalent to elemental iron **4.5 mg**	Natural Betacarotene 3 mg Vitamin B1 25 mg Vitamin B2 20 mg Vitamin B3 30 mg Vitamin B5 25 mg Vitamin B6 total content 25 mg Pyridoxine hydrochloride 22.12 mg Pyridoxal 5-phosphate monohydrate 10.7 mg Folic Acid 200 mcg Vitamin B12 200 mcg Biotin 100 mcg Vitamin D3 500 IU Choline bitartrate 40 mg	Take 2 capsules daily	1	1

		Inositol 20 mg Calcium 20 mg Chromium 25 mcg Chromium 75 mcg Copper 50 mcg Magnesium 20 mg Manganese 500 mcg Molybdenum 25 mcg Iodine 140 mcg Potassium 5 mg Selenium 50 mcg Zinc 10 mg Vitamin K 50 mcg Vitamin C 82.2 mg Citrus bioflavonoids extract 15 mg Peppermint oil 1 mg			
Prenatal Ease[2] preconception (General sales)	Ferrous fumarate equivalent to elemental iron **15 mg**	Vitamin A 2500 IU Vitamin C 110 mg Vitamin D3 400 IU Vitamin E 15 IU Thiamine 25 mg Vitamin B2 25 mg Niacinamide 25 mg Vitamin B6 25 mg Folic Acid 800 mcg Vitamin B12 400 mcg Biotin 30 mcg Vitamin B5 25 mg Calcium 60 mg Iodine 75 mcg Magnesium 25 mg Zinc 20 mg Selenium 50 mcg Copper 800 mcg Chromium 25 mcg Choline 25 mg Inositol 25 mg	Take 1 capsules daily	1	0

Prenatal Ease[2] Stage 1 (General sales)	Ferrous fumarate equivalent to elemental iron **7 mg**	Vitamin A 2500 IU Vitamin C 40 mg Vitamin D3 100 IU Vitamin E 11 IU Thiamine 700 mcg Vitamin B2 700 mcg Niacinamide 9 mg Vitamin B6 1 mg Folate 400 mcg Vitamin B12 1.3 mcg Biotin 15 mcg Vitamin B5 3 mg Calcium 40 mg Iodine 110 mcg Magnesium 25 mg Zinc 5 mg Selenium 30 mcg Copper 500 mcg Ginger (rhizome) 500 mg	Take 2 capsules daily	1	0
Prenatal Ease[2] Stage 2 (General sales)	Ferrous fumarate equivalent to elemental iron **13.5 mg**	Vitamin A 2500 IU Vitamin C 50 mg Vitamin D3 200 IU Vitamin E 11 IU Thiamine 700 mcg Vitamin B2 700 mcg Niacinamide 9 mg Vitamin B6 1 mg Folic Acid 400 mcg Vitamin B12 1.3 mcg Biotin 15 mcg Vitamin B5 3 mg Calcium 110 mg Iodine 110 mcg Magnesium 25 mg Zinc 5 mg Selenium 30 mcg Copper 500 mcg	Take 2 capsules daily	1	0

Prenatal Ease[2] Stage 3 (General sales)	Ferrous fumarate equivalent to elemental iron **15 mg**	Vitamin A 3000 IU Vitamin C 55 mg Vitamin D3 200 IU Vitamin E 11 IU Vitamin K1 25 mcg Thiamine 700 mcg Vitamin B2 700 mcg Niacinamide 9 mg Vitamin B6 2 mg Folic Acid 500 mcg Vitamin B12 2 mcg Biotin 15 mcg Vitamin B5 5 mg Calcium 120 mcg Iodine 115 mcg Magnesium 25 mg Zinc 6 mg Selenium 30 mcg Copper 500 mcg Chromium 45 mcg Proprietary Herbal Blend 60 mg Peppermint Leaf (Mentha piperita leaf), Red Raspberry Leaf (Rubus idaeus leaf)	Take 2 capsules daily	1	0

[1]The number includes two participants who took iron-containing MMNS postpartum exclusively.

[2]Prenatal Ease preconception, Stage 1, Stage 2 and Stage 3 were consumed by the same participant. Due to insufficient information to identify the exact product the participant took, the elemental iron quantity per capsule/tablet was averaged by the four products (15+7+13.5+15)/4=12.6mg.

Appendix F: The reported reason for taking and self-purchasing iron-containing MMNS (n=249)

Reason for taking MMNS (n=249)

Reason took MMNS	Category	Total n (%)
	Self-directed reasons	195 (78.3)
	Advice from health professionals	51 (20.5)
	As a gift	2 (0.8)
	Choose not to answer	1 (0.4)

Self-directed reasons for self-purchasing MMNS (n=195, participants could indicate more than one reason)

Self-directed reasons	Category	Total n (%)
	General knowledge	159 (82.0)
	Internet information	58 (29.9)
	Recommendations from family members/ friends	28 (14.4)
	Book, newspaper, or magazine	12 (6.2)
	Other[2]	19 (9.8)
	Advice from health professionals[1]	4 (2.1)
	Do not know	1 (0.5)
	Choose not to answer	1 (0.5)
	Missing	1

[1]Advice from health professionals was one part of the reason in multiple choices. It is combined with other self-directed reasons.

[2]Participants comments for Other:

1) For iron - low dose given slight deficiency but issues taking higher strength iron
2) Do not know,Thought it was the right thing to do. “Doesn’t hurt
3) For general health prior to pregnancy. I take Complan to help with milk supply
4) Had a bad cold and wanted to supplement my diet during sickness
5) Had a lot of nausea and food aversions so wanted to still make sure I was having a good intake of vitamin
6) I choose to take a multivitamin as I believed I was having a reaction to the iodine supplement I was taking
7) I feel better when I take one
8) found out I was pregnant and knew I needed Iodine and folate but didn't know how to get it until I found out by midwife
9) needed gluten free folic acid and the prescribed one was not gluten free
10) I was already taking multivitamin as I was breastfeeding my toddler
11) I was getting milk blisters, blocked milk ducts and it was suggested by the pharmacist and online that multivitamin could help
12) I was interested in the choline and having small amounts of iron
13) I have PCOS and therefore am likely to have absorption problem
14) Laziness bc it’s all one tablet rather than having to take iodine and folic acid individually.
15) Previous knowledge from working with bepure plus personal research
16) Preference to only take one medication/pill a day so it was easier to remember
17) Started taking elevit before conception but stopped in 2nd trimester due to finding out I had iron overload
18) Trying to boost immunity to avoid all the winter illnesses
19) We had been trying for 2 years with no success. So I was trying anything and everything to improve my chance to get pregnant

The health professionals who advise to purchase MMNS (n=51)

The health professionals	Total n (%)
Midwife	22 (43.1)
General Practitioner	11 (21.6)
Obstetrician/Specialist	4 (7.8)
Naturopath	4 (7.8)
Nutritionist	3 (5.9)
Dietician	3 (5.9)
Naturopath and Dietician	2 (3.9)
Dietician and the Midwife	1 (2.0)
Pharmacist	1 (2.0)