NUTRIENT REQUIREMENTS FOR HEALTHY PREGNANCY OUTCOMES

Fact versus fiction: Understanding the evidence base supporting vitamin and mineral supplementation

Maternal diet and nutrient requirements in pregnancy and lactation

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Maternal nutrient intake during pregnancy can affect foetal development and may also affect the baby's health later in life. Recognising this, health professionals recommend that women of childbearing age maintain higher levels of particular nutrients in order to best prepare for pregnancy. Pharmacists are often called on to answer questions on medicine use during pregnancy and lactation,[1] and are therefore well placed to also provide information about nutrient requirements and the use of supplements. To ensure relevancy, it is important to understand the rationale behind these recommendations.[2]

AFTER READING THIS ARTICLE, THE LEARNER SHOULD BE ABLE TO:

- discuss how maternal nutrition can impact on foetal development.
- describe the additional requirements for energy, macronutrients and micronutrients during pregnancy and lactation.
- discuss the 7 key micronutrients and the important role of these nutrients before, during and after pregnancy.

The 2016 Competency Standards addressed by this activity include: 1.4, 1.5, 3.1, 3.6

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Introduction

Pregnancy is a dynamic state during which nutrient requirements are increased to support the growing foetus, placenta and maternal tissues.[3] Maternal micronutrient status at the time of pregnancy can impact immediate, short-term, and long-term outcomes for the child.[4]

Adequate nutrition in the first 1000 days of life (from conception to 2 years) is crucial,[5] and may play a vital role in the prevention of common chronic diseases in adulthood, such a type 2 diabetes and metabolic syndrome.[6] Current research linking foetal nutrition with the risk of disease in later life has led to the hypothesis of 'foetal programming'. Foetal programming occurs during the critical period in which tissues and organs are created. When nutritional status is compromised, the foetus adapts in a way that may negatively impact foetal genomic expression and affect a wide range of physiological processes.[7]

The scientific literature widely supports the importance of good dietary habits during pregnancy and breastfeeding. However, for it to be of most benefit, women need to receive nutrition advice in time to enable them to make informed decisions regarding their pregnancy.[2]

Maternal nutrition

Australian women are falling short of current dietary recommendations

The Australian Guide to Healthy Eating (AGHE) provides a number of food and nutrition-related recommendations to help women optimise their dietary behaviour during pregnancy and breastfeeding (see Table 1[8]). Familiarity with this guideline among pregnant women is low.[9]

BACKGROUND

There is a large evidence base supporting the use of vitamin and mineral supplementation. However, sometimes the data appear conflicting leaving consumers with mixed messages about whether they should or shouldn't take them.

This educational series, brought to you by Sanofi Healthcare Australia in concert with key experts, aims to summarise the science and answer key questions about a variety of different supplements. It provides pharmacists with up-to-date information to ensure that customers wishing to use these products to supplement their diet do so appropriately.

IN THIS ISSUE...

Dr Denise Furness describes the nutritional toll that pregnancy takes on the body, provides insights into how maternal nutrition affects oocyte, embryo and foetal development and discusses key micronutrient requirements for pre-conception care, as well as during pregnancy and beyond.

TABLE 1: **AUSTRALIAN GUIDE TO HEALTHY EATING: RECOMMENDED AVERAGE DAILY NUMBER OF SERVES FROM EACH OF THE FIVE FOOD GROUPS FOR WOMEN[8]***

	19–50	51–70	70+	PREGNANT	BREASTFEEDING
Vegetables and legumes/beans	5	5	5	5	7.5
Fruit	2	2	2	2	2
Grain (cereal) foods, mostly wholegrain	6	4	3	8.5	9
Lean meat and poultry, fish, eggs, nuts and seeds, and legumes/beans	2.5	2	2	3.5	2.5
Milk, yoghurt, cheese and/or alternatives (mostly reduced fat)	2.4	4	4	2.5	2.5
Approx. number of additional serves from the five food groups for taller or more active women or discretionary choices	0–2.5	0–2.5	0–2	0–2.5	0–2.5

* Includes an allowance for unsaturated spreads or oils, nuts or seeds 2 serves [14–20g] per day.

In the Australian Longitudinal Study on Women's Health only half of the women adhered to the recommended intake of fruit, with much lower adherence in the other four groups (dairy: 22%, meat/meat alternatives: 10%, cereals: 2.5% and vegetables: 1.7%) during pregnancy.[10] Survey data suggest that the majority of pregnant women in Australia believe their diets to be healthy and almost two-thirds report that they have made changes specifically for pregnancy.[11] Nevertheless, none of the women met the AGHE recommended intakes for all five food groups.[11,12] Moreover, knowledge of multivitamin and mineral supplements and the importance of key nutrients was variable—in one survey 90% of women were aware of the need for folic acid supplementation but only 48.3% were aware of recommendations for iodine supplementation.[9]

Pregnancy and lactation place increased demands on maternal nutrition

Energy expenditure increases during pregnancy to account for the growing foetus. However, it does not increase immediately—energy requirements are the same as non-pregnant women in the first trimester, and then increase by an estimated 340kcal (1400kJ)/day in the second trimester and 452kcal (1900kJ)/day in the third trimester.[13,14] Women who breastfeed need a further 500kcal (2000–2100kJ) per day beyond the recommendations for non-pregnant women.[13,14] Multiple gestations further increase the demands on the mother's body, metabolic rate is increased by around 10% versus a singleton pregnancy and it is suggested that a 40% higher-calorie diet may be required to adequately maintain a woman's nutritional state during a twin pregnancy.[13]

Physiological changes during pregnancy alter normal ranges of several laboratory values. For example, haemodilution and anaemia may occur because there is a greater increase in plasma volume than there is in total red blood cell mass.[13] Consequently, definitions of anaemia in pregnancy are different to the normal values in non-pregnant women. There is greater protein binding of corticosteroids, sex steroids, thyroid hormones, and vitamin D during pregnancy because oestrogen increases hepatic protein production, resulting in lower free levels.

Among the macronutrients, protein requirements increase considerably, especially later in the pregnancy and during breastfeeding. To meet these demands, the recommended daily protein intake should be increased according to trimester and during breastfeeding (see Table 2).[14] Overall total fat intake does not need to change during pregnancy and lactation, but there should be increased focus on

TABLE 2: **RECOMMENDED DIETARY PROTEIN REQUIREMENTS IN WOMEN**[14]

	19–50 YEARS	PREGNANCY* 1ST TRIMESTER	PREGNANCY* 2ND/3RD TRIMESTERS	BREASTFEEDING*
EAR	37g/day (0.60g/kg)	37g/day (0.60g/kg)	49g/day (0.80g/kg)	54g/day (0.88g/kg)
RDI	46g/day (0.75g/kg)	46g/day (0.75g/kg)	60g/day (1.00g/kg)	67g/day (1.1g/kg)

* Values for pregnancy/lactation are in adults aged 19–50 years.

EAR = Estimated Average Requirement: Daily nutrient level estimated to meet the requirements of half the healthy individuals in a particular life stage and gender group.

RDI = Recommended Dietary Intake: Average daily dietary intake level that is sufficient to meet the nutrient requirements of nearly all (97–98%) healthy individuals in a particular life stage and gender group.

the quality of fats with strategies to improve the relative proportion of polyunsaturated fats (long chain omega 3 fatty acids).[15] Supplementation should be considered in women whose dietary intake of omega-3 fatty acids is low.[16]

Micronutrient requirements before, during and after pregnancy

During pregnancy and lactation micronutrient requirements increase more than do macronutrient requirements.[6] Micronutrients support a variety of biological roles that are vital to maternal health and foetal development.

Adverse health outcomes of gestational micronutrient deficiency include:[4]

Short-term

- Miscarriage
- Stillbirth
- Birth defects
- Foetal growth restriction
- Preterm birth

Long-term

- Death
- Altered growth, body composition
- Compromised cardiometabolic, pulmonary and immune function
- Poor neurodevelopment and cognition

Nutrient sufficiency is paramount during the periconceptional period. This 5–6 month window around the time of conception is the primary time for subfertility, miscarriage, congenital malformations, foetal growth restriction and placental-related disorders to originate.[17] One-carbon metabolism is fundamental for DNA synthesis, amino acid metabolism and methylation of a large number of nucleic acids, proteins and lipids. A deficiency in micronutrients involved in one-carbon metabolism (folate, vitamin B6 and vitamin B12) results in elevated systemic and follicular homocysteine, which in turn contributes to disturbances at key stages in the periconceptional period.[17] High homocysteine is associated with semen abnormalities, early gestation complications such as miscarriage and late gestation complications such as foetal growth restriction. Disruption to one-carbon metabolism has also been implicated in epigenetic modifications to DNA methylation, with long-term consequences on the health of the child.[17]

In the second and third trimesters, there is emphasis on growth and accumulation of nutrient stores in the foetus. Adequate accumulation of foetal nutrients is related to maternal micronutrient status and gestation duration, and is of particular importance for micronutrients that are not available via breast milk after birth.[4] For example, iron transfer to the foetus is at its peak in the third trimester, such that a pre-term baby born with limited iron stores is at high risk of anaemia by the time they reach 1 year of age.[4]

Requirements of many micronutrients are increased further during breastfeeding compared to pregnancy. Water-soluble vitamins (C, B1, B6, B12, and folate) and fat-soluble vitamins (vitamins A, D, K) are secreted into breast milk, and levels are reduced in breast milk when there is a maternal vitamin deficiency.[13]

Recommendations—7 key micronutrients

The National Health and Medical Research Council (NHMRC) recommends an increase in daily intake of most micronutrients during pregnancy.[14] Currently, routine supplementation is only recommended for folic acid and iodine.[16]

Established associations between pregnancy complications and deficiencies in folate, vitamin B12, vitamin D, calcium iodine, iron, zinc and selenium make these the key micronutrients and most of these are included in leading Australian pregnancy multivitamin formulations.[3] Table 3 lists the recommendations for daily intake of these 7 key micronutrients for non-pregnant, pregnant and lactating women.[14] Each is then discussed in further detail below.

Folate

Folic acid is the synthetic form of the naturally occurring B vitamin, folate. Folic acid is the form used in most vitamin supplements and food fortification. An adequate supply of folate is essential during pregnancy to support rapid cell growth, cell replication, cell division, and nucleotide synthesis for foetal and placental development.[13]

However, it is estimated that around half of all pregnancies in Australia are unplanned,[18] and many women may not realise they are pregnant until later in the first trimester.[3] Folic acid fortification of all wheat flour used for bread was implemented in Australia in 2009 in an effort to reduce the risk of folate deficiencies.[3]

Despite this, around 9% of women in Australia are reported to have inadequate dietary folate intake.[19] Aside from inadequate dietary intake, some women may benefit from (or require) higher folate due to genetic polymorphisms such as the methylenetetrahydrofolate reductase (MTHFR) C677T, an important

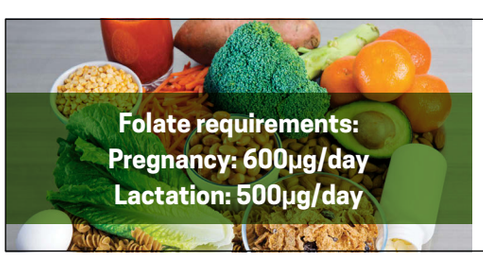
TABLE 3: **RECOMMENDATIONS FOR INTAKE OF KEY MICRONUTRIENTS IN NON-PREGNANT, PREGNANT AND BREASTFEEDING WOMEN (AGED 19–59 YEARS)[14]**

	NON-PREGNANT	PREGNANT	BREASTFEEDING	RATIONALE FOR INCREASED REQUIREMENTS[4]
MINERALS				
Calcium				N/A
EAR	840mg/day	840mg/day	840mg/day	
RDI	1000mg/day	1000mg/day	1000mg/day	
Iron				Increase of red blood cells; basal losses; foetal iron uptake, iron deposition in foetal and placental tissues; increased maternal absorption
EAR	8mg/day	22mg/day	6.5mg/day	
RDI	18mg/day	27mg/day	9mg/day	
Iodine				Additional foetal requirement
EAR	100µg/day	160µg/day	190µg/day	
RDI	150µg/day	220µg/day	270µg/day	
Selenium				Additional foetal requirement for saturation of foetal selenoproteins
EAR	50µg/day	55µg/day	65µg/day	
RDI	60µg/day	65µg/day	75µg/day	
Zinc				Maternal and foetal tissue accumulation
EAR	6.5mg/day	9mg/day	10mg/day	
RDI	8mg/day	11mg/day	12mg/day	
VITAMINS				
B9: Folate				Enhanced single-carbon metabolism to support materno-placental tissue expansion and foetal growth; active materno-foetal folate transfer, but no gains in maternal absorption compared to non-pregnant state
EAR	320µg/day	520µg/day	450µg/day	
RDI	400µg/day	600µg/day	500µg/day	
B12: Cobalamin				Foetal accumulation; maternal absorption improves and transcobalamin increase in 2nd and 3rd trimesters
EAR	2.0mg/day	2.2mg/day	2.4mg/day	
RDI	2.4mg/day	2.6mg/day	2.8mg/day	
Vitamin D				N/A
AI	5µg (200IU)/day	5µg (200IU)/day	5µg (200IU)/day	

AI = Adequate intake: an estimate of the nutrient intake necessary to maintain a healthy state.

EAR = Estimated Average Requirement: Daily nutrient level estimated to meet the requirements of half the healthy individuals in a particular life stage and gender group.

RDI = Recommended Dietary Intake: Average daily dietary intake level that is sufficient to meet the nutrient requirements of nearly all (97–98%) healthy individuals in a particular life stage and gender group.



- Folic acid should be taken for a minimum of one month before conception and for the first 12 weeks of pregnancy.[16]
- The recommended dose of folic acid is at least 0.4mg daily to aid the prevention of neural tube defects (NTD).[16]
- Where there is a known increased risk of NTD or a risk of malabsorption, a 5mg daily dose is recommended.[16]

TABLE 4: **OVERVIEW OF RESULTS FROM RECENT COCHRANE REVIEWS OF FOLIC ACID SUPPLEMENTATION DURING PREGNANCY[22,23]**

OUTCOME	RISK RATIO (95% CONFIDENCE INTERVAL)	NUMBER OF STUDIES, PARTICIPANTS
Preterm birth	1.01 (0.73 to 1.38)	3 studies, 2959 participants
Stillbirths/neonatal deaths	1.33 (0.96 to 1.85)	3 studies, 3110 participants
Improving pre-delivery anaemia	0.62 (0.35 to 1.10)	8 studies, 4149 participants
Reduced incidence of megaloblastic anaemia	**0.21 (0.11 to 0.38)**	**4 studies, 3839 participants**
Preventing NTD	**0.31 (0.17 to 0.58)**	**5 studies; 6708 births**
Protective effect for reoccurrence of NTD	**0.34 (0.18 to 0.64)**	**4 studies; 1846 births**
Preventive or negative effects on: • cleft palate • cleft lip • congenital cardiovascular defects • any other birth defects	 0.73 (0.05 to 10.89) 0.79 (0.14 to 4.36) 0.57 (0.24 to 1.33) 0.94 (0.53 to 1.66)	3 studies; 5612 births
Preventive or negative effects on miscarriages	1.10 (0.94 to 1.28)	5 studies; 7391 pregnancies

folate-metabolising enzyme, which occurs in approximately 10–40% of the population.[20,21]

Two Cochrane reviews state that maternal folate deficiency is associated with megaloblastic anaemia in pregnancy, but not with other adverse pregnancy outcomes such as preterm birth or stillbirths (see Table 4).[22] Folic acid supplementation, alone or in combination with vitamins and minerals, leads to a 72% decrease in the risk neural tube defects (NTDs) (see Table 4).[23]

In order to reduce the risk for neural tube defects in their offspring, women are recommended to take folic acid from fortified food or supplements daily from one month before pregnancy.[16] For women at increased risk of NTD should take a higher daily dose (5mg) of folic acid. These include:[16]

- pre-existing diabetes mellitus;
- family history of NTD or women with a child with NTD;
- women taking epilepsy medications (e.g. carbamazepine, valproic acid);
- increased BMI (>30kg/m^2);
- malabsorption syndrome.

Vitamin B12

The metabolic roles of vitamin B12 are closely related to those of folate and homocysteine.[24] Vitamin B12 is a coenzyme important in the formation of red blood cells and is essential for the metabolism of fats and carbohydrates and protein synthesis.

It is estimated that 8% of women in Australia have an inadequate dietary intake of vitamin B12.[19] Vitamin B12 is mainly sourced from animal foods, hence inadequate intake is most common in people who follow vegetarian or vegan diets. Vitamin B12-deficiency during pregnancy is common.[24]

While a recent systematic review and meta-analysis did not find an association between vitamin B12 levels in pregnancy and birth weight, it did show that lower maternal B12 levels were associated with increased risk of preterm birth.[24] Importantly, the risk of preterm birth was particularly high in the presence of B12-deficiency during pregnancy: 21% increased risk (adjusted risk ratio 1.21; 95% CI: 0.99 to 1.49).[24]

These results suggest that observations of a higher risk for low birth weight in B12-deficient women may be explained by preterm birth rather than by reduced foetal growth.[24]

Calcium and Vitamin D

Calcium is essential for bone development. Adequate intake is especially crucial during pregnancy and lactation because of the potential adverse effect on maternal bone health if maternal calcium stores are depleted.[25] It is estimated that around 70% of women aged 18–30 years do not have adequate calcium in their diet.[26] In women with low dietary calcium intake, supplementation has been shown to reduce the risk of pre-eclampsia by 88% (relative risk 0.22, 95% CI 0.12 to 0.42) and pre-term birth by 24% (relative risk 0.76, 95% CI 0.60 to 0.97).[27]

While an average baby has about 30g of calcium at birth, this is not gained uniformly throughout gestation—at least 80% is accreted during the third trimester.[25] Despite this, women who obtain adequate dietary calcium do not need to increase their intake. This is because several adaptations take place during pregnancy (the efficiency of intestinal calcium absorption doubles to meet the foetal requirement for calcium)

- Routine supplementation is not recommended in every pregnancy.[16]
- Supplements should be considered in women who follow vegetarian or vegan diets.[16]

Calcium is essential for bone development. Adequate intake is especially crucial during pregnancy and lactation because of the potential adverse effect on maternal bone health if maternal calcium stores are depleted.

- Routine supplementation is not recommended.[16]
- Women who avoid dairy in their usual diet and do not consume alternative high calcium foods, should take a calcium supplementation of at least 1000mg per day.[16]
- Serum vitamin D testing should be considered in pregnant women at increased risk of vitamin D deficiency and supplementation instituted where needed:[16]

Vitamin D level below 50nmol/L

- Vitamin D level 30–49 nmol/L, commence 1000IU (25µg)/day.
- Vitamin D level < 30 nmol/L should commence 2000IU (50µg)/day.
- Repeat the vitamin D level at 28 weeks gestation.

Vitamin D level above 50nmol/L

- Take 400IU (10µg) vitamin D daily as part of a pregnancy multivitamin.

- All women who are pregnant, breastfeeding or considering pregnancy, should take an iodine supplement of 150µg each day.[16,30]
- Women with pre-existing thyroid conditions should seek advice from their medical practitioner prior to taking a supplement.[30]

and lactation (skeletal resorption increases to provide calcium to milk). Heartburn is common in pregnancy. Calcium-based antacids are a suitable option because they provide symptomatic relief while also serving as a dietary calcium supplement.[28]

Vitamin D is a fat-soluble vitamin, sourced from food or manufactured in the skin when exposed to sunlight it undergoes further processing in the liver and the kidney to create the active form, 1,25-dihydroxyvitamin D. This promotes calcium absorption from the intestines, facilitating appropriate bone mineralisation and growth.[13]

Around one-third of women aged 18–35 in Australia do not have adequate vitamin D.[29] Insufficiency during pregnancy is associated with an increased risk of complications, including pre-eclampsia, preterm birth and low birth weights.[3] Maternal vitamin D levels correlate with low neonatal levels, which predispose the baby to impaired skeletal development.[16]

There is insufficient evidence to recommend screening all pregnant women for vitamin D deficiency or routine supplementation during pregnancy.[13] Targeted measurement is recommended for pregnant women with at least one risk factor for low vitamin D at the first antenatal visit.[16] Risk factors for low vitamin D include: reduced skin exposure to sunlight, dark skin, conditions affecting vitamin D metabolism and storage (obesity) and being born to a mother with low vitamin D. Supplementation with doses higher than 400IU (10µg) should be offered in women with levels below 50nmol/L and paired with health education and advice about sensible sun exposure.

Iodine

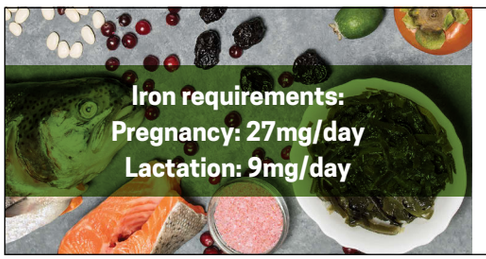
Iodine is a major component of thyroid hormones, inadequate iodine availability in the body leads to a deficiency in circulating thyroid hormones and an increase in pituitary thyroid stimulating hormone.[6]

Iodine deficiency is the largest preventable cause of brain damage and mental impairment worldwide.[31] However, nearly two-thirds of women of childbearing age in Australia have a urinary iodine concentration less than 150µg/L, which is the iodine level recommended by WHO for pregnant and breastfeeding women.[29]

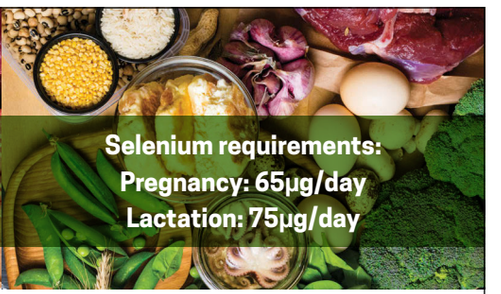
Mandatory fortification of iodised salt in bread was implemented in Australia in 2009.[31] Among women, consumption of fortified bread at ≥100g/day has been shown to be associated with five times greater odds of achieving an adequate iodine intake (odds ratio 5.0, 95% CI 4.96–5.13; $p < 0.001$) compared to lower bread consumption.[31] But, only 8–9% of women are currently consuming bread at that level.

Foetal thyroid function starts at the end of the first trimester. Because iodine is also required for foetal thyroid hormones, maternal iodine intake needs to increase by at least 50%.[32] Iodine deficiency during pregnancy increases the risk of spontaneous abortion, perinatal mortality, birth defects and neurological disorders.[32] The consequences are dependent upon the timing and severity of the hypothryoxinaemia.

The mandatory fortification program was not designed to meet increased requirements during pregnancy and lactation,[31] iodine supplementation is recommended instead.[30]



- Routine iron supplementation is not recommended in every pregnancy.[16]
- All women should have their haemoglobin level checked at the first antenatal visit and again at approximately 28 weeks' gestation and any anaemia investigated and treated.[16]



- Routine supplementation is not recommended.[16]

Iron

Iron is essential for good health. It plays an essential role in the transfer of oxygen to tissues, energy production, synthesis of DNA and neurotransmitters, growth and development.[33] Iron deficiency anaemia (IDA), defined clinically as haemoglobin <110g/L with serum ferritin <30µg/L and normal C-reactive protein, is one of the most common nutritional deficiencies globally. Estimates suggest that 12–15% of women in Australia have IDA.[34]

Iron requirements increase progressively during pregnancy in parallel with foetal growth. However, the amount of iron secreted in breast milk is low; iron requirements are therefore not as high during breastfeeding and may be offset to some extent by amenorrhea.[13] Routine iron supplementation is not required in every pregnancy, but is generally recommended for women at particular risk of IDA, such as vegetarians, multiparity pregnancies, previous anaemia, consecutive pregnancy (<1 year), teenage pregnancies and Aboriginal and Torres Straight Islanders.[16] Women with IDA should be given a specific supplement containing at least 60mg of iron daily.

Inadequate dietary intake plus the added demands of the foetus heighten the risk of iron deficiency and consequent impacts on the health of the baby and the mother, such as pre-term delivery, low birth weight, small for gestational age and post-partum haemorrhages.[35] Emerging research suggests a U-shaped risk curve with an increase in short- and longer-term adverse outcomes iron supplementation of iron-replete pregnant women.[33]

Blood loss at delivery can increase maternal susceptibility to IDA. Current Australian data suggest a rate of 3.3–26.5% for post-partum haemorrhage (PPH).[36] Recent data support a significant inverse correlation between haemoglobin values and blood loss during delivery—the more severe the anaemia the greater the likelihood of blood loss.[37] Supplemental iron during the later stages of pregnancy may help to reduce the risk of PPH if haemoglobin levels are low. Key issues to consider include the need for iron supplementation to counter increased fatigue and/or risk of depression associated with IDA after PPH.[38]

Zinc and selenium

Zinc and selenium are both trace minerals required in small amounts but essential in a wide range of antioxidant and cellular functions, including cell division and differentiation, which makes them essential for successful embryogenesis.[39,40] Although deficiencies are considered scarce, inadequate zinc is associated with adverse pregnancy outcomes (prolonged labour, restriction of foetal growth and embryonic death) and reduced serum selenium concentrations are associated with recurrent early pregnancy loss.[39] The concentrations required early in pregnancy in relation to the development of pregnancy complications remains to be established.

Zinc plays an important role in pregnancy and lactation and it is estimated that maternal zinc requirements in the third trimester are double that required by non-pregnant women.[40] However, supplementation has been shown to reduce the risk of pre-term birth by 14% (relative risk 0.86, 95% CI 0.76 to 0.97), but not the incidence of low birth weight.[41] Strong evidence to support routine zinc and/or selenium supplementation during normal pregnancy is lacking.[40] Interventions to address overall nutritional status may be of more benefit than those focusing only on micronutrient supplementation.

Conclusion

To meet nutritional needs and maintain health during pregnancy it is recommended that women follow a balanced, diverse and nutritious diet.[4] While the ability to achieve required micronutrient intakes may be challenging, high quality evidence to suggest that all women require the increased levels of all the nutrients in a typical prenatal vitamin is lacking.[13]

Currently, only folic acid and iodine are recommended for routine

Currently, only folic acid and iodine are recommended for routine supplementation for all women during pregnancy. When dietary intake of other micronutrients is insufficient a supplement may be of value.

KEY MESSAGE SUMMARY

- Energy, macronutrient, and micronutrient requirements increase during both pregnancy and lactation.
- A healthy, balanced diet is strongly recommended before, during and after pregnancy, however the majority of women of child-bearing age are not meeting the recommended guidelines for healthy eating.[11,12]
- Micronutrient deficiencies have been linked to compromised conception, length of gestation, and foetal development and growth, which can lead to pregnancy loss, preterm delivery, small birth size, birth defects, and long-term metabolic disturbances.[4]
- Practitioners should emphasise the importance of nutrition and how maternal diet impacts on the health of a child for life.
- The National Health and Medical Research Council (NHMRC) recommends an increase in daily intake of most micronutrients during pregnancy.[14]
- Routine supplementation during pregnancy is only recommended for folic acid and iodine.[16]
- **Folic acid:** Should be taken for a minimum of one month before conception and for the first 12 weeks of pregnancy. The recommended dose is at least 0.4mg daily to aid the prevention of NTD, this should be increased to 5mg daily where there is a known increased risk of NTD or a risk of malabsorption.
- **Iodine:** All women who are pregnant, breastfeeding or considering pregnancy, take an iodine supplement of 150µg each day.[16,30] Women with pre-existing thyroid conditions should seek advice from their medical practitioner prior to taking a supplement.[30]
- **Vitamin B12:** Supplements should be considered in women who follow vegetarian or vegan diets.[16]
- **Calcium:** Women who avoid dairy in their usual diet and do not consume alternative high calcium foods, should take a calcium supplementation of at least 1000mg per day.[16]
- **Vitamin D:** Serum vitamin D testing should be considered in pregnant women at increased risk of vitamin D deficiency and supplementation instituted where needed.[16]
- **Iron:** All women should have their haemoglobin level checked at the first antenatal visit and again at approximately 28 weeks' gestation and any anaemia investigated and treated.[16]
- Optimal doses for therapeutic benefits of curcumin have not been established and the doses and formulations evaluated in clinical trials have varied.
- Curcumin has a well-established safety profile and it is generally recognised that curcumin does not cause significant short-term toxicity at doses up to 8g/day.[3]
- Despite the intensity of the research to date, challenges remain predominantly around the establishment of an optimal dose and the development and testing of high-bioavailability formulations.[14]

supplementation for all women during pregnancy. When dietary intake of other micronutrients is insufficient a supplement may be of value. In this situation, the Royal Australian and New Zealand College of Obstetricians and Gynaecologists guidelines suggest that most proprietary pregnancy and lactation multivitamin preparations are adequate for the majority of pregnancies.[16] However, there may be some exceptions; the most common being the need for additional iron in women on vegetarian/vegan diets and those in whom who high dose (5mg) of folic acid or pharmacological doses of vitamin D are required.[16]

ABOUT THE AUTHOR

Dr Denise Furness is a molecular geneticist, nutritionist, medical researcher, author, public speaker and exercise professional. She conducted her PhD at CSIRO Human Nutrition investigating folate nutrigenomics, methylation and DNA damage in relation to late gestation pregnancy outcomes including pre-eclampsia, foetal growth restriction and preterm birth. Dr Furness then completed a postdoctoral fellowship with the University of Adelaide's Research Centre for Reproductive Health expanding her work on folate nutrigenomics to include vitamin D and anti-oxidant genes in relation to miscarriage and foetal loss. She has won various awards for her research and published her work in medical and nutrition journals. In 2012 Dr Furness founded Your Genes & Nutrition, helping patients and practitioners understand the role of nutrigenomics and genetic profiling in relation to fertility and optimal health.

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3 CPD CREDITS
GROUP TWO

VITAMIN & MINERAL SUPPLEMENTS

Maternal diet and nutrient requirements in pregnancy and lactation

This unit attracts up to 3 Group Two CPD credits. Accreditation number A1810AJP3. Accreditation expires: 01/10/2020.

Each question has only ONE answer.

1. When maternal nutritional status is compromised, the foetus:
- **A** adapts and does not have any long term complications or consequences.
- **B** adapts by depleting all required nutritional stores from the mother.
- **C** may have negative impacts on the foetal genomic expression and can affect a wide range of physiological processes.
- **D** B and C

2. Which of the following statements is TRUE?
- **A** In the first trimester, energy requirements are lower than in non-pregnant women.
- **B** In the first trimester, energy requirements are the same as non-pregnant women.
- **C** In the first trimester, energy requirements are the double that in non-pregnant women.
- **D** In the first trimester, energy requirements are three times that in non-pregnant women.

3. Routine supplementation during pregnancy is only recommended for which to micronutrients?
- **A** Folate and vitamin B12
- **B** Iodine and iron
- **C** Calcium and vitamin D
- **D** Folate and iodine

4. Which of the following statements is CORRECT?
- **A** Maternal selenium requirements in the third trimester are double that required by non-pregnant women.
- **B** Maternal zinc requirements in the third trimester are double that required by non-pregnant women.
- **C** Maternal calcium requirements in the third trimester are double that required by non-pregnant women.
- **D** Maternal vitamin D requirements in the third trimester are double that required by non-pregnant women.

5. In pregnant women, the requirements of which of the following macronutrients may have an impact on foetal development?
- **A** Proteins
- **B** Carbohydrates
- **C** Fats
- **D** All of the above

6. Supplementing with folic acid reduced the risk of neural tube defects by how much?
- **A** 42%
- **B** 52%
- **C** 62%
- **D** 72%

7. Which of the following statements is TRUE?
- **A** Folic acid should be taken for a minimum of one week before conception and for the first 2 weeks of pregnancy.
- **B** Folic acid should be taken for a minimum of one month before conception and for the first 12 weeks of pregnancy.
- **C** Folic acid should be taken for a minimum of 6 months before conception and for the first 12 weeks of pregnancy.
- **D** Folic acid should be taken for a minimum of one year before conception and for the first 12 weeks of pregnancy.

8. True or False? During pregnancy, maternal iodine intake needs to increase by at least 20%.
- **A** True
- **B** False

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