

Clinical Practice Guidelines: Pregnancy care

Recently reviewed topics

CONSULTATION DRAFT – 1 June 2020

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Summary of draft recommendations and practice points

The recommendations in this document were developed by the methodologists (Philippa Middleton and Jenny Ramson) in consultation with the Expert Working Group (EWG) Chairs (Caroline Homer and Jeremy Oats). They were then refined and graded following input from the broader EWG.

Where evidence was limited or lacking, consensus-based recommendations (CBRs) were developed.

For areas beyond the scope of the systematic reviews, practice points (PPs) were developed.

Definition of grades of recommendations

Type	Definition
Evidence-based recommendation (EBR)	Body of evidence can be trusted to guide practice
Qualified evidence-based recommendation (QEBR)	Body of evidence can be trusted to guide practice in most situations
CBR	Recommendation formulated in the absence of quality evidence (where a systematic review of the evidence was conducted as part of the search strategy)
PP	Area is beyond the scope of the systematic literature review and advice was developed by the EAC

Draft recommendations and practice points¹

Recommendation/practice point	Grade	Section	
Lifestyle considerations			
<i>Nutrition</i>			
A	Eating the recommended number of daily serves of the five food groups and drinking plenty of water is important during pregnancy and breastfeeding.	PP	1.1
<i>Nutritional supplements</i>			
1	Recommend dietary supplementation of 500 micrograms per day folic acid, from 12 weeks before conception and throughout the first 12 weeks of pregnancy to reduce the risk of neural tube defects.	EBR	1.2
2	Advise women that taking vitamin A, C or E supplements is of little or no benefit in pregnancy and may cause harm.	EBR	1.2
3	Only advise iron supplementation to pregnant women if their dietary iron intake is low or they have iron-deficiency anaemia.	EBR	1.2
4	Advise pregnant women with low dietary iron intake that intermittent supplementation is as effective as daily supplementation in preventing iron-deficiency anaemia, with fewer adverse effects.	EBR	1.2
5	Advise pregnant women to take a low-dose calcium supplement.	EBR	1.2
I	Advise pregnant women to take an iodine supplement of 150 micrograms each day. Women with pre-existing thyroid conditions should seek advice from their medical practitioner before taking a supplement.	CBR	1.2
6	Advise pregnant women that supplementation with omega-3 long-chain polyunsaturated fatty acids may reduce their risk of preterm birth.	EBR	1.2
<i>Physical activity</i>			
7	Advise women that regular moderate-intensity physical activity during pregnancy is associated with a range of health benefits and is generally not associated with adverse outcomes.	EBR	1.3

¹ Recommendations are numbered using Arabic numerals (eg 1, 2, 3), consensus-based recommendations using Roman numerals (eg I, II, III) and practice points using letters (eg A, B, C).

Recommendation/practice point		Grade	Section
Weight and body mass index			
II	Measure women's weight and height at the first antenatal visit and calculate their body mass index (BMI) and give them advice about the benefits of gaining weight within the recommended weight gain range for their BMI.	CBR	2.3
III	At every antenatal visit, offer women the opportunity to be weighed so that low or high gestational weight gain is identified and risk of associated adverse outcomes monitored.	CBR	2.3
8	At every antenatal visit, give women tailored advice on weight gain, including the benefits of a healthy diet, regular physical activity and self-monitoring.	EBR	2.3
B	Adopting a respectful, positive and supportive approach and providing information about healthy eating and physical activity in an appropriate format may assist discussion of weight management. This should be informed by appropriate education for health professionals.	PP	2.3

GRADE levels of evidence

High certainty: We are very confident that the true effect lies close to that of the estimate of the effect

Moderate certainty: We are moderately confident in the effect estimate: The true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different

Low certainty: Our confidence in the effect estimate is limited: The true effect may be substantially different from the estimate of the effect

Very low certainty: We have very little confidence in the effect estimate: The true effect is likely to be substantially different from the estimate of effect

Introduction

The Australian *Clinical Practice Guidelines: Pregnancy Care* provide evidence-based recommendations to support high quality, safe pregnancy care and contribute to improved outcomes for all mothers and babies. To ensure that the recommendations are current, an ongoing process for evaluation of the evidence is in progress. Stage 1 of the most recent review was completed in October 2017, with National Health and Medical Research Council (NHMRC) approval of recommendations on a range of topics. This is the second round of topics being reviewed as part of Stage 2 of the review. This document provides current guidance on nutrition, nutritional supplements, physical activity and weight assessment and monitoring. The membership of the Expert Working Group involved in development of this guidance is listed in Appendix A, the process is described in Appendix B and the review of the literature is summarised in Appendix C. The remaining topics in Stage 2 are still under review and are listed in Appendix D. A full list of topics covered in the Guidelines is included in Appendix E.

Application of the Guidelines

Objective of the Guidelines

The Guidelines aim to improve the health and wellbeing of both mothers and babies, and ensure women consistently receive high quality, evidence-based pregnancy care. They provide a summary of the current evidence on aspects of care and are intended to complement the education and skills of health professionals. It is expected that implementation of the Guidelines will improve maternal, fetal, newborn and family outcomes in the short and longer terms.

Scope

The Guidelines cover the antenatal care of healthy pregnant women (ie women who do not have identified pre-existing conditions and are not at higher risk of complications such as in multiple pregnancy). They are intended for use in all settings where antenatal care is provided, including primary care, obstetric and midwifery practice and public and private hospitals.

The Guidelines do *not* include:

- information on preconception or postnatal care
- advice on clinical management of women and babies when risks are identified through testing or clinical assessment
- discussion of specific topics where a practice is already established (eg testing of blood group) or where the topic was not considered a priority for inclusion in these Guidelines and advice is given by other organisations (eg vaginal discharge, backache).

Intended audience

The Guidelines are intended for all health professionals who contribute to antenatal care, including midwives, general practitioners (GPs), obstetricians, maternal and child health nurses,² Aboriginal and Torres Strait Islander Health Practitioners; Aboriginal and Torres Strait Islander Health Workers, multicultural health workers, practice nurses, allied health professionals, childbirth and parenting educators and sonographers. The way in which different professionals use these Guidelines will vary depending on their knowledge, skills and role, as well as the setting in which care is provided.

These Guidelines will be of interest and relevance to pregnant women in Australia. In addition, it is expected that policy makers will be able to draw on the Guidelines in the development of policy and the planning and delivery of health services.

Dissemination and review

Following approval by the NHMRC, the chapters in this document will replace the previous versions of the chapters in the online version of the Guidelines.

² Also referred to as child and family health nurses in some jurisdictions.

LIFESTYLE CONSIDERATIONS

1 Nutrition and physical activity

Consuming a wide variety of nutritious foods during pregnancy is important to ensure that the nutritional requirements of both mother and baby are met. While supplementation of vitamins and minerals is common during pregnancy, only some supplements are beneficial. Regular moderate-intensity physical activity has benefits for mother and baby and is safe.

1.1 Nutrition

The nutritional status of a woman before and during pregnancy plays a vital role in fetal growth and development. The basic principles of healthy eating remain the same, though requirements for some nutrients (eg iron, folic acid) may increase.

1.1.1 Background

Knowledge about healthy eating during pregnancy

Observational studies carried out in Australia have found:

- low levels of awareness of dietary guidelines during pregnancy among women (Bookari et al 2016; Lee et al 2016)
- low levels of women meeting dietary recommendations for the five food groups (Mishra et al 2015; Malek et al 2016a; Bookari et al 2017; Lee et al 2018a)
- low levels of knowledge of foods to avoid during pregnancy (Bryant et al 2017)
- limited dietary counselling by health professionals (Lee et al 2016; Lee et al 2018b).

An Irish cohort study (McGowan & McAuliffe 2013) found that women with a 'health conscious' dietary pattern were older, had a higher level of education and had a lower BMI than those with an 'unhealthy' dietary pattern. A study in New Zealand also found that a 'health conscious' dietary pattern was associated with increasing age, better self-rated health, lower pre-pregnancy BMI and not smoking (Wall et al 2016).

Access to healthy food

- ***Geographical location:*** The decreased availability and affordability of nutritious foods (such as fresh fruit and vegetables and wholegrain bread), especially in remote and regional areas in Australia has been described frequently. The cost of nutritious foods in these areas can be over 30% higher than in major cities and may affect food purchases (NHMRC 2000c; NT DHCS 2007; Harrison et al 2010; Landrigan & Pollard 2011).
- ***Socioeconomic status:*** In some urban centres, there is less access to supermarkets and greater access to fast food outlets than in more socioeconomically advantaged areas (Burns & Inglis 2007; Ball et al 2009).
- ***Aboriginal and Torres Strait Islander women:*** Diet and nutritional status of Aboriginal and Torres Strait Islander people are influenced by many factors, such as socioeconomic disadvantage and geographical, environmental and social factors (Lee & Ride 2018). Very few Aboriginal and Torres Strait Islander people meet dietary recommendations for intake of healthy foods (Lee & Ride 2018). A high proportion (41%) of daily energy intake is derived from unhealthy 'discretionary' foods and drinks that are high in saturated fat, added sugar and salt, compared to 35% among non-Indigenous Australians. The current nutritional health of Aboriginal and Torres Strait Islander people is in marked contrast to the situation prior to European settlement in Australia, when Aboriginal and Torres Strait Islander peoples were generally healthy and enjoyed a varied traditional diet low in energy density and rich in nutrients (Lee & Ride 2018).

- *Migrant and refugee women:* Following migration, dietary behaviour may be influenced by post-migration environments, culture, religion and food-related beliefs and perceptions (Ngongalah et al 2018). Similarly, financial and language difficulties may affect access to education and employment opportunities, which then affects income, health and nutrition literacy, and access to nutritious foods. Some migrant people experience disadvantages such as social isolation and poor housing, which can affect access to safe food and safe preparation of food, and are generally in a relatively vulnerable position in their new environments, regardless of the type of migration (WHO 2010).

1.1.2 Discussing nutrition

Australian dietary guidelines for pregnant women

As outlined in the *Australian Dietary Guidelines* (NHMRC 2013a), consuming a variety of nutritious foods is particularly important during pregnancy and breastfeeding.

- *Vegetables, legumes/beans and fruit:* Consumption of vegetables and fruit before and during pregnancy make important contributions to health outcomes for women and their children.
- *Grain (cereal) foods:* Wholegrain foods are a valuable source of iron and zinc and fibre. Most bread in Australia is fortified with folic acid and made with iodised salt.
- *Lean meats and poultry, fish, eggs, tofu, nuts and seeds, and legumes/beans:* Lean red meat and chicken are good sources of protein, iron and zinc. Maternal consumption of fish during pregnancy is likely to have a range of health benefits for women and their children but the fish should be low in mercury (see Table 2). Nuts, seeds and legumes/beans are important foods for people who choose vegetarian or vegan dietary patterns and meals without meat, as they can provide an alternative source of nutrients. For several nutrients, including iron, calcium and vitamin B₁₂, care needs to be taken to include a variety of alternatives if animal foods are excluded.
- *Milk, yoghurt and cheese and/or their alternatives:* Milk, yoghurt and cheese or their alternatives are good sources of calcium.
- *Water:* Pregnant women require more water to support fetal circulation, amniotic fluid and a higher blood volume.

Practice point

- A. Eating the recommended number of daily serves of the five food groups and drinking plenty of water is important during pregnancy and breastfeeding.

Table 1: Recommended number of daily serves during pregnancy

Food group	Sample serve	Pregnancy		Breastfeeding	
		<19 yrs	19-50 yrs	<19 yrs	19-50 yrs
Vegetables of different types and colours, and legumes/ beans	½ cup cooked green or orange vegetables; ½ cup legumes; 1 cup raw green leafy vegetables; ½ medium potato (or sweet potato, taro or cassava); ½ cup sweet corn; 1 medium tomato	5	5	5 ½	7 ½
Fruit	1 medium apple, banana, orange or pear; 2 small apricots, kiwi fruits or plums; 1 cup diced or canned fruit (no sugar)	2	2	2	2
Grain (cereal) foods, mostly wholegrain and/or high cereal fibre varieties, such as breads, cereals, rice, pasta, noodles, polenta, couscous, oats, quinoa and barley	1 slice bread; ½ medium roll or flat bread; ½ cup cooked rice, pasta, noodles, polenta or quinoa; ½ cup porridge; 2/3 cup wheat cereal flakes; ¼ cup muesli; 3 crispbreads	8	8 ½	9	9

Food group	Sample serve	Pregnancy		Breastfeeding	
		<19 yrs	19-50 yrs	<19 yrs	19-50 yrs
Lean meats and poultry, fish, eggs, tofu, nuts and seeds, and legumes/beans	65 g cooked lean red meat; 80 g cooked chicken; 100 g cooked fish fillet; 2 large eggs; 1 cup cooked lentils or canned beans; 170 g tofu; 30 g nuts, seeds, peanut or almond butter or tahini	3 ½	3 ½	2 ½	2 ½
Milk, yoghurt, cheese and/or their alternatives (mostly reduced fat)	1 cup milk; 200 g yoghurt; 40 g hard cheese; ½ cup ricotta cheese; 1 cup soy, rice or other cereal drink with added calcium	3 ½	2 ½	4	2 ½
Approximate number of additional serves from the five food groups or discretionary choices		0-3	0-2 ½	0-3	0-2 ½

Source: (NHMRC 2013a).

Table 2: Practical advice on nutritious foods during pregnancy

Food group	Considerations
Vegetables, legumes/beans and fruit	<ul style="list-style-type: none"> Many women need to increase their consumption of vegetables, legumes/beans and fruit Due to the risk of listeriosis, pre-prepared or pre-packaged cut fruit or vegetables should be cooked. Pre-prepared salad vegetables (eg from salad bars) should be avoided
Grain (cereal) foods	<ul style="list-style-type: none"> While bread in Australia contains iodine and folate, supplementary folate is recommended preconception and in the first trimester and iodine should be supplemented preconception and throughout pregnancy and breastfeeding
Lean meats and poultry, fish, eggs, tofu, nuts and seeds, legumes/beans	<ul style="list-style-type: none"> Raw or undercooked meat, chilled pre-cooked meats, and pâté and meat spreads should be avoided during pregnancy due to risk of listeriosis Care needs to be taken with consumption of some fish species (eg shark/flake, marlin or broadbill/swordfish, orange roughy and catfish) due to the potentially higher mercury content Foods containing raw eggs should be avoided due to the risk of salmonella Nuts need only be avoided if the woman has an allergy to them
Milk, yoghurt, cheese and/or alternatives	<ul style="list-style-type: none"> Unpasteurised dairy products and soft, semi-soft and surface-ripened cheese should be avoided due to the risk of listeriosis Women who avoid milk products should consume alternative calcium-fortified products
Water	<ul style="list-style-type: none"> Fluid need is 750-1,000 mL a day above the estimated daily intake of 2.1 L.

Source: (NHMRC 2013a).

Recent evidence on dietary patterns

Dietary patterns associated with positive outcomes are generally characterised by high intake of fruits, vegetables, legumes, wholegrains, fish, seafood, lean meats, low-fat dairy and water. Dietary patterns associated with poorer outcomes include those high in sweetened foods and beverages, foods high in saturated fats (eg fried foods), red and processed meats and refined grains.

A healthy dietary pattern can help reduce the risk of:

- gestational diabetes (Martin et al 2016; Schoenaker et al 2016; Assaf-Balut et al 2017; Zareei et al 2018; Pham et al 2019)
- gestational hypertension (Schoenaker et al 2014; Gresham et al 2016; Ikem et al 2019)
- antenatal depression (Miyake et al 2018).

Conversely, an unhealthy dietary pattern may increase the risk of gestational diabetes (Shin et al 2015; Flynn et al 2016) and antenatal depression (Baskin et al 2017).

The evidence is inconsistent on the association between dietary pattern in pregnancy and:

- preterm birth (Englund-Ogge et al 2014; Rasmussen et al 2014; Saunders et al 2014; Smith et al 2015; Assaf-Balut et al 2017; Assaf-Balut et al 2018; Chia et al 2018; Chia et al 2019; Raghavan et al 2019)
- fetal growth (Martin et al 2015; Flynn et al 2016; Gresham et al 2016; Assaf-Balut et al 2017; Chia et al 2018; Emond et al 2018; Martinez-Galiano et al 2018; Assaf-Balut et al 2019; Chia et al 2019; Englund-Ogge et al 2019)
- childhood growth (van den Broek et al 2015; Fernandez-Barres et al 2016; Chatzi et al 2017; Fernandez-Barres et al 2019)
- childhood cardiometabolic health (Fernandez-Barres et al 2016; Chatzi et al 2017; Leermakers et al 2017)
- childhood wheeze (Castro-Rodriguez et al 2016; Alvarez Zallo et al 2018; Zhang et al 2019).

In systematic reviews of outcomes among women who choose vegan-vegetarian diets, findings on birthweight were inconsistent, duration of pregnancy between vegan-vegetarian and omnivorous diets was similar and there was a suggestion of risk of iron, vitamin B₁₂ (Piccoli et al 2015) and zinc deficiency (Foster et al 2015; Piccoli et al 2015) with vegan-vegetarian diets.

A systematic review found that fasting during Ramadan among well-nourished women did not increase the risk of preterm birth or low birthweight (Glazier et al 2018).

Recent evidence on consumption of specific foods/food categories during pregnancy

Fruit, vegetables and legumes

There is evidence from observational studies that eating vegetables, fruit and legumes during pregnancy is beneficial to both mother and baby, with

- a reduction in risk of neural tube defects (OR 0.32; 95%CI 0.14 to 0.71; n=918) (Wang et al 2015a)
- possible associations with improvements in glucose tolerance (p<0.05; n=180) (Soto et al 2015), fetal growth (aOR 0.63; 95%CI 0.40 to 0.98; n=1,036) (Martinez-Galiano et al 2018), pre-eclampsia (aRR 0.20; 95%CI 0.04 to 0.98; p for trend=0.041; n=987) (Torjusen et al 2014; Mi et al 2019), preterm birth (OR 0.67; 95%CI 0.50 to 0.91; n=923) (Smith et al 2015; Chia et al 2016) and wheeze at 12 months (OR: 0.44; 95%CI 0.20 to 0.99; n=1,087) (Alvarez Zallo et al 2018).

Low fruit intake is associated with higher prevalence of major depressive disorder (PR 1.43, 95%CI 1.04 to 1.95; n=712) and low intake of legumes is associated with generalised anxiety disorder (PR 1.40, 95%CI 1.01 to 1.93; n=712) (n=712) (Paskulin et al 2017). A lower risk of childhood leukaemia is associated with maternal consumption of fruit (OR: 0.81, 95% CI: 0.67 to 0.99), vegetables (OR: 0.51, 95% CI: 0.28 to 0.94) and legumes (OR 0.76, 95% CI: 0.62 to 0.94) (n=903) (Dessypris et al 2017). Total daily fruit and vegetable consumption during pregnancy does not appear to be associated with maternal sleep duration (β -0.03; 95%CI -0.07 to 0.00; n=2,951) (Duke et al 2017).

Dairy

There is evidence from observational studies that higher maternal intake of all dairy products (255 vs 32 g/day) is associated with a reduced risk of eczema in babies (aOR 0.64; 95%CI 0.42 to 0.98) (Miyake et al 2015). Maternal milk intake is associated with reduced risk of neural tube defects (1-2 vs <1 time/week; OR 0.50; 95%CI 0.28 to 0.88; n=918) (Wang et al 2015a), asthma (OR 0.83; 95% CI 0.69 to 0.99; n=1,227), allergic rhinitis (OR 0.85; 95%CI 0.74 to 0.97; n=1,227) (Bunyavanich et al 2014) and cow's milk allergy in children (OR 0.56, 95%CI 0.37 to 0.86; p<0.01; n=6,288) (Tuokkola et al 2016). Higher yoghurt intake (80 g vs 4 g a day) is associated with lower prevalence of depressive symptoms during pregnancy (aOR 0.69; 95%CI 0.48 to 0.99, p for trend 0.03; n=1,745) (Miyake et al 2015).

Potential allergens

There is evidence from observational studies that a lower risk of peanut allergy in the infant is associated with maternal peanut consumption during the first trimester (OR 0.53; 95%CI 0.30 to 0.94; n=1,227) (Bunyavanich et al 2014) or pre-pregnancy and during pregnancy (≥ 5 times vs <1 time per month: OR 0.31; 95% CI 0.13 to 0.75; P(trend)=0.004; n=8,205) (Frazier et al 2014). Maternal wheat intake during the second trimester may reduce atopic dermatitis in the infant (OR 0.64; 95%CI 0.46 to 0.90; n=1,227) (Bunyavanich et al 2014).

Meat

There is evidence from observational studies that lower maternal meat consumption may be protective against wheeze in the child ($p=0.039$; $n=1,000$) (Castro-Rodriguez et al 2016) but that maternal intake of cured meats may be associated with a risk of childhood retinoblastoma (OR 5.07, 95% CI 1.63 to 15.70; $n=199$) (Lombardi et al 2015).

Fish

There is evidence from systematic reviews of observational studies that maternal fish intake may be associated with positive neurodevelopmental outcomes (qualitative review; 8 studies) (Starling et al 2015) and a reduced risk of childhood leukaemia (OR 0.27, 95% CI: 0.14 to 0.53; 2 studies) (Dessypris et al 2017). It does not appear to affect the risk of infant eczema (RR 0.88; 95%CI 0.75 to 1.04; 10 studies), wheeze (RR 0.94; 95%CI 0.83 to 1.07; 8 studies), allergic rhinitis (RR 0.95; 95%CI 0.62 to 1.45; 3 studies) or asthma (RR 0.94; 95%CI 0.75 to 1.18; 4 studies) (Zhang et al 2017).

Observational studies have found positive associations between maternal seafood intake during pregnancy and language and communication scales in the infant ($n=38,351$) (Vejrup et al 2018) and metabolic health of children ($\beta = -0.96$; 95%CI -1.49 to -0.42; $n=805$) (Stratakis et al 2020) but were inconsistent regarding the effect on child growth (Stratakis et al 2016; van den Berg et al 2016).

There is evidence from observational studies that low intake of seafood may be associated with increased risk of antenatal depression (aOR 1.54; 95%CI 1.25 to 1.89; $n=12,418$) (Emmett et al 2015).

A cohort study ($n=3,279$) (Mohanty et al 2016) found a possible association between lean fish intake and preterm birth (RR 1.55; 95% CI 1.04 to 2.30). The study noted that studies of mechanisms and potential contributing factors (including seafood preparation and nutrient contaminant content) are warranted. There was no association between fatty fish intake and preterm birth and no association between other pregnancy complications and either lean or fatty fish consumption.

While fish consumption during pregnancy may have benefits for the women and child, high fetal exposure to mercury through maternal fish consumption is associated with low birthweight (MD -34 g; 95%CI -46 g to -22 g; $n=56,988$) and small-for-gestational age (aOR 1.19; 95%CI 1.08 to 1.30; $n=56,988$) (Vejrup et al 2014), delayed language and communication skills in a generally low exposed population ($n=46,750$ mother-child pairs) (Vejrup et al 2016) and an unfavourable metabolic profile in children (β per 2-fold increase in mercury concentration 0.18; 95% CI 0.01 to 0.34) (Stratakis et al 2020). Types of fish that should be avoided during pregnancy due to potential high mercury content are listed in Table 2.

Carbohydrates

There is RCT evidence that, in obese women with impaired glucose tolerance, a lower carbohydrate intake in late pregnancy is associated with a lower fat mass in the baby at birth (188 vs 238 g/day; p -trend=0.006; $n=222$) (Renault et al 2015a). There is evidence from cohort studies that high maternal carbohydrate consumption may be associated with increases in birthweight (4g for each additional 10 g/day; 95%CI 1.0 to 7.0; $p=0.003$; $n=1,196$) (Sharma et al 2018) and with infant wheeze (potatoes once or twice a week OR 1.75; 95%CI 1.22 to 2.51; $n=1,087$; pasta never or occasionally; $p=0.049$) (Castro-Rodriguez et al 2016; Alvarez Zallo et al 2018).

Protein

There is evidence from observational studies that maternal protein intake may be associated with a higher risk of gestational diabetes (OR highest vs lowest quartile of intake 2.15; 95% CI 1.27 to 3.62; $p=0.016$; $n=980$) (Pang et al 2017), may increase fat-free mass in the infant (β 0.14; 95% CI 0.03 to 0.25 for highest vs lowest quartile of intake; $n=2,694$ mother-child pairs) (Tielemans et al 2017), may reduce newborn abdominal adipose tissue (-0.18 mL; 95%CI -0.35 to -0.001 mL per 1% protein-to-carbohydrate substitution and -0.25 mL; 95%CI -0.46 to -0.04 mL per 1% protein-to-fat substitution; $n=320$ mother-child pairs) (Chen et al 2016) and may reduce early length growth (-0.09 cm/year 6 months to late childhood; 95% CI: -0.14 to -0.05; $n=1,961$) (Switkowski et al 2016).

Fats

There is evidence from observational studies that women with uncomplicated pregnancies had lower daily fat intake (32.1%) than women who developed gestational diabetes (36.2%) ($p=0.0251$; $n=55$) (Mizgier et al 2019) and that an additional 10 g/day fat intake was associated with a lower birthweight (MD -8 g; 95%CI -16 to -0.3; $p=0.04$; $n=1,196$), with the authors concluding that balancing intake of dietary carbohydrate and fat during pregnancy could support optimal birthweight (Sharma et al 2018).

Sweetened foods and beverages

There is evidence from an RCT that higher consumption of foods and drinks that contribute to intake of added sugars (2 times daily versus <1 time/week) is associated with higher gestational weight gain (MD 5.4 kg; 95% CI 2.1 to 8.7; n=342) (Renault et al 2015b). Observational studies report an association between sugar-sweetened foods and drinks and impaired glucose tolerance (p<0.05; n=180) (Soto et al 2015) and gestational diabetes (aOR for highest vs lowest category 2.03; 95%CI 1.25 to 3.31; n=3,396) (Donazar-Ezcurra et al 2018). It is also associated with an increased prevalence of major depressive disorder (adjusted prevalence ratio [aPR] 1.91; 95%CI 1.19 to 3.07; n=712) (Paskulin et al 2017).

Fetal and child growth is also affected by higher intake of sweetened foods and drinks, with increased risks of large for gestational age (aRR 1.57; 95%CI 1.05 to 2.35; n=918 mother-child pairs) (Zhu et al 2017), increased infant BMI z score (0.20-unit increase in infant BMI z score; 95% CI 0.02 to 0.38; n=2,686) and overweight at 1 year (aOR 2.19; 95%CI 1.23 to 3.88,686) (Azad et al 2016) and 7 years of age (aRR 1.93; 95%CI 1.24 to 3.01; 918 mother-child pairs) (Zhu et al 2017). Maternal consumption of sweetened foods and beverages is also associated with infant atopy (OR for highest versus lowest quintile of sugar intake 1.38, 95%CI 1.06 to 1.78; per quintile p-trend=0.006; n=8,956) and asthma (OR 2.01, 95% CI 1.23-3.29; per quintile p-trend=0.004 n=8,956) (Bedard et al 2017).

Fast foods

There is evidence from cohort studies that 'fast food' (eg food that is high in calories and low in nutrition) consumption is associated with an increased risk of gestational diabetes (aOR for high vs low consumption 1.86; 95% CI 1.13 to 3.06; n=3,048) (Dominguez et al 2014), infant eczema (p=0.005; n=1,000) (Castro-Rodriguez et al 2016) and asthma (RR 4.46; 95%CI 1.36 to 14.6; n=1,201 mother-child pairs) (von Ehrenstein et al 2015). A small case-control study found a positive association between maternal intake of fried foods and retinoblastoma in the child (OR 4.89, 95% CI 1.72 to 13.89; n=299) (Lombardi et al 2015).

Caffeine

There is insufficient evidence to confirm or refute the effectiveness of caffeine avoidance on birth weight or other pregnancy outcomes (Jahanfar & Jaafar 2015). Food Standards Australia and New Zealand suggests limiting intake during pregnancy to 200 mg of caffeine (FSANZ 2019), noting that caffeine is present in coffee, tea, colas, energy drinks and chocolate.

There is evidence from observational studies that the risks of preterm birth (OR per 100 mg/d caffeine increase 1.28; 95%CI 1.03 to 1.58; P=0.03; n=858) (Okubo et al 2015) and childhood brain tumours (OR \geq 2 cups per day 2.52; 95% CI 1.26 to 5.04; n=1,019) (Greenop et al 2014) increase with caffeine intake.

1.2 Nutritional supplements

The evidence supports routine supplementation with folic acid preconception and in the first trimester. NHMRC advises iodine supplementation preconception and during pregnancy and breastfeeding. Iron supplementation may prevent iron deficiency in women with limited dietary iron intake and calcium supplementation may be beneficial in women with low dietary intake. Vitamin B₁₂ supplementation may be needed if a woman has a vegetarian or vegan diet. Vitamin D supplementation, which is discussed in Chapter 47, may be a consideration for women with vitamin D levels lower than 50 nmol/L.

1.2.1 Vitamins

Folic acid (vitamin B₉)

Background

A survey of pregnant women conducted in Sydney found that 30.6% were taking a folic acid supplement (Shand et al 2016). A cross-sectional study that included national and South Australian cohorts found that, while awareness of recommendations on folic acid supplementation was high (90%), adherence was low (27%) (Malek et al 2016b).

In an Australian cohort study (Livock et al 2017), 19-46% of women did not meet the recommended daily intake for folate. Conversely, 15-19 % of women consumed beyond the recommended upper limit for folate.

Dietary sources of folate include green vegetables (eg spinach), legumes, rice, avocado, fruit and beef liver and fortified products (many breakfast cereals, bread, fruit juice, vegemite).

Summary of the evidence

There is high certainty evidence that folic acid supplementation in pregnancy is associated with a reduction in risk of neural tube defects (RR 0.31; 95%CI 0.17 to 0.58; 5 RCTs; n=6,708) and low certainty evidence that it may also reduce the risk of cleft palate (RR 0.73; 95%CI 0.05 to 0.89; 3 RCTs; n=5,612) (De-Regil et al 2015). Evidence from observational studies suggests it may reduce congenital heart defects (RR 0.72; 95%CI 0.63 to 0.82 (Feng et al 2015); OR 0.60; 95%CI 0.49 to 0.71 (Xu et al 2016)).

There is evidence from systematic reviews of observational studies that folic acid supplementation during pregnancy may reduce the risk of acute myeloid leukaemia (OR 0.52; 95%CI 0.31 to 0.89) (Metayer et al 2014), brain and spinal cord tumours in the child (OR 0.77; 95%CI 0.66 to 0.90) (Chiavarini et al 2018) and autism spectrum disorders (RR 0.77; 95%CI 0.64 to 0.93, 16 studies) (Wang et al 2017).

The evidence suggests that folic acid supplementation during pregnancy does not affect the risk of early or late miscarriage (RR 0.97; 95%CI 0.65 to 1.44; 1 RCT; n=903), stillbirth (RR 0.67; 95%CI 0.11 to 4.02; 1 RCT; n=903), total fetal loss (RR 0.95; 95%CI 0.64 to 1.40; 1 RCT; n=903) (Balogun et al 2016), preterm birth (RR 0.99; 95%CI 0.82 to 1.18; 1 RCT; n=1,654 (Saccone & Berghella 2016); RR 1.09; 95%CI 0.77 to 1.54; 1 RCT; n=2,797 (Lassi et al 2013)), low birthweight (RR 0.79; 95%CI 0.49 to 1.28; 4 RCT; n=4,453 (Saccone & Berghella 2016); RR 0.80; 95%CI 0.63 to 1.02; 3 studies; n=3,089 (Lassi et al 2013)), infant asthma (RR 1.04; 95%CI 0.94 to 1.16; 3 observational studies) or infant wheeze (RR 1.04; 95%CI 0.94 to 1.16; 3 observational studies) (Wang et al 2015b).

There is unclear evidence on the effect of folic acid supplementation on gestational hypertension, pre-eclampsia (Hua et al 2016; Bulloch et al 2018; Liu et al 2018a; Wen et al 2018) and acute lymphoblastic leukaemia in the infant (Metayer et al 2014; Dessypris et al 2017).

Evidence-based recommendation

1	Recommend dietary supplementation of 500 micrograms per day folic acid, from 12 weeks before conception and throughout the first 12 weeks of pregnancy to reduce the risk of neural tube defects.
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Other vitamins

- **Vitamin B₆:** There is insufficient evidence to detect clinical benefits in pregnancy (Salam et al 2015), although it appears to be of benefit in reducing nausea (MD in nausea score -3.7; 95%CI -6.9 to -0.5; very low certainty) (Sridharan & Sivaramakrishnan 2018). See also Chapter 54.
- **Vitamin B₁₂:** The evidence on vitamin B₁₂ supplementation in pregnancy is of insufficient certainty to draw conclusions, although it may be of benefit for women with vegetarian or vegan diets, who often have low vitamin B₁₂ concentrations (Pawlak et al 2014).
- **Vitamin C:** The evidence does not support routine vitamin C supplementation for preventing fetal loss (RR 1.28; 95%CI 0.58 to 2.83; 2 RCTs; n=224) (Balogun et al 2016) or perinatal death (RR 0.51; 95%CI 0.05 to 5.54; 1 RCT; n=182) (Rumbold et al 2015b), intrauterine growth restriction (RR 1.56; 95%CI 0.63 to 3.89; 1 RCT; n=159; high certainty), preterm birth (RR 1.06; 95%CI 0.75 to 1.48; 5 RCTs; n=1,685; high certainty) or pre-eclampsia (RR 0.88; 95%CI 0.48 to 1.61; 3 RCTs; n=1,191) (Rumbold et al 2015b). Further research is required to clarify the possible role of vitamin C in the prevention of placental abruption and prelabour rupture of membranes (Rumbold et al 2015b).
- **Vitamin E:** The evidence on vitamin E supplementation is of insufficient certainty to draw conclusions (Fu et al 2018).
- **Vitamins C and E combined:** Supplementation with vitamins C and E during pregnancy appears to reduce the risk of placental abruption (RR 0.64; 95% CI 0.44 to 0.93, 7 RCTs, n=14,922; high certainty) but increases the risk of term prelabour rupture of the membranes (RR 1.77; 95% CI 1.37 to 2.28, 2 RCTs, n=2,504) (Rumbold et al 2015a). It does not appear to affect other perinatal outcomes (Rumbold et al 2015a; Balogun et al 2016; Vahdaninia M. et al 2017; Fu et al 2018; Tenorio et al 2018). Combined vitamins C and E may reduce the risk of preterm birth (RR 0.76; 95% CI 0.58 to 0.99) and placental abruption (RR 0.09; 95% CI 0.00 to 0.87) in pregnant women who smoke (Abramovici et al 2015).

- **Vitamin A:** The evidence does not support vitamin A supplementation for the prevention of fetal loss (RR 1.05; 95%CI 0.90 to 1.23; 3 RCTs; n=52,480) (Balogun et al 2016), maternal mortality (RR 0.88; 95%CI 0.65 to 1.20; 4 RCTs; n=154,039; high certainty), perinatal mortality (RR 1.01; 95%CI 0.95 to 1.07; 1 RCT, n=76,178; high certainty) or preterm birth (RR 0.98; 95%CI 0.94 to 1.01; 5 RCTs, n=48,007; high certainty) (McCauley et al 2015). The evidence on the role of vitamin A supplementation in reducing risk of maternal clinical infection (RR 0.45; 95%CI 0.20 to 0.99; 5 RCTs; n=17,313; low certainty) and preventing anaemia (RR 0.64; 95%CI 0.43 to 0.94; 3 RCTs; n=15,649; moderate certainty) (McCauley et al 2015) may not be generalisable to the Australian context.

Evidence-based recommendation

2 Advise women that taking vitamin A, C or E supplements is of little or no benefit in pregnancy and may cause harm.

1.2.2 Minerals

Iron

Background

Australian studies have investigated rates of iron supplementation, intake and anaemia among Australian women during pregnancy. In an Australian cohort study (Livock et al 2017) 68-82% of women did not meet the recommended daily intake level for iron; conversely, 11-24% of women consumed beyond the recommended upper limit for iron. Australian cross-sectional studies have found that levels of iron-only supplementation are relatively low in general (7-30%) (Chatterjee et al 2016; Shand et al 2016) and among women with diagnosed iron deficiency (65%) or with diagnosed anaemia (62%) (Chatterjee et al 2016).

Studies among Aboriginal and Torres Strait Islander women have found very low levels of women meeting the estimated average requirement for iron in some areas (Lee et al 2018c) and high levels of iron deficiency and anaemia (Leonard et al 2018).

Iron-rich staple foods (such as meat, seafood, poultry, legumes, wholegrains) can help women reach dietary targets for iron (Bokhari et al 2012). Absorption is aided by vitamin C and limited by tea and coffee (Marsh et al 2009). Where iron-rich foods are not available (eg due to geographical location or socioeconomic factors), women may be at high risk of iron deficiency.

Summary of the recent evidence

There is moderate certainty evidence that iron supplementation in pregnancy may reduce the risk of preterm birth (RR 0.93; 95%CI 0.84 to 1.03, 13 RCTs, n=19,286) (Peña-Rosas et al 2015; Abraha et al 2019).

There is low certainty evidence that iron supplementation in pregnancy reduces the risk of maternal anaemia at term (RR 0.30; 95%CI 0.19 to 0.46, 14 RCTs, n=2,199 (Peña-Rosas et al 2015); RR 0.38; 95% CI 0.27 to 0.33; 13 RCTs (Abraha et al 2019)) and iron deficiency at term (RR 0.43; 95%CI 0.27 to 0.66, 7 RCTs, n=1,256) (Peña-Rosas et al 2015).

There is also low certainty evidence that iron supplementation has no clear effect on neonatal death (RR 0.91; 95%CI 0.71 to 1.18, 4 RCTs, n=16,603 (Peña-Rosas et al 2015); RR 0.93; 0.72 to 1.20; 7 RCTs (Abraha et al 2019)), low birthweight (RR 0.84; 95%CI 0.69 to 1.03; n=17,613; 11 RCTs (Peña-Rosas et al 2015); RR 0.94, 95% CI 0.79 to 1.13; 7 RCTs (Abraha et al 2019)) or congenital anomalies (RR 0.88, 95%CI 0.58 to 1.33, 4 RCTs, n=14,636) (Peña-Rosas et al 2015).

There is very low certainty evidence that iron supplementation in pregnancy has no clear effect on the risk of maternal death (RR 0.33; 95%CI 0.01 to 8.19, 2 RCTs, n=12,560) (Peña-Rosas et al 2015) or maternal adverse effects (RR 1.29; 95%CI 0.83 to 2.02, 11 RCTs, n=2,423 (Peña-Rosas et al 2015); RR 1.42; 95%CI 0.91 to 2.21; 12 RCTs (Abraha et al 2019)). A systematic review indicates that iron supplementation has no clear effect on infant neurodevelopment (MD 0.54 units across different measures; 95% CI -0.67 to 1.75; 3 RCTs) (Jayasinghe et al 2018).

Evidence-based recommendation

3 Only advise iron supplementation to pregnant women if their dietary iron intake is low or they have iron-deficiency anaemia.

There is low certainty evidence that intermittent versus daily iron supplementation in pregnancy has no clear effect on preterm birth (RR 1.03; 95%CI 0.76 to 1.39; n=1,177; 5 RCTs), birthweight (MD 5.13 g; 95%CI -29.46 to 39.72; n=1,939; 9 RCTs) or low birthweight (RR 0.82; 95%CI 0.55 to 1.22; n=1,898; 8 RCTs) (Pena-Rosas et al 2015).

There is very low certainty evidence that maternal adverse effects such as constipation and nausea (RR 0.56; 95%CI 0.37 to 0.84; n=1,777; 1 RCT) are reduced with intermittent versus daily iron supplementation with no clear effect on the risk of maternal anaemia at term (RR 1.22; 95%CI 0.84 to 1.80; n=676; 4 RCTs), maternal iron-deficiency at term (RR 0.71; 95%CI 0.08 to 6.63; 1 RCT) or neonatal death (RR 0.49; 95%CI 0.04 to 5.42; n=795; 1 RCT) (Pena-Rosas et al 2015).

Evidence-based recommendation

4 Advise pregnant women with low dietary iron intake that intermittent supplementation is as effective as daily supplementation in preventing iron-deficiency anaemia, with fewer adverse effects.

Testing for and treating anaemia is discussed in Chapter 30.

Calcium

Background

A survey of pregnant women conducted in Sydney found that 13% were taking a calcium supplement (Shand et al 2016).

Dietary sources of calcium include dairy products, canned fish and tofu.

Summary of recent evidence

There is consistent evidence from systematic reviews that calcium supplementation reduces the risk of gestational hypertension (Hofmeyr et al 2018; Sun et al 2019) and pre-eclampsia (Hofmeyr et al 2014; Khaing et al 2017; Hofmeyr et al 2018; Sun et al 2019).

High-dose calcium supplementation (≥ 1 g/day) reduces the risk of gestational hypertension (RR 0.65; 95%CI 0.53 to 0.81; 12 RCTs; n=15,470), with a clearer effect among women with low dietary calcium (RR 0.44; 95%CI 0.28 to 0.70; 7 RCTs; n=10,418) than among women with adequate dietary calcium (RR 0.90; 95%CI 0.81 to 0.99; 4 RCTs; n=5,022) (Hofmeyr et al 2018). High-dose calcium also reduces the risk of pre-eclampsia (RR 0.45; 95%CI 0.31 to 0.65; 13 trials; n=15,730; low certainty).

Low-dose calcium (<1 g/day) also reduces the risk of gestational hypertension (RR 0.57; 95%CI 0.39 to 0.82; 3 RCTs; n=558) (Hofmeyr et al 2018) and pre-eclampsia (RR 0.36; 95%CI 0.23 to 0.57; 4 RCTs; n=980) (Hofmeyr et al 2014).

A Cochrane review (Hofmeyr et al 2018) found a reduction in risk of preterm birth <37 weeks with high-dose calcium among all women (RR 0.76; 95%CI 0.60 to 0.97; 11 trials, n=15,275; low certainty). Another Cochrane review of calcium supplementation trials not specifically targeted at preventing pre-eclampsia (Buppasiri et al 2015) found no clear difference in risk of preterm birth <34 weeks (RR 1.04; 95%CI 0.80 to 1.36; 4 RCTs, n=5,669; moderate certainty).

Calcium supplementation does not appear to be of benefit in preventing low birthweight (RR 0.93; 95%CI 0.81 to 1.07; 6 RCTs; n=14,162; moderate certainty) (Buppasiri et al 2015).

There is some evidence that routine calcium supplementation in pregnancy is more cost-effective than selective supplementation (Meertens et al 2018).

Evidence-based recommendation

5 Advise pregnant women to take a low-dose calcium supplement.

Iodine

Background

Iodine deficiency re-emerged in Australia in the 1990s, motivating mandatory fortification of bread with iodised salt in 2009. The AIHW reports that, while mandatory fortification delivered sufficient amounts of iodine to the general population, intakes for many pregnant and breastfeeding women were insufficient due to their increased requirements (AIHW 2016).

In a review of Australian cohort studies post-fortification (7 studies) (Hurley et al 2019), three studies found that the pregnant women in their studies were iodine replete and four found that pregnant women were in the mild-to-moderate iodine deficiency category. Only two studies, documented iodine sufficiency among pregnant women in the absence of iodine supplementation.

The NHMRC (2010) *NHMRC Public Statement: Iodine Supplementation for Pregnant and Breastfeeding Women* advises pregnant women to take an iodine supplement of 150 micrograms each day to avoid poor infant neurodevelopment.

A survey of pregnant women conducted in Sydney found that 6.3% were taking an iodine supplement (Shand et al 2016). A study conducted in Gippsland Victoria, a mildly iodine deficient area, found that only 18.9% of participants followed the NHMRC recommendation, with 42.3% of participants not taking any supplements (or supplements with no iodine or insufficient iodine) (Mitchell et al 2018). The remaining women (38.7%) were taking supplements with doses of iodine much higher (200-300 µg) than the NHMRC recommended dose or were taking multiple supplements containing iodine. In a South Australian study, 85.9% women met the estimated average requirement (≥ 160 µg/day) for iodine intake from food and supplements (Condo et al 2017). When iodine from supplements was excluded, 44.5% of women met the estimated average requirement for iodine intake during pregnancy. In a Western Australian study, 66% of pregnant women were taking iodine supplements (Hine et al 2018). A Tasmanian study (n=255) found that, despite recommendations for iodine supplementation, pregnant Tasmanian women remain at risk of iodine deficiency (Hynes et al 2019).

An analysis of cross-sectional data from two Australian longitudinal studies pre- and post-fortification of iodine (n=368) (Singh et al 2019) found that the median urinary iodine concentration of pregnant Indigenous women in remote locations remains low and targeted interventions are needed to ensure healthy fetal development. In a cross-sectional study in Western Australia (n=425) (Sherriff et al 2019) ethnicity was associated with iodised salt use, with 76% of Asian women used iodised salt compared with 33% of Caucasian women.

In a national survey of maternity care providers, while 71% were aware of the NHMRC advice on iodine supplementation, fewer were aware of the recommended dose (38%) or duration (44%), with 73% advising iodine supplements in pregnancy (Guess et al 2017).

Summary of recent evidence

There is low certainty evidence that, in settings with mild to moderate iodine deficiency, iodine supplementation may reduce the risk of postpartum hyperthyroidism (average RR 0.32; 95%CI 0.11 to 0.91; three RCTs; n=543 women) with very low certainty evidence of an increased likelihood of gastrointestinal intolerance during pregnancy (average RR 15.33; 95%CI 2.07 to 113.70; one RCT; n=76) (Harding et al 2017). There is low certainty evidence that iodine supplementation has effects on other outcomes or side effects for mothers or infants (Harding et al 2017; Farebrother et al 2018).

RCTs have reported that iodine supplementation:

- increased maternal urinary iodine levels in areas with iodine deficiency ($p < 0.05$) (Chawanpaiboon 2019) and mild-moderate deficiency ($p < 0.0001$) (Censi et al 2019)
- decreased maternal thyroglobulin levels ($p = 0.02$) (Censi et al 2019)
- decreased median neonatal thyroid stimulating hormone levels ($p < 0.05$) (Chawanpaiboon 2019)
- had no effect on child neurodevelopment at age 5-6 years in mildly iodine-deficient pregnant women (Gowachirapant et al 2017).

Consensus-based recommendation

- I. Advise pregnant women to take an iodine supplement of 150 micrograms each day. Women with pre-existing thyroid conditions should seek advice from their medical practitioner before taking a supplement.

Zinc

Background

A survey of pregnant women conducted in Sydney found that 5.6% were taking a zinc supplement (Shand et al 2016). In an Australian cohort study (Livock et al 2017) 17-24% of pregnant women did not meet the recommended daily intake for zinc.

Summary of recent evidence

There is moderate certainty evidence that zinc supplementation may play a role in reducing the risk of preterm birth (RR 0.86; 95%CI 0.76 to 0.97; 16 RCTs; n=7,637) (Ota et al 2015), with no clear effect on low birthweight (RR 0.93; 95%CI 0.78 to 1.12; 14 RCTs; n=5,643) (RR 0.76, 95%CI: 0.52 to 1.11) (Ota et al 2015; Liu et al

2018b). Zinc supplementation does not appear to increase or reduce the risk of other outcomes (Nossier et al 2015; Ota et al 2015; Zahiri Sorouri et al 2016; Oh et al 2020).

Other minerals

- There is insufficient high-certainty evidence to show whether dietary magnesium supplementation during pregnancy is beneficial (Makrides et al 2014).
- There is insufficient evidence to draw conclusions on selenium supplementation in pregnancy (Tara et al 2010; Rayman et al 2014).

1.2.3 Other nutritional supplements

Multiple micronutrients

Background

In Australian observational studies:

- 79% of pregnant women used multiple micronutrient supplements (Shand et al 2016)
- 42% of participants used pregnancy multivitamins, with 26.8% using multivitamins in combination with individual micronutrients and 9.8% using specific micronutrient supplements; nulliparous women were more likely to take supplements (McAlpine et al 2020)
- 83% of women took a multivitamin during pregnancy, with 90% of women with post-secondary education and 64% of women with secondary education only using these supplements (Malek et al 2018)
- pregnancy-specific multivitamin use was reported by 47% of women in the first trimester, 51% in the second trimester and 46% in the third trimester and general multivitamin use was reported by 31% of women in the first trimester, 27% in the second trimester and 35% in the third trimester (Livock et al 2017).

Summary of recent evidence

There is high certainty evidence from studies conducted in low- to middle-income countries that the use of multiple micronutrients (including iron and folic acid) during pregnancy reduces the risk of low birthweight and may reduce the risk of stillbirth but does not affect the risk of perinatal or neonatal mortality (Keats et al 2019). There is moderate certainty evidence of a reduction in risk of small for gestational age and a possible reduction in risk of preterm birth (<37 weeks) (Keats et al 2019). There is evidence that multiple micronutrient use is associated with a reduction in risk of early preterm birth (<34 weeks), a possible reduction in risk of miscarriage, with no effect on maternal mortality, maternal anaemia, caesarean section or congenital anomalies (Keats et al 2019). These findings may not be generalisable to the Australian context.

There is very low to low certainty evidence that antenatal multivitamin supplementation among women in high income countries is associated with a reduced risk of small for gestational age (RR 0.77; 95%CI 0.63 to 0.93; 3 cohort studies; very low certainty) and some congenital anomalies and a possible reduced risk of preterm birth (RR 0.84; 95%CI 0.69 to 1.03; 4 cohort studies; very low certainty) (Wolf et al 2017).

Omega-3 fatty acids

Background

In an Australian cross-sectional study, 12% of women took fish oil (which contains omega-3 fatty acids) during pregnancy (Shand et al 2016).

Summary of the evidence

There is high certainty evidence that rates of preterm birth <37 weeks (10.1% versus 8.1%; RR 0.89, 95%CI 0.82 to 0.97; 30 RCTs, n=21,271) and early preterm birth <34 weeks (2.6% vs 1.6%; RR 0.64, 95%CI 0.44 to 0.93; 11 RCTs, n=15,750) are lower in women receiving omega-3 long-chain polyunsaturated fatty acids compared with no omega-3 (Middleton et al 2018). There is moderate-certainty evidence that prolonged pregnancy >42 weeks is probably increased with omega-3 fatty acid supplementation (RR 1.61 95%CI 1.11 to 2.33; n=5,141; 6 RCTs) but insufficient evidence to determine the effect of supplementation on induction post-term (Middleton et al 2018). There is high certainty evidence of a reduced risk of low birthweight (15.6% vs 14%; RR 0.90, 95%CI 0.82 to 0.99; 15 trials, n=8,449;) and moderate certainty evidence for a possible reduced risk of perinatal death (RR 0.75, 95%CI 0.54 to 1.03; 10 RCTs, n=7,416), neonatal care admission (RR 0.92, 95%CI 0.83 to 1.03; 9 RCTs, n=6,920) and a possible

small increase in risk of large-for-gestational age babies (RR 1.15, 95%CI 0.97 to 1.36; 6 RCTs, n=3,722) with omega-3 fatty acid supplementation (Middleton et al 2018).

Evidence-based recommendation

6 Advise pregnant women that supplementation with omega-3 long-chain polyunsaturated fatty acids may reduce their risk of preterm birth.

Probiotics

A meta-analysis of RCTs conducted to inform these Guidelines (Ramson et al 2020) found low certainty evidence that supplementation with probiotics may be associated with a possible reduction in caesarean section (RR 0.92; 95%CI 0.81 to 1.05; 15 RCTs; n=2,650), and very low certainty evidence of a reduction in Group B streptococcus colonisation (RR 0.76; 95%CI 0.61 to 0.97; n=244) and a possible reduction in risk of gestational diabetes (RR 0.87; 95%CI 0.71 to 1.08; 8 RCTs; n=1,722).

There is very low or low certainty evidence that probiotic supplementation has no clear effect on gestational hypertension (RR 1.24; 95%CI 0.74 to 2.06; 4 RCTs; n=955), pre-eclampsia (RR 1.88; 95%CI 0.96 to 3.71; 2 RCTs; n=598), bacterial vaginosis (RR 1.73; 95%CI 0.89 to 3.38; 2 RCTs; n=509), perinatal death (RR 1.17; 95%CI 0.62 to 2.24; 6 RCTs; n=1,670), preterm birth (RR 1.10; 95%CI 0.81 to 1.50; 16 RCTs; n=3,671), small for gestational age (RR 1.04; 95%CI 0.55 to 1.94; 3 RCTs; n=318), large for gestational age (RR 0.95; 95%CI 0.47 to 1.93; 3 RCTs; n=316) or macrosomia (RR 1.06; 0.85 to 1.33; 7 RCTs; n=1,407).

Herbal preparations

Background

An Australian cohort study (n=1,835) found that 34.4% of women were using herbal preparations during pregnancy, of whom 77.9% were self-prescribing these products (Frawley et al 2015). Women were more likely to use herbal medicine if they had anxiety (OR 1.30; 95%CI, 1.02 to 1.64; p=0.031), sleeping problems (OR 1.55; 95%CI 1.15 to 2.11; p=0.005) or fatigue (OR 1.32; 95%CI 1.04 to 1.68; p=0.025) and less likely to use herbal medicine if they had nausea (OR 0.71; 95%CI 0.56 to 0.91; p=0.007). Women who used herbal preparations viewed them as a preventative measure, were looking for something holistic and were concerned about evidence of clinical efficacy when considering the use of these products during pregnancy (Frawley et al 2016).

Summary of the evidence

The evidence on the efficacy and safety of herbal preparations during pregnancy is limited. There is moderate certainty evidence that ginger reduces nausea (MD -4.2 nausea score; 95%CI -6.5 to -1.9), with a low risk of adverse effects (OR 0.4; 95%CI 0.1 to 0.9) (Sridharan & Sivaramakrishnan 2018). There is very low certainty evidence that chamomile is also effective in reducing nausea (MD -4.2; 95%CI -6.7 to -1.7; 1 RCT) (Sridharan & Sivaramakrishnan 2018). There is evidence from a systematic review that garlic may reduce gestational hypertension (RR 0.50; 95%CI 0.25 to 1.00) but does not affect the risk of pre-eclampsia (RR 0.78, 95% CI 0.31 to 1.93) or caesarean section (RR 1.35, 95% CI 0.93 to 1.95), with odour likely to be experienced (RR 8.50, 95%CI 2.07 to 34.88) (Meher & Duley 2006). There is insufficient evidence on the efficacy and safety of Echinacea and elderberry during pregnancy (Holst et al 2014).

1.3 Physical activity

1.3.1 Background

Physical activity can be defined as any body movement that involves the use of one or more large muscle groups and raises the heart rate. This includes sport, exercise and recreational activities and incidental activity that accrues throughout the day (eg walking to the shops, climbing stairs).

Levels of physical activity in Australia

Data specific to pregnant women are not available but results from national surveys give some indication of patterns of physical activity and sedentary behaviour.

In 2014-15, an estimated 52% of adults aged 18-64 did less than the recommended 150 minutes of moderate intensity physical activity, or 75 minutes of vigorous intensity physical activity, across 5 or more sessions each

week. An estimated 70% of adults did no strength-based activities. Only 19% of adults aged 18-64 did the recommended amount of physical activity and strength-based training (AIHW 2018).

An Australian cross-sectional study found that fewer women participated in exercise during pregnancy (61%) compared to before pregnancy (87%) and that they exercised at a significantly lower frequency ($p < 0.05$), intensity ($p < 0.05$) and for a shorter time/duration ($p < 0.05$) (Hayman et al 2016).

In a survey of regionally-based Australian women ($n=142$) (Hayman et al 2019), around half of women (53%) reported receiving advice on exercise as part of antenatal care. However, the advice given was frequently inconsistent with evidence-based guidelines concerning frequency, intensity, duration and benefits and harms.

Systematic reviews have found that barriers to participating in physical activity were:

- categorised as intrapersonal (pregnancy-related symptoms and limitations, time constraints, perceptions of already being active, lack of motivation and mother-child safety concerns), interpersonal (lack of advice and information and lack of social support) and environmental, organisational and policy barriers (adverse weather, lack of resources) (Coll et al 2017)
- predominantly intrapersonal such as fatigue, lack of time and pregnancy discomforts, while enablers included maternal and fetal health benefits (intrapersonal), social support (interpersonal) and pregnancy-specific programs (Harrison et al 2018).

1.3.2 Discussing physical activity

Guidelines on physical activity in pregnancy

The *Australian Physical Activity and Sedentary Behaviour Guidelines* (DoH 2014) recommend that pregnant women do some physical activity every day and accumulate 150-300 minutes of moderate-intensity physical activity each week. Women are advised to talk with their health professional regarding the best form of activity and to check with them before undertaking vigorous intensity physical activity.

Table 3: Definition of levels of physical activity

Moderate intensity	Physical activity that requires some effort, but still allows the person to speak easily while undertaking the activity. Examples include active play, brisk walking, recreational swimming, dancing, social tennis, or riding a bike.
Vigorous intensity	Physical activity that requires more effort and makes the person breathe harder and faster (“huff and puff”). Examples include running, fast cycling, many organised sports or tasks that involve lifting, carrying or digging.

Source: (DoH 2014)

Recent evidence on the effects of leisure-time physical activity during pregnancy

Physical fitness and quality of life

There is a possible increase in physical fitness associated with exercise in pregnancy (Hopkins et al 2010; de Oliveria Melo et al 2012; Halvorsen et al 2013; Bisson et al 2015; Guelfi et al 2016; Seneviratne et al 2016; Cai et al 2020) and rates of injury appear to be low (4.1 per 1,000 exercise hours; $n=1,469$). The evidence on the effect on quality of life suggests an improvement with physical activity (Montoya Arizabaleta et al 2010; Gustafsson et al 2016; Haakstad et al 2016; Prabha et al 2019; Rodriguez-Blanque et al 2020).

Effect on common conditions in pregnancy

- ***Glycaemic control:*** An acute bout of exercise is associated with a decrease in maternal blood glucose from before to during exercise (MD -0.94 mmol/L, 95%CI -1.18 to -0.70; 6 studies, $n=123$) and following exercise (MD -0.57 mmol/L, 95% CI -0.72 to -0.41; $n=333$) (Davenport et al 2018).

- *Pelvic girdle and low back pain*: There is evidence from systematic reviews (Shiri et al 2018; Davenport et al 2019b), an RCT (Sklempe Kokic et al 2017) and a cohort study (Gjestland et al 2013) that physical activity during pregnancy is associated with a possible reduction in risk of low back (RR 0.91, 95%CI 0.83 to 0.99; 7 studies; n=1,175) and lumbopelvic pain (RR 0.96, 95%CI 0.90 to 1.02; 8 studies; n=1,737) and a reduction in severity of pain during pregnancy (SMD -1.03; 95%CI -1.58 to -0.48; 10 studies; very low to moderate certainty). The evidence on the effect of exercise on pelvic girdle pain and pain in the postpartum period is unclear.
- *Sleep*: Moderate to vigorous exercise during pregnancy appears to improve sleep quality (Loprinzi et al 2012; Kocsis et al 2017; Rodriguez-Blanque et al 2018; Yang et al 2020) but is not effective in treating insomnia in pregnancy (Yang et al 2020).

Effect on labour

One systematic review (Kramer & McDonald 2006) and eleven RCTs (Salvesen & Morkved 2004; Baciuk et al 2008; Barakat et al 2008; Salvesen et al 2014; Perales et al 2016a; Perales et al 2016b; Taniguchi & Sato 2016; Barakat et al 2018; Sanda et al 2018; Rodriguez-Blanque et al 2019a; Perales et al 2020) reported on duration of labour among women who had participated in a physical activity intervention during pregnancy and those who had not. The systematic review found no clear difference in length of the first (MD 2.00; 95%CI -1.15 to 5.15; 1 study; n=18) or second (MD -5.72; 95%CI -15.22 to 3.78; 1 study; n=18) stage of labour (Kramer & McDonald 2006). With some exceptions, (Salvesen et al 2014; Perales et al 2016a; Barakat et al 2018; Rodriguez-Blanque et al 2019a; Perales et al 2020), the RCTs found no clear difference in duration of any stage of labour.

Five RCTs (Baciuk et al 2008; Barakat et al 2009; Salvesen et al 2014; Taniguchi & Sato 2016; Sanda et al 2018) reported on pain relief during labour among women who had participated in a physical activity intervention during pregnancy and those who had not. One study reported fewer requests for analgesia in labour (RR 0.42; 95%CI 0.23 to 0.77; n=71) (Baciuk et al 2008) but there was no clear difference in the other studies.

Five RCTs (Salvesen & Morkved 2004; Salvesen et al 2014; Garnaes et al 2016; Seneviratne et al 2016; Rodriguez-Blanque et al 2019b) reported on perineal tears among women who had participated in a physical activity intervention during pregnancy and those who had not. One study found higher rates of intact perineum among the intervention group (aOR 8.57; 95% CI 1.85 to 39.68) (Rodriguez-Blanque et al 2019b) but there was no clear difference in rates of perineal tears in any other study.

Effect on the infant and child

There is evidence from systematic reviews that leisure-time exercise during pregnancy is not associated with congenital anomalies (OR 1.23, 95%CI 0.77 to 1.95; 14 studies; n=78,735; very low certainty) (Davenport et al 2019c) and appears to be protective against macrosomia (aOR 0.77; 95%CI 0.61 to 0.96; n=36,896) (Owe et al 2009) and low birthweight, with women who did not exercise before and during pregnancy having an increased risk of very low birthweight (OR 1.75; 95%CI 1.50 to 2.04; n=2,245) (Leiferman & Evenson 2003). Cohort studies suggest a positive association between physical activity during pregnancy and offspring neurodevelopment (4 studies) (Nino Cruz et al 2018). Physical activity during pregnancy does not appear to affect childhood weight (n=802) (Kong et al 2016).

Adverse effects

The evidence did not support an association between:

- any exercise during pregnancy and:
 - risk of miscarriage (OR 0.69; 95%CI 0.40 to 1.22; 10 studies) or perinatal mortality (OR 0.79; 95%CI 0.26 to 2.38; 6 studies) (Davenport et al 2019a)
 - adverse impact on fetal heart rate or uteroplacental blood flow metrics (9 studies; 4,651 women) (Skow et al 2019).
- vigorous exercise during pregnancy and:
 - risk of small for gestational age, low birthweight (Beetham et al 2019; Hoffmann et al 2019), large for gestational age or high birthweight (Hoffmann et al 2019)
 - risk of preterm birth with exercise in the first (OR 0.80; 95%CI 0.48 to 1.35) or second trimester (OR 0.52; 95%CI 0.24 to 1.11; n=1,699) (Evenson et al 2002)
 - risk of preterm birth with vigorous activity up to 435 min/week (OR 1.2; 95%CI 0.5 to 3.1; n=1,647) (Jukic et al 2012)

- risk of post-term birth with exercise in the first (OR 0.93; 95%CI 0.45 to 1.89) or second (OR 1.15; 95%CI 0.47 to 2.79) trimester (n=1,699) (Evenson et al 2002)
- supine exercise and low birthweight (3 RCTs; very low to low certainty) (Mottola et al 2019)
- swimming or aqua aerobics and:
 - risk of miscarriage <22 weeks (19-22 weeks HR 0.9; 95%CI 0.4 to 1.9; n=92,671) (Madsen et al 2007)
 - risk of spina bifida (aOR 0.68; 95%CI 0.47 to 0.99; n=8,655)(Agopian et al 2013)
 - significant increase in maternal body temperature (mean increase 0.16±0.35°C; n=109) (Brearley et al 2015).

However, a cohort study (n=92,671) (Madsen et al 2007) found that bicycling and horseback riding may be associated with miscarriage at 11-14 weeks (HR 1.7; 95%CI 1.4 to 2.0) but not at other times before 22 weeks.

The same study suggested an increase in risk of miscarriage <18 weeks with high impact exercise (jogging, ball games and racket sports) or workout/fitness training (75-269 minutes/week). However, the authors noted that it is too early to draw any public health inferences on this basis.

A systematic review noted that there was insufficient evidence to ascertain whether maternal exercise in the supine position is safe or should be avoided during pregnancy (Mottola et al 2019).

Evidence-based recommendation

7 Advise women that regular moderate-intensity physical activity during pregnancy is associated with a range of health benefits and is generally not associated with adverse outcomes.

Recent evidence on the effects of occupational physical activity during pregnancy

The evidence on risks associated with occupational physical activity during pregnancy is unclear.

Heavy lifting (eg >200 kg/day) may be associated with an increased risk of pelvic pain (201-500 kg/day: aOR 1.45; 95%CI 1.31 to 1.60; n=50,143) (Larsen et al 2013), stillbirth among women with a previous fetal loss (201-975 kg per day: adjusted hazard ratio [aHR] 2.87; 95%CI 1.37 to 6.01; n=68,086) (Juhl et al 2013) and preterm birth among primigravid women (201-975 kg/day: aHR 1.43; 95%CI 1.13 to 1.80; n=65,530) (Mocevic et al 2014) but does not appear to be associated with small-for-gestational age (Pompeii et al 2005; Snijder et al 2012; Juhl et al 2014) or low birthweight (Snijder et al 2012).

There is a possible association between occupational standing and increased risk of miscarriage (>6 hours a day: RR 1.16; 95%CI 1.01 to 1.32; 30 studies) or preterm birth (Ritsmitchai et al 1997) (>3 hours per day: OR 1.25; 95%CI 0.99 to 1.57; 11 studies) but no clear difference in small-for-gestational age, birthweight (Eunhee et al 2002) or pelvic pain (Juhl 2005).

There is insufficient evidence to draw conclusions on strenuous occupational physical exertion in pregnancy but it may be associated with preterm premature rupture of the membranes (OR 1.72; 95%CI 1.16 to 2.56; n=2,929) (Newman et al 2001) and pelvic pain (OR 1.47; 95%CI 1.17 to 1.84; n=2,758) (Juhl 2005).

1.4 Practice summary: nutrition and physical activity

Nutrition

When: All antenatal visits

Who: Midwife; GP; obstetrician; Aboriginal and Torres Strait Islander Health Practitioner; Aboriginal and Torres Strait Islander Health Worker; multicultural health worker; accredited dietitian; nutritionist

- Assess levels of nutrition:** Ask women about their current eating patterns.
- Provide advice:** Explain the benefits of healthy nutrition for the mother and baby. Give examples of culturally appropriate foods in the five food groups, sample serves for each group, how many serves are recommended a day and 'eating a rainbow'. Discuss foods that are rich in iron (eg meat, seafood and poultry, vegetarian or vegan options), dietary factors that aid or limit absorption, and supplementing iron if the woman has a low dietary intake.
- Discuss use of nutritional supplements with women:** Explain that some supplements (folic acid, iodine, calcium) are recommended for all women during some stages of pregnancy, while others (vitamins A, C and E) are not of benefit and may be harmful and that iron should only be supplemented if a deficiency is identified.
- Consider referral:** Referral to an accredited dietitian may be a consideration if there is concern about the quality of nutritional intake, the woman would like information about nutrition for herself and her family, clinical assessment confirms underweight or overweight of the woman or there are other factors of concern (eg diabetes, gastrointestinal disorders).
- Take a holistic approach:** Tailor dietary advice to the individual woman. Consider the availability and affordability of foods appropriate to the woman's cultural practices and preferences and the need and affordability of supplements.

Physical activity

When: All antenatal visits.

Who: Midwife; GP; obstetrician; Aboriginal and Torres Strait Islander Health Practitioner; Aboriginal and Torres Strait Islander Health Worker; multicultural health worker; physiotherapist or accredited exercise physiologist.

- Assess levels of activity:** Ask women about their current levels of physical activity, including the amount of time spent being active and the intensity of activity.
- Provide advice:** Explain the benefits of regular moderate-intensity physical activity. Give examples of activities that are of sufficient intensity to achieve health benefits (eg brisk walking, swimming, cycling). Advise women to discuss their plans with a health professional before starting or continuing a program of physical activity.
- Provide information:** Give information about local supports for physical activity (eg women's walking groups, swimming clubs). Advise women to avoid exercising in the heat of the day and to drink plenty of water when active.
- Take a holistic approach:** Assist women to identify ways of being physically active that are appropriate to their cultural beliefs and practices (eg activities they can do at home).

1.5 Resources

1.5.1 Nutrition

FSANZ (2011) [Mercury in Fish](#). Food Standards Australia New Zealand.

FSANZ (2018) [Listeria](#). Food Standards Australia New Zealand.

NHMRC (2013) [Australian Dietary Guidelines](#). Canberra: National Health and Medical Research Council.

NHMRC (2010) [NHMRC Public Statement: Iodine Supplementation for Pregnant and Breastfeeding Women](#). Canberra: National Health and Medical Research Council.

NHMRC (2006) [Nutrient Reference Values for Australia and New Zealand](#). Canberra: National Health and Medical Research Council.

1.5.2 Physical activity

DoH (2014) [Australia's Physical Activity and Sedentary Behaviour Guidelines](#).

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CLINICAL ASSESSMENTS

2 Weight and body mass index

Body mass index (prior to pregnancy or at the first antenatal visit) and weight gain during pregnancy are among the important determinants of the health of both mother and baby.

2.1 Background

2.1.1 Weight classification

Body mass index (BMI) is commonly used to classify adults as being underweight, of healthy weight, overweight or obese. It is calculated by dividing weight by the square of height: $\text{weight (kg)}/\text{height (m)}^2$. The WHO classification of BMI classification is given in Table 4.

Table 4: Classification of adult underweight, overweight and obesity according to BMI

BMI (kg/m ²)	Classification
<18.50	Underweight
18.5-24.9	Healthy weight
25.0-29.9	Overweight
>30.0	Obese

2.1.2 Weight classification during pregnancy in Australia

Among women who gave birth in Australia in 2018 (AIHW 2020):

- 3.8% were underweight, 49.5% were in the healthy weight range, 26.0% were overweight but not obese and 21.0% were obese at the beginning of their pregnancy
- Aboriginal and Torres Strait Islander women were more likely than non-Indigenous women to be either obese (31.0% vs 21.0%) or underweight (6.8% vs 3.8%) and less likely to be in the healthy weight range (38% vs 49.5%), with a similar likelihood of being overweight but not obese (24%)
- compared to women in the highest socioeconomic status quintile, those in the most disadvantaged quintile were more likely to be obese (26.7 vs 12.4%), less likely to be in the healthy weight range (42.0 vs 60.3%) and had a similar likelihood of being overweight (27.1 vs 23.1%) or underweight (both 4.2%)
- obesity was most common in very remote areas (27.1 vs 18.7% in major cities), prevalence of overweight was similar across geographical regions, prevalence of healthy weight decreased with increasing remoteness (51.7% in major cities to 39.2% in very remote areas) and underweight was more common in very remote areas (7.1 vs 3.8% in major cities).

2.2 Assessing BMI

2.2.1 Measuring height and weight and calculating BMI

Routine measurement of women's weight and height and calculation of BMI at the first antenatal contact allows identification of women who require additional care during pregnancy. When there is an accurate record of a woman's pre-pregnancy BMI, this may be used to estimate gestational weight gain (see Section 2.3). Note that the BMI can be less accurate for assessing healthy weight in certain groups due to variations in muscle mass and fat mass (eg cut-offs lower than the WHO classifications may be appropriate for women from Asian backgrounds and higher cut-offs for women from the Pacific Islands).

2.2.2 Risks associated with a low or high BMI

Low pre-pregnancy BMI

Systematic reviews are consistent in finding that low pre-pregnancy BMI is associated with an increased risk of:

- preterm birth (Han et al 2011; Liu et al 2016)
- small for gestational age (Yu et al 2013; Liu et al 2016; Goto 2017; Liu et al 2019)
- low birthweight (Han et al 2011; Yu et al 2013; Liu et al 2016; Liu et al 2019).

Systematic reviews have also found a possible increase in risk of miscarriage (Balsells et al 2016) and placental abruption (Adane et al 2019) and a decreased risk of gestational diabetes (Torloni et al 2009). There was no clear effect on risk of congenital heart defects (Zhu et al 2018).

High pre-pregnancy BMI

Systematic reviews are consistent in finding that pre-pregnancy overweight and obesity is associated with:

- large for gestational age (Yu et al 2013; Liu et al 2016; Liu et al 2019)
- macrosomia (Yu et al 2013; Liu et al 2016; Liu et al 2019)
- childhood overweight/obesity (Yu et al 2013; Voerman et al 2019).

Systematic reviews have also found associations between high pre-pregnancy BMI and:

- increased risk of gestational diabetes (Torloni et al 2009), preterm birth, neonatal asphyxia (Liu et al 2019), admission to neonatal intensive care, stillbirth (Liu et al 2016) and congenital heart defects (Cai et al 2014; Zhu et al 2018)
- reduced risk of small for gestational age (Goto 2017) and placental abruption (Adane et al 2019).

Systematic reviews found a decreased likelihood of initiating breastfeeding among obese women (Garcia et al 2016; Huang et al 2019).

2.2.3 Discussing weight with women

Women who have a BMI that is below or above the healthy range are likely to require additional care and support during pregnancy. For women with an elevated BMI, there may be additional implications for care during pregnancy (eg the potential for poor ultrasound visualisation) and the birth (eg need for the birth to take place in a larger centre, difficulties with fetal monitoring). Relevant risks associated with a woman's BMI should be explained and the woman given the opportunity to discuss these and how they might be minimised.

Assessment of fetal growth is discussed in Section 22.1 and assessment for risk of preterm birth in Chapter 23.

2.3 Monitoring weight gain

While BMI prior to or early in pregnancy is independently associated with pregnancy outcomes, the amount of weight gained during pregnancy is also a contributing factor. The US Institute of Medicine (IOM) provides guidance on weight gain in pregnancy based on pre-pregnancy BMI. The IOM recommendations are consensus-based and were written in 2009. More recently, the US Centers for Disease Control and Prevention (CDC) have provided recommendations on gestational weight gain, which are also consensus-based.

Table 5: Recommendations for weight gain in pregnancy (kg)

Pre-pregnancy BMI (kg/m ²)	IOM recommendations	CDC 2019 recommendations
Underweight	12.5-18.0	16.0-18.0
Healthy weight	11.5-16.0	16.0-18.0
Overweight	7.0-11.5	12.0-16.0
Obese	5.0-9.0	6.0-9.0

Note: The recommended weight gain ranges are indicative only and provide suggested limits rather than specific goals. Sources: (NHMRC 2013b) based on (IOM 2009) and (CDC 2019).

An individual participant-level meta-analysis (25 cohort studies; n=196,670) (LifeCycle Project-Maternal et al 2019) estimated optimal gestational weight gain ranges for each pre-pregnancy BMI category by selecting the range of gestational weight gain that was associated with lower risk for any adverse outcome. This process identified weight gain ranges for women who are overweight or obese that were considerably lower than the IOM recommendations. However, the authors noted that while the estimates may inform antenatal counselling, the gestational weight gain ranges had limited predictive value for the outcomes assessed.

A number of studies have suggested that the IOM guidelines may not be applicable to all women.

- A systematic review of the utility of IOM-2009 guidelines among Indian and other Asian pregnant women in terms of maternal and fetal outcomes (n=13 studies) (Arora & Tamber Aeri 2019) highlighted the need for gestational weight gain recommendations across the different body mass index levels specifically for Indian women and other Asian populations.
- A retrospective cohort study in China (n=8,209) (Jiang et al 2019) found that the lowest accumulated risk of low birthweight and macrosomia was not always achieved among women who gained weight within recommendations and suggested that the IOM weight gain ranges are too high for Chinese women.
- A cohort study in the United States (n=181,948) (Khanolkar et al 2020) found that adherence to the 2009 IOM guidelines for weight gain during pregnancy reduced risk for various adverse maternal outcomes in all ethnic groups studied. However, the guidelines were better at predicting small and large for gestational age than other infant outcomes.

Consensus-based recommendation

- II. Measure women's weight and height at the first antenatal visit and calculate their body mass index (BMI) and give them advice about the benefits of gaining weight within the recommended weight gain range for their BMI.

2.3.1 Determinants of gestational weight gain

Weight gain below guidelines

A systematic review found that women with lower educational attainment had an increased risk of inadequate weight gain (OR 1.3; 95% CI 1.0 to 1.6, p=0.017) (O'Brien et al 2019).

An analysis of observational data from a longitudinal cohort study of Aboriginal women during pregnancy (n=110) (Schumacher et al 2018) found that 32% of women had inadequate weight gain.

Cohort studies in the United States (Mendez et al 2014; Headen et al 2015; Mendez et al 2016) have found that African American women, Hispanic women and women in socially disadvantaged areas are more likely to experience inadequate weight gain.

Weight gain exceeding guidelines

Systematic reviews have found associations between weight gain exceeding recommendations and:

- lower educational attainment (O'Brien et al 2019)
- body image dissatisfaction (Hartley et al 2015; Kapadia et al 2015a)
- lack of social support (Hartley et al 2015)
- concern about weight gain, negative attitude towards weight gain, inaccurate perceptions regarding weight, higher than recommended target weight gain, less knowledge about weight gain, higher levels of cognitive dietary restraint, and perceived barriers to healthy eating (Kapadia et al 2015a).

There were no clear associations between weight gain exceeding recommendations and:

- anxiety (Hartley et al 2015; Kapadia et al 2015a), stress (Hartley et al 2015; Kapadia et al 2015a), self-efficacy (Hartley et al 2015), self-esteem (Hartley et al 2015) or social support (Ratan et al 2020)
- parity (r 0.04, 95%CI 0.10 to 0.16, p=0.61; 17 studies), including after adjusting for pre-pregnancy BMI (r 0.08, 95%CI 0.19 to 0.03, p=0.16; 16 studies) (Hill et al 2017)

The evidence of an association between weight gain exceeding recommendations and depression was inconsistent (Hartley et al 2015; Kapadia et al 2015a).

Protective factors included a perception of control over weight gain, lower than recommended target weight gain and higher self-efficacy for healthy eating (Kapadia et al 2015a).

Cohort studies have found associations between weight gain exceeding guidelines and:

- pre-pregnancy BMI (≥ 25 vs < 25) (OR 3.35; 95%CI 2.44 to 4.64; $p < 0.0001$) (Morisset et al 2017)
- stopping smoking compared to women who never smoked (weekly weight gain in second and third trimesters MD 0.09 kg; 95%CI 0.03 to 0.15) (Hulman et al 2016)

There was no clear association in cohort studies between weight gain exceeding guidelines and:

- experiencing hardship in childhood (OR 1.45, 95%CI 0.99 to 2.14), in adulthood (OR 0.72; 95%CI 0.41 to 1.26) or in pregnancy (OR 1.09; 95%CI 0.43 to 2.76) (Provenzano et al 2015)
- maternal age (< 30 vs ≥ 30) (OR 1.02; 95%CI 0.98 to 1.02; $p = 0.89$) (Morisset et al 2017)
- household income ($< \text{CAN}\$60,000$ vs $\geq \text{CAN}\$60,000$) (OR 1.06; 95%CI 0.71 to 1.26; $p = 0.71$) (Morisset et al 2017)
- education level ($< \text{university}$ vs $\geq \text{university degree}$) (OR 1.26; 95%CI 0.93 to 1.70; $p = 0.14$) (Morisset et al 2017)
- country of birth (other countries vs Canada) (OR 1.05; 95%CI 0.78 to 1.41; $p = 0.73$). (Morisset et al 2017).

An analysis of observational data collected from a longitudinal cohort study of Aboriginal women during pregnancy ($n = 110$) (Schumacher et al 2018) found that 54% of women had weight gain exceeding recommendations.

2.3.2 Risks associated with low or high gestational weight gain

A meta-analysis of individual participant data ($n = 265,270$) (Santos et al 2019) found that low or high gestational weight gain was associated with pregnancy complications across all BMI classifications.

Weight gain among women of any BMI

Weight gain lower than recommendations

In a systematic review of cohort studies of pregnant women of any BMI (23 studies; 1,309,136 women) (Goldstein et al 2017), weight gain *lower* than recommendations was associated with an increased risk of:

- preterm birth (OR 1.70; 95%CI 1.32 to 2.20)
- small for gestational age babies (OR 1.53; 95% CI 1.44 to 1.64).

There was an association between weight gain *lower* than recommendations and a lower likelihood of:

- large-for-gestational-age babies (OR 0.59; 95%CI 0.55 to 0.64)
- macrosomia (OR 0.60; 95%CI 0.52 to 0.68).

There was an association between weight gain *lower* than recommendations and a possible lower likelihood of caesarean section (OR 0.98; 95%CI 0.96 to 1.02).

In an analysis of individual participant data from the control arms of 36 RCTs ($n = 4,429$) (Rogozinska et al 2019) the odds of preterm birth (aOR 1.94; 95%CI 1.31 to 2.28) and small-for-gestational-age babies (aOR 1.52; 95%CI 1.18 to 1.96) were increased with gestational weight gain *lower* than recommendations. Findings on caesarean section and large-for-gestational-age babies were inconclusive.

Weight gain higher than recommendations

The systematic review of cohort studies (Goldstein et al 2017) found that weight gain *higher* than recommendations was associated with an increased risk of:

- large-for-gestational age babies (OR 1.85; 95%CI 1.76 to 1.95)
- macrosomia (OR 1.95; 95%CI 1.79 to 2.11)
- caesarean section (OR 1.30; 95%CI 1.25 to 1.35).

There was an association between weight gain higher than recommendations and lower likelihood of small-for-gestational-age babies (OR 0.66; 95%CI 0.63 to 0.69) and preterm birth (OR 0.77; 95%CI 0.69 to 0.86).

The analysis of individual participant data from the control arms of RCTs (Rogozinska et al 2019) found that weight gain higher than recommendations was associated with increased odds of caesarean section (aOR 1.50; 95%CI 1.25 to 1.80), large-for-gestational-age babies (aOR 2.00; 95%CI 1.58 to 2.54), and reduced odds of small-for-gestational-age babies (aOR 0.66; 0.50 to 0.87). No significant effect on preterm birth was detected.

A meta-analysis of individual participant data (37 studies, 162,129 mothers and children) (Voerman et al 2019) found that, relative to the effect of maternal pre-pregnancy BMI, excessive gestational weight gain only slightly increased the risk of childhood overweight/obesity within each clinical BMI category (p-values for interactions of maternal BMI with gestational weight gain: $p=0.038$, $p<0.001$, and $p=0.637$ in early, mid, and late childhood, respectively).

Systematic reviews of cohort studies have found that:

- the risk of urinary incontinence increased with each 10 kg of weight gain (RR 1.34; 95%CI 1.11 to 1.62) (Aune et al 2019)
- weight gain exceeding recommendations may increase the risk of autism spectrum disorder (OR 1.23; 95%CI 1.09 to 1.38; $p=0.0008$) but more studies are needed to confirm this result (Tian et al 2019).

High weight gain in early pregnancy

A secondary analysis of an RCT ($n=7,895$) (Carreno et al 2012) found that among women who gained weight exceeding the IOM guidelines by week 15-18, 93% exceeded the recommended total gestational weight gain. In contrast, only 55% of women with early gestational weight gain within recommendations had total gestational weight gain higher than recommendations ($p<0.001$). Women with excessive early gestational weight gain had higher rates of gestational diabetes (OR 1.4; 95%CI 1.1 to 1.9), large-for-gestational-age babies (OR 1.4; 95%CI 1.2 to 1.6), and macrosomia $>4,000$ g (OR 1.5; 95%CI 1.3 to 1.8).

Outcomes among women from US/Europe and Asia

Weight gain lower than recommended was associated with preterm birth among women from the USA/Europe (OR 1.35; 95%CI 1.17 to 1.56) but not women from Asia (OR 1.06; 95%CI 0.78 to 1.44) (Goldstein et al 2018). It was associated with an increase in risk of small-for-gestational-age babies among women from both groups.

Weight gain higher than recommended was associated with large-for-gestational age babies, macrosomia and caesarean section among women from both groups.

Gestational weight gain among underweight women

A meta-analysis of individual participant data ($n=265,270$) (Santos et al 2019) found that among underweight women:

- low weight gain was associated with an increased risk of preterm birth and small for gestational age (both $p<0.001$) and a reduced risk of gestational hypertension ($p<0.05$) and large for gestational age ($p<0.001$)
- high weight gain was associated with a reduced risk of small for gestational age ($p<0.05$).

Gestational weight gain among women with healthy pre-pregnancy weight

In the meta-analysis of individual participant data ($n=265,270$) (Santos et al 2019), among women with healthy pre-pregnancy BMI:

- low weight gain was associated with an increased risk of preterm birth and small for gestational age and a reduced risk of large for gestational age (all $p<0.001$)
- high weight gain was associated with an increased risk of gestational diabetes, gestational hypertension, pre-eclampsia, preterm birth and large for gestational age and a reduced risk of small-for-gestational age (all $p<0.001$).

Gestational weight gain among overweight women

In the meta-analysis of individual participant data ($n=265,270$) (Santos et al 2019), among overweight women:

- low weight gain was associated with gestational diabetes, gestational hypertension, pre-eclampsia, small for gestational age (all $p<0.001$) and preterm birth ($p<0.05$)
- high weight gain was associated with gestational diabetes, gestational hypertension, pre-eclampsia, preterm birth and large for gestational age (all $p<0.001$).

Gestational weight gain among obese pregnant women

In the meta-analysis of individual participant data ($n=265,270$) (Santos et al 2019), among obese women both low and high weight gain were associated with increased risk of gestational diabetes, gestational hypertension, pre-eclampsia, preterm birth and large for gestational age (all $p<0.001$).

Weight gain lower than recommendations

A retrospective cohort study in the United States (n=12,000,000 birth records) (Thompson & Thompson 2019) found that weight gain lower than the IOM guidelines among obese women reduced the risk of gestational hypertension, eclampsia, induction of labour and Caesarean section but was also associated with increased risks for multiple adverse neonatal outcomes with macrosomia the exception.

A systematic review of cohort studies of obese pregnant women (18 cohort studies; 99,723 women) (Kapadia et al 2015b) found that weight gain *lower* than recommendations was associated with an increase in risk of:

- preterm birth (aOR 1.46; 95%CI 1.07 to 2.00)
- small-for-gestational-age babies (OR 1.24; 95%CI 1.13 to 1.36).

Weight gain lower than recommendations was associated with a lower likelihood of:

- large-for-gestational-age babies (aOR 0.77; 95%CI 0.73 to 0.81)
- macrosomia (aOR 0.64; 95%CI 0.54 to 0.77)
- gestational hypertension (aOR, 0.70; 95%CI 0.53 to 0.93)
- pre-eclampsia (aOR 0.90; 95%CI 0.82 to 0.99).
- caesarean section (aOR 0.87; 95%CI 0.82 to 0.92).

There was no difference in risk of gestational diabetes (aOR 1.15; 95%CI 0.91 to 1.45), low birthweight (aOR 1.08; 95%CI 0.76 to 1.54), Apgar score <7 at 5 minutes (aOR 0.92; 95%CI 0.67 to 1.27) or postpartum weight retention (MD -5.3 kg; 95%CI -9.0 to 1.17).

Weight loss

A systematic review of cohort studies (n=60,913) (Kapadia et al 2015c) found that, among women who were obese, gestational weight loss compared to weight gain within the guidelines:

- increased the risk of small-for-gestational-age babies (aOR 1.76; 95%CI 1.45 to 2.14; 2 studies) and low birthweight (aOR 1.68; 95%CI 1.10 to 2.57; 1 study)
- was associated with a lower likelihood of large for gestational age (aOR 0.57; 95%CI 0.52 to 0.62; 2 studies), macrosomia (aOR 0.58; 95%CI 0.38 to 0.89; 1 study) and caesarean section (aOR 0.73; 95%CI 0.67 to 0.80; 2 studies).

There was a possible reduction in risk of pre-eclampsia (aOR 0.82; 95%CI 0.66 to 1.02; 1 study) and no clear difference in risk of gestational diabetes (aOR 0.88; 95%CI 0.62 to 1.25; 1 study) or Apgar score <7 at 5 minutes (aOR 1.08; 95%CI 0.81 to 1.44; 2 studies). No studies reported on preterm birth.

Consensus-based recommendation

III. At every antenatal visit, offer women the opportunity to be weighed so that low or high gestational weight gain is identified and risk of associated adverse outcomes monitored.

2.3.3 Women's views on advice on weight gain during pregnancy

A systematic review of qualitative studies (Vanstone et al 2017) found that women are highly motivated to change their behaviour to improve fetal health but may not recognise the link between excess gestational weight gain and negative fetal health outcomes. Regular, clear, sensitive counselling geared to individual circumstances was frequently mentioned as a strong facilitator of healthy weight gain in pregnancy.

An Australian cross-sectional study (n=536) (Hill et al 2019) found that only half of pregnant women were aware of IOM recommendations on gestational weight gain.

Cross-sectional studies from overseas have found that:

- more than half (57%) of women reported that their healthcare provider talked to them about personal weight gain limits during pregnancy and a third of these women were counselled regularly; among those not counselled, over half (56%) reported that healthcare provider guidance would have been helpful to achieve their target weight (Weeks et al 2020)
- two-thirds (67%) of women received advice on gestational weight gain as part of antenatal care and women who reported following this advice had lower odds of weight gain exceeding recommendations (OR 0.18; 95%CI 0.03 to 0.91) (n=91) (Lopez-Cepero et al 2018)

- experiences of regular weighing were positive and participants believed it should be part of standard antenatal care, that there was a lack of information provided on gestational weight gain and healthy lifestyle in pregnancy, and that healthcare professionals are ideally placed to provide this advice (n=10) (Allen-Walker et al 2017).

2.3.4 Health professional's views on weight monitoring as part of pregnancy care

An Australian focus group that examined barriers and enablers to the regular weighing of women throughout pregnancy (n=44) (Hasted et al 2016) found that, while most health professionals supported regular weighing, various concerns were raised. These included access to resources and staff, the ability to provide appropriate counselling and evidence-based interventions, and the impact of weighing on women and the therapeutic relationship.

In an Australian study following introduction of a pregnancy weight gain chart (n=42) (de Jersey et al 2019), 63% of health professionals surveyed used the chart, 76% reported that they needed more training in counselling pregnant women about weight gain, and insufficient time was the main barrier to weighing and discussing weight gain with women.

An Australian cohort study found that recording of weight is improved by providing scales to clinics and staff training (18.9%) and medical record prompts (61.8%) (n=13,000 per cohort) (Wilkinson et al 2019).

A cohort study in the United States (n=733) (Lindberg & Anderson 2014) found that introduction of a "best practice alert" into an electronic medical record system improved the rate of gestational weight counselling (p<0.001), documented weight gain (p<0.001) and weight gain consistent with guidelines (p=0.003).

2.3.5 Recent evidence on regular weighing

A systematic literature review found no clear difference in weekly weight gain (MD -0.00 kg; 95%CI -0.03 to 0.02) or weight gain exceeding the IOM guidelines for women who were underweight (OR 1.50; 95%CI 0.14 to 16.54), in the healthy weight range (OR 0.72; 95%CI 0.48 to 1.09), overweight (OR 0.85; 95%CI 0.45 to 1.62) or obese (OR 1.60; 95%CI 0.72 to 3.54) (Fealy et al 2017). The interventions assessed in the two included studies (n=977) differed in that one involved regular weighing by a health professional (Brownfoot et al 2016a) and the other involved self-weighing (Jeffries et al 2009).

The systematic literature review conducted to inform these Guidelines (Ramson et al 2020) focused on weighing by a health professional and included three studies.

An Australian RCT (n=782) (Brownfoot et al 2016b; Brownfoot et al 2016a) addressed regular weighing at antenatal care visits plus advice on weight gain versus usual care. The study found no difference in weight gain, proportion of women gaining more weight than IOM recommended range or secondary outcomes (Brownfoot et al 2016a). Among a subset of women who provided feedback (n=586), 73% were comfortable with being weighed routinely (Brownfoot et al 2016b).

A pilot study in the United Kingdom (n=76) (Daley et al 2015) combined regular weighing by midwives and advice on weight gain with self-weighing between antenatal visits. Compared to usual care, there was no difference in the percentage of women gaining excessive weight during pregnancy or in mean depression and anxiety scores. Feedback in a subset of participants showed support for routine weighing among participants (9/12) and midwives (7/7). The same group then conducted a larger study of the intervention (n=656) (Daley et al 2019), which also found no clear difference in weight gain exceeding IOM guidelines, depression or anxiety.

When these three trials were pooled, there was no difference in weight gain exceeding guidelines (RR 1.01 95% CI 0.92 to 1.12; 3 RCTs; n=1,327; very low certainty) or mean weekly weight gain (MD 0.01 kg per week 95%CI -0.03 to 0.05; 2 RCTs; n=711; very low certainty). When the two United Kingdom studies were pooled, there was a small reduction in the risk of depression (MD -0.77; 95%CI -1.44 to -0.09; low certainty) and anxiety (MD -0.77; 95%CI -1.48 to -0.06; low certainty). There was no indication in the three trials that either excessive gestational weight gain or mean gestational weight gain differed in women in the healthy weight range at the beginning of pregnancy compared with women who were overweight or obese.

2.3.6 Preventing weight gain that exceeds recommendations

The literature review conducted to inform these Guidelines (Ramson et al 2020) analysed the results of randomised controlled trials that compared usual care to:

- *dietary intervention*: common themes in dietary advice provided included increasing consumption of fruit and vegetables, protein and fibre and reducing intake of saturated fats, carbohydrates and sugar (eg in soft drinks)
- *exercise intervention*: interventions mostly involved aerobic (treadmill, stationary cycling, walking, dance, circuit training, swimming) and muscle strengthening exercises (including pelvic floor exercises) for around 60 minutes, three times a week at an intensity of 60-80% of maximum heart rate or 12-14 on the Borg scale and continued to 36 to 39 weeks pregnancy
- *lifestyle counselling intervention*: most interventions involved counselling with a focus on gestational weight gain, diet and exercise with weight gain recommendations based on IOM guidelines and encouraged some form of self-monitoring (eg through weight gain charts, log books, pedometers).

Mean gestational weight gain was lower among women participating in a dietary intervention (MD -3.76 kg; 95%CI -6.38 to -1.13; 6 RCTs; n=1,432; very low certainty), exercise intervention (MD -0.95 kg; 95%CI -1.20 to -0.69; 29 RCTs; n=5,680; moderate certainty) or lifestyle counselling (MD -1.25 kg; 95%CI -1.64 to -0.86; 36 RCTs; n=9,083; low certainty). The risk of weight gain exceeding guidelines was also reduced by dietary intervention (RR 0.65; 95%CI 0.54 to 0.77; 4 RCTs; n=538; very low certainty), exercise intervention (RR 0.77; 95%CI 0.69 to 0.87; 16 RCTs; n=4,333; low certainty) and lifestyle counselling intervention (RR 0.83; 95%CI 0.78 to 0.89; 29 RCTs; n=7,905; low certainty). The risk of postnatal weight retention was reduced with lifestyle counselling (MD -1.19 kg; 95%CI -1.62 to -0.76; 11 RCTs; n=2,483; moderate certainty). There was no clear difference in postnatal weight retention with a dietary intervention (MD -0.55 kg; 95%CI -2.02 to 0.92; 2 RCTs; n=556; very low certainty) or exercise intervention (MD -0.20 kg; 95%CI -1.48 to 1.09; 5 RCTs; n=388; moderate certainty).

Risk of gestational diabetes was reduced by exercise interventions (RR 0.74; 95%CI 0.60 to 0.90; 20 RCTs; n=5,592; low certainty), probably reduced by lifestyle counselling (RR 0.90; 95%CI 0.81 to 1.01; 26 RCTs; n=9,011; moderate certainty) with no differences seen with dietary interventions (RR 0.86; 95%CI 0.64 to 1.17; 6 RCTs; n=1,424; very low certainty).

There was a reduction in risk of gestational hypertension with dietary intervention (RR 0.29; 95%CI 0.13 to 0.61; 3 RCTs; n=429; moderate certainty) or exercise intervention (RR 0.51; 95%CI 0.37 to 0.71; 7 RCTs; n=3,060; moderate certainty) but no difference was seen with lifestyle counselling (RR 0.99; 95%CI 0.77 to 1.28; 13 RCTs; n=4,890; low certainty). No difference in risk of pre-eclampsia was seen with any type of intervention (low to moderate certainty).

Risk of caesarean section was reduced with exercise intervention (RR 0.85; 95%CI 0.74 to 0.98; 25 RCTs; n=5,704; moderate certainty) and probably reduced with lifestyle counselling (RR 0.95; 95%CI 0.89 to 1.02; 25 RCTs; n=9,049; low certainty). There was no difference in risk of caesarean section with a dietary intervention (RR 0.85; 95%CI 0.64 to 1.11; 6 RCTs; n=1,461; very low certainty).

The risk of antenatal depression was reduced with exercise intervention (RR 0.44; 95%CI 0.32 to 0.61; 6 RCTs; n=798; moderate certainty) but not lifestyle counselling (RR 0.99; 95%CI 0.80 to 1.22; 2 RCTs; n=2,908; low certainty). The risk of postnatal depression was reduced with exercise intervention (RR 0.47; 95%CI 0.34 to 0.65; 5 RCTs; n=1,613; moderate certainty).

The risk of preterm birth was reduced with a dietary intervention (RR 0.43; 95%CI 0.24 to 0.79; 4 RCTs; n=1,296; moderate certainty), probably reduced with lifestyle counselling (RR 0.85; 95%CI 0.72 to 1.01; 18 RCTs; n=7,497; moderate certainty) but not changed by exercise intervention (RR 0.95; 95%CI 0.74 to 1.22; 15 RCTs; n=4,388; moderate certainty).

There was no difference in risk of macrosomia >4,000g with dietary intervention (RR 0.97; 95%CI 0.84 to 1.11; 3 RCTs; n=1,138; very low certainty) but there was a reduction with exercise intervention (RR 0.75; 95%CI 0.59 to 0.96; 15 RCTs; n=4,759; moderate certainty) and a probable reduction with lifestyle counselling (RR 0.91; 95%CI 0.82 to 1.01; 17 RCTs; n=7,664; low certainty). There was also a reduction of risk of macrosomia >4,500 g with lifestyle counselling (RR 0.67; 95%CI 0.46 to 0.97; 5 RCTs; n=3,435; moderate certainty). There was no difference seen in risk of low birthweight with an exercise intervention (RR 0.94; 95%CI 0.68 to 1.28; 11 RCTs; n=3,247; moderate certainty) or lifestyle counselling (RR 0.87; 95%CI 0.65 to 1.17; 4 RCTs; n=3,665; low certainty). There was a possible reduction in risk of large-for-gestational age with lifestyle counselling (RR 0.89; 95%CI 0.79 to 1.00; 22 RCTs; n=8,455; moderate certainty) but no clear difference in risk with the other interventions.

There was no clear difference in risk of small-for-gestational age, Apgar score <7 at 5 minutes or weight in early childhood with any intervention.

A systematic review that assessed cost-effectiveness analyses of lifestyle counselling interventions compared with usual care found that results were inconsistent and further research is required to determine the effective components of lifestyle interventions (Bailey et al 2020). Cost-effectiveness studies from overseas found that lifestyle interventions were cost-effective for gestational weight gain (Broekhuizen et al 2018) but not blood glucose levels, insulin resistance (Oostdam et al 2012; Broekhuizen et al 2018) or infant weight (Oostdam et al 2012), were inconsistent regarding quality-adjusted life years (Oostdam et al 2012; Broekhuizen et al 2018) and a better understanding of the short- and long-term costs of large for gestational age and weight gain exceeding IOM recommendations is necessary (O'Sullivan et al 2020).

Evidence-based recommendation

8 At every antenatal visit, give women tailored advice on weight gain, including the benefits of a healthy diet, regular physical activity and self-monitoring.

Practice point

B. Adopting a respectful, positive and supportive approach and providing information about healthy eating and physical activity in an appropriate format may assist discussion of weight management. This should be informed by appropriate education for health professionals.

Nutrition and physical activity in pregnancy are discussed in Chapter 11.

2.3.7 Other considerations include

- The potential for sub-optimal visualisation on ultrasound for women with elevated BMI (delaying the ultrasound until 20 to 22 weeks pregnancy for women with BMI ≥ 30 may provide better results but needs to be balanced against the possibility of a delayed diagnosis of structural anomalies) (SOGC 2010).
- Antenatal consultation with an obstetric anaesthetist to identify any potential difficulties with venous access, regional or general anaesthesia for women with a BMI ≥ 40 .
- For women with a high BMI, ongoing nutritional advice following childbirth from an appropriate health professional, with a view to weight reduction and maintenance.

2.4 Practice summary: measuring weight and BMI

When: At all antenatal visits

Who: Midwife; GP; obstetrician; Aboriginal and Torres Strait Islander health worker; multicultural health worker

- Explain the purpose of assessing weight and weight gain during pregnancy:** For women with a BMI outside the healthy range, discuss the risks associated with a woman's weight being below or above the healthy range before, during pregnancy and in between pregnancies.
 - Engage women in discussions about weight gain:** Offer women the opportunity to be weighed and to discuss their weight gain since the last antenatal visit. Use the IOM recommendations to give women advice about the risks of inadequate or excessive weight gain. Provide advice on nutrition and exercise based on the Australian dietary and physical activity guidelines and encourage self-monitoring.
 - Take a holistic approach:** Provide women with culturally appropriate advice on the benefits of a healthy diet and regular physical activity.
 - Consider referral:** Women who are gaining weight at a rate below or above recommendations for gestational weight gain may benefit from referral for nutrition and lifestyle advice (eg from an accredited practising dietitian).
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2.5 Resources

2.5.1 Health professionals

- CMACE & RCOG (2010) *CMACE & RCOG Joint Guideline. Management of Women with Obesity in Pregnancy*. London: Centre for Maternal and Child Enquiries & Royal College of Obstetricians and Gynaecologists.
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2.5.2 Women and families

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APPENDICES

A Membership and terms of reference of the Expert Working Group

Membership

Expert Working Group Members	Discipline/expertise/special Interest	Position and organisation	Location
<i>Co-chairs</i>			
Professor Jeremy Oats	Obstetrics & Gynaecology	Obstetrics and gynaecology specialist Professorial Fellow Melbourne School of Population & Global Health, University of Melbourne	VIC
Professor Caroline Homer AO	Midwifery	Co-Director Maternal and Child Health Program, Burnet Institute Distinguished Professor of Midwifery, University of Technology Sydney	VIC
<i>Members</i>			
Associate Professor Martin Byrne	GP Obstetrics	RACGP	QLD
Ms Ann Catchlove (Jorgensen)		Consumer representative	VIC
Dr Marilyn Clarke	Aboriginal and Torres Strait Islander representative	Obstetrics and gynaecology specialist, Grafton and Coffs Harbour	NSW
Ms Leah Hardiman		Consumer representative	QLD
Ms Tracy Martin	Midwifery	Midwifery Director Statewide Obstetric Support Unit, Women and Newborn Health Service, WA Department of Health	WA
Adjunct Professor Sue McDonald	Midwifery, Perinatal Health	Professor of Midwifery, La Trobe University	VIC
Associate Professor Philippa Middleton	Perinatal Epidemiology	Principal Research Fellow, Women and Kids, SA Health and Medical Research Institute/The University of Adelaide	SA
Ms Natalija Nesvadba	Migrant and refugee women representative	Manager, Multicultural Services, Mercy Health	VIC
Professor Michael Permezel	Obstetrics & Gynaecology	RANZCOG (former RANZCOG President)	VIC
Ms Alecia Staines	Consumer representative	Director, Maternity Consumer Network	QLD
Ms Cindy Turner	Midwifery	Australian College of Midwives	NT

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Ms Samantha Diplock Assistant Director, Maternity Policy Team, Chronic Disease Management Section,
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Terms of reference

The Expert Working Group will oversee the review and revision of the National Evidence-based Clinical Practice Guidelines – Antenatal Care (incorporating both Modules I and II of the Guidelines). The role of the Expert Working Group will include:

- providing advice, expertise and direction in relation to the combining of the two modules, and the review of the Guidelines to promote optimal care for pregnant women across Australia;
- reviewing the existing Guidelines to identify topics and guidelines that require updating;
- advising on the review of national and international literature on antenatal care to inform amendments required to the existing Guidelines;
- identifying any new topics and drafting new evidence-based guidelines for inclusion in the Guidelines;
- developing a plan and strategies to promote and disseminate the finalised Guidelines to ensure clinical uptake of the Guidelines;
- advising on the development of a consultation strategy (in the event that the review results in major changes to the existing Guidelines or the inclusion of new guidelines); and
- ensuring the review is conducted in accordance with the National Health and Medical Research Council's (NHMRC) protocols and submitted to the NHMRC for approval.

B Administrative report

B1 Scope and purpose

Objective

Health intents

The Guidelines aim to improve the health and wellbeing of both mothers and babies, and ensure women consistently receive high quality, evidence-based pregnancy care.

Expected benefits/outcomes

It is expected that implementation of the Guidelines will improve maternal, fetal, newborn and family outcomes in the short and longer terms.

Target population

The Guidelines cover the antenatal care of healthy pregnant women (ie women who do not have identified pre-existing conditions and are not at higher risk of complications such as in multiple pregnancy).

Questions

Identification of topics for review

The topics for review were identified by the Expert Working Group (EWG) established to guide the review. Members identified twelve topics (nutrition, nutritional supplements and physical activity, weight and body mass index, anaemia, diabetes, syphilis, chlamydia, cytomegalovirus, group B streptococcus, cervical abnormalities and prolonged pregnancy) from the pregnancy care guidelines as high priorities for review as it was more than 5 years since the previous review. Members also agreed that four new topics (cervical length measurement to predict preterm birth, ultrasound assessment for women who have cell-free DNA testing for chromosomal anomalies, vaccines and genetic carrier screening) should be examined. These topics were selected to provide evidence-based advice on emerging practices. The list of proposed review topics and research questions was then sent to three key professional colleges (Australian College of Midwives, Royal Australian and New Zealand College of Obstetricians and Gynaecologists and Royal Australian College of General Practitioners) for comment. The Colleges agreed with the proposed topics and questions.

Chapters on syphilis, chlamydia, cytomegalovirus and prolonged pregnancy were revised and approved by the NHRMC in October 2017 as were new sections on cervical length measurement and progesterone treatment for inclusion in the chapter on preterm birth.

This document includes revised chapters on nutrition and physical activity and on weight and body mass index. The remaining topics remain under review (see Appendix D).

Research questions

For topics already included in the Guidelines, the original research questions were used, with some additional questions developed by the EWG to capture evidence on emerging practices. Questions for new topics were developed by the EWG. All questions were reviewed by three professional colleges (Australian College of Midwives, Royal Australian and New Zealand College of Obstetricians and Gynaecologists and Royal Australian College of General Practitioners).

Research questions for each topic are included in Appendix C.

Population

As noted above, the Guidelines cover the antenatal care of healthy pregnant women (ie women who do not have identified pre-existing conditions and are not at higher risk of complications such as in multiple pregnancy).

B2 Stakeholder involvement

Group membership

In establishing the EWG for this review, the Department of Health approached the Australian College of Midwives (ACM) and the Royal Australian and New Zealand College of Obstetricians and Gynaecologists (RANZCOG) and invited them to nominate representatives to be on the EWG. The Chief Nursing and Midwifery

Officer and the Chair of the Maternity Services Inter-Jurisdictional Committee (which concluded in June 2016) were also included in the EWG, along with the consumer representative and methodologist who had been involved in the development of earlier reviews. Where possible, it was considered desirable to include EWG members involved in earlier stages of the development of the Guidelines on the EWG as this would provide continuity to the project. A range of academics and practitioners working in obstetrics and midwifery who were previously involved in the project were therefore contacted and accepted invitations to be on the EWG. An additional consumer representative was also included.

A list of the EWG members and the Terms of Reference for the EWG is included in Appendix A.

Target population preferences and views

Capturing consumer perspectives

A two-pronged strategy was used to capture the perspectives of consumers, including ensuring consumer representation on the EWG and inviting comment through public consultation.

- The establishment of the EWG with dedicated consumer representation was considered fundamental to the inclusion of consumer perspectives in the development of the Guidelines.
- Further perspectives of consumers will be gathered through the consultation process.

Capturing perspectives of specific population groups

A three-pronged strategy was used to capture the perspectives of specific population groups.

- Aboriginal and Torres Strait Islander women and migrant and refugee women were represented on the EWG. These representatives had been involved in development of previous versions of the Guidelines as members of the Working Group for Aboriginal and Torres Strait Islander Women's Antenatal Care and the Working Group for Migrant and Refugee Women's Antenatal Care, respectively.
- The review of the literature for all topics included a research question on additional considerations for Aboriginal and Torres Strait Islander women. Specific searches of Australian Indigenous Healthinfonet were conducted for each topic. This resource is a bulletin rather than a database so each relevant topic was scanned rather than searching specific terms (as this would likely have missed relevant material). A research question on additional considerations for migrant and refugee women was included.
- Where available, epidemiological information was included describing differences in risks and outcomes between:
 - Aboriginal and Torres Strait Islander women and non-Indigenous women
 - women born overseas and those born in Australia
 - women of different socioeconomic status
 - women living in different geographical regions (eg rural and remote vs metropolitan and/or by jurisdiction).

Target users

The Guidelines are intended for all health professionals who contribute to antenatal care, including midwives, general practitioners (GPs), obstetricians, maternal and child health nurses,³ Aboriginal and Torres Strait Islander health practitioners; Aboriginal and Torres Strait Islander health workers, multicultural health workers, practice nurses, allied health professionals, childbirth and parenting educators and sonographers. The way in which different professionals use these Guidelines will vary depending on their knowledge, skills and role, as well as the setting in which care is provided.

These Guidelines will be of interest and relevance to pregnant women in Australia. In addition, it is expected that policy makers will be able to draw on the Guidelines in the development of policy and delivery of health services.

³ Also referred to as child and family health nurses in some jurisdictions.

B3 Rigour of development

Search methods

Searches were conducted in Pubmed, Ovid, EMBASE, PsychInfo, Scopus, Informit, CINAHL, the Cochrane Database of Systematic Reviews and Australian Indigenous HealthInfoNet. Search terms were searched for as keywords, exploded where possible, and as free text within the title and/or abstract, in the EMBASE and Medline databases, with modifications to suit the keywords and descriptors of other search platforms. The reference lists of included papers were reviewed to identify any peer-reviewed evidence that may have been missed in the literature search.

Titles and abstracts of identified studies were screened by two methodologists (PM and AB) and full text articles were reviewed by a third methodologist (JR).

Time periods searched varied for each research question, depending on when previous reviews were conducted. Time periods searched for each topic are included in Appendix C.

Full search strategies and search terms are included in the Technical Report, which will be available from the NHMRC and Department of Health websites following approval of the new guideline topics by the NHMRC.

Evidence selection criteria

Inclusion criteria applied to studies were:

- specific to healthy pregnant women (ie women who do not have identified pre-existing conditions and are not at higher risk of complications such as in multiple pregnancy)
- specific to the antenatal care setting
- in English.

Due to the size of the body of evidence, some searches were limited to systematic reviews and randomised controlled trials.

Exclusion criteria applied to studies were:

- narrative review or opinion paper (editorial, letter, summary, comment, interview) or background information (eg guidelines, statements not based on systematic review)
- not specific to target population (eg specific to non-pregnant women or high-risk women) or care setting (eg not specific to antenatal care)
- wrong intervention
- wrong study design
- wrong outcomes
- wrong comparator
- systematic literature review with all studies included in another systematic review
- included in high quality systematic review
- does not answer research question
- duplicate.

Strengths and limitations of the evidence

The evaluation of the strengths and limitations of the evidence used GRADE and other methods for critical analysis of the literature, with the aim of providing a robust assessment of the relevance and quality of the evidence that met the requirements of the *Procedures and Requirements for Meeting the 2011 NHMRC Standard for clinical practice guidelines* (2011) (NHMRC 2011).

Data extraction

Data extraction tables were created for each research question and listed the study design; sample size; aim/population/methods/outcomes reported; result and limitations (as assessed using adapted NHMRC criteria for quality assessment of systematic reviews [see Table B.2] and GRADE criteria for quality assessment of randomised controlled trials and observational studies [see Table B.3]).

Table B.1: Assessment of quality of systematic literature reviews

Considerations in assessing quality of systematic reviews
Questions and methods clearly stated
Search procedure sufficiently rigorous to identify all relevant studies
Review includes all the potential benefits and harms of the intervention
Review only includes randomised controlled trials
Methodological quality of primary studies assessed
Data summarised to give a point estimate of effect and confidence intervals
Differences in individual study results are adequately explained
Examination of which study population characteristics (disease subtypes, age/sex groups) determine the magnitude of effect of the intervention is included
Reviewers' conclusions are supported by data cited
Sources of heterogeneity are explored

Source: Adapted from (NHMRC 2000b; NHMRC 2000a; SIGN 2004).

Table B.2: Assessment of limitations of randomised controlled trials

Study limitation	Explanation
Lack of allocation concealment	Those enrolling patients are aware of the group (or period in a crossover trial) to which the next enrolled patient will be allocated (a major problem in "pseudo" or "quasi" randomised trials with allocation by day of week, birth date, chart number, etc.).
Lack of blinding	Patient, caregivers, those recording outcomes, those adjudicating outcomes, or data analysts are aware of the arm to which patients are allocated (or the medication currently being received in a crossover trial).
Incomplete accounting of patients and outcome events	Loss to follow-up and failure to adhere to the intention-to-treat principle in superiority trials; or in noninferiority trials, loss to follow-up, and failure to conduct both analyses considering only those who adhered to treatment, and all patients for whom outcome data are available. The significance of particular rates of loss to follow-up, however, varies widely and is dependent on the relation between loss to follow-up and number of events. The higher the proportion lost to follow-up in relation to intervention and control group event rates, and differences between intervention and control groups, the greater the threat of bias.
Selective outcome reporting	Incomplete or absent reporting of some outcomes and not others on the basis of the results.
Other limitations	Stopping trial early for benefit. Substantial overestimates are likely in trials with fewer than 500 events and large overestimates are likely in trials with fewer than 200 events. Empirical evidence suggests that formal stopping rules do not reduce this bias. Use of unvalidated outcome measures (e.g. patient-reported outcomes) Carryover effects in crossover trial Recruitment bias in cluster-randomised trials

Source: (Schünemann et al 2013).

Table B.3: Assessment of limitations of observational studies

Study limitation	Explanation
Failure to develop and apply appropriate eligibility criteria (inclusion of control population)	Under- or over-matching in case-control studies Selection of exposed and unexposed in cohort studies from different populations
Flawed measurement of both exposure and outcome	Differences in measurement of exposure (e.g. recall bias in case-control studies) Differential surveillance for outcome in exposed and unexposed in cohort studies
Failure to adequately control confounding	Failure of accurate measurement of all known prognostic factors Failure to match for prognostic factors and/or adjustment in statistical analysis
Incomplete or inadequately short follow-up	Especially within prospective cohort studies, both groups should be followed for the same amount of time.

Source: (Schünemann et al 2013).

Selection of outcomes for GRADE analysis

The methodologists identified outcomes reported in the evidence for each topic. These were then reviewed and agreed upon by the Co-chairs and the EWG.

Assessing the evidence

For many research questions, the evidence was observational and heterogeneous and did not allow meta-analysis. For these questions, findings were tabulated and summarised in the text of the reviews and, in some cases, consensus-based recommendations were developed.

For research questions where comparable outcomes were reported, these were pooled using Revman 5 and the pooled results transferred to GRADE evidence tables, which take into account the risk of bias (the degree to which included studies have a high likelihood of protection against bias), inconsistency (the degree to which included studies find the same direction or magnitude of effect), imprecision (the confidence in the estimates of effect), indirectness (degree to which the evidence can be linked to important health outcomes) and the potential for publication bias (degree to which non-reporting or selective analysis of results may influence interpretation of study results). The evidence tables provided a basis for development of GRADE Summary of Findings tables, which give anticipated absolute effects (usually in terms of numbers per 1,000) and relative risk, and provide a summation of the quality of the evidence. Evidence summaries were also developed based on the Summary of Findings tables to facilitate understanding of the implications of the evidence. The evidence-based recommendations developed were worded and graded based on this summation.

Synthesising the evidence

A summary of the evidence was developed for each research question for which studies were identified. This noted the study designs included (ie whether searches were limited to systematic reviews, RCTs or included observational studies) and the quality of the studies that contributed to the body of evidence and listed the studies of greatest relevance.

Formulation of recommendations

The methodologists engaged to conduct the review searched the literature, evaluated the evidence and developed Technical Reports for each topic. The technical writer then revised or drafted a chapter based on the evidence. Each Technical Report and associated draft chapter was then reviewed by the Co-Chairs and draft recommendations and practice points were developed in consultation with the methodologists. Documents were then circulated for comment from the EWG by email and comments collated by the Department.

The EWG was guided by the methodologists and technical writer in the approach to evaluating the evidence and developing recommendations (ie wording was to be in plain English, specific, unambiguous, clearly describe the action/s to be taken by users and match the strength of the body of evidence). An iterative approach was taken to finalising the wording.

Consensus-based recommendations and practice points were also agreed using the same process.

Recommendations and practice points will be further refined to incorporate feedback from health professionals and consumers through the public consultation process.

Grading recommendations

Grading of recommendations was conducted by the EWG with advice from the methodologists. Grades were based on the GRADE summation of the evidence and key factors influencing the direction and strength of a recommendation as outlined below.

Table B.4: Domains that contribute to the strength of a recommendation

Domain	Comment
Balance between desirable and undesirable outcomes (trade-offs) taking into account: <ul style="list-style-type: none"> • best estimates of the magnitude of effects on desirable and undesirable outcomes • importance of outcomes (estimated typical values and preferences) 	The larger the differences between the desirable and undesirable consequences, the more likely a strong recommendation is warranted. The smaller the net benefit and the lower certainty for that benefit, the more likely a qualified recommendation is warranted
Confidence in the magnitude of estimates of effect of the interventions on important outcomes (overall quality of evidence for outcomes)	The higher the quality of evidence, the more likely a strong recommendation is warranted
Confidence in values and preferences and their variability	The greater the variability in values and preferences, or uncertainty about typical values and preferences, the more likely a qualified recommendation is warranted
Resource use	The higher the costs of an intervention (the more resources consumed), the less likely a strong recommendation is warranted

The GRADE method supports two types of evidence-based recommendation – ‘strong’ and ‘weak’. The EWG agreed that preferable terminology was ‘recommendation’ and ‘qualified recommendation’, using the following definitions:

- *Recommendation* – implies that most/all individuals will be best served by the recommended course of action; used when confident that desirable effects clearly outweigh undesirable effects; used when confident that undesirable effects clearly outweigh desirable effects
- *Qualified recommendation* – implies that not all individuals will be best served by the recommended course of action; used when desirable effects probably outweigh undesirable effects; used when undesirable effects probably outweigh desirable effects.

Note that no new recommendations were graded as ‘qualified’. The principles applied in wording recommendations are outlined in Section B4.

Consideration of harms and benefits

The topics under review related to assessing risk or information provision rather than intervention. The harms of not assessing/testing/providing information and the health benefits of doing so are outlined in Appendix C. These are based on information provided in the body of the Guidelines.

Link between evidence and recommendations

See Appendix C.

External review

[AGREE appraisal](#)

The Guidelines and associated technical reports will be assessed against the AGREE II instrument by two independent reviewers. Following review, any changes suggested will be made to the Guidelines and summarised in this appendix.

[Independent peer review](#)

Peer review will be sought from two clinicians with expertise in antenatal care. Following review, any changes suggested will be made to the Guidelines and summarised in this appendix.

[Independent methodological review](#)

Independent methodological review will be sought to assess whether the Guidelines meets the NHMRC Standards for Clinical Practice Guidelines. Following review, any changes suggested will be made to the Guidelines and summarised in this appendix.

Updating procedures

Due to the number of topics considered in the Guidelines, the EWG has prioritised topics for future reviews, which will be conducted sequentially. The reviews will be conducted using the same methodology as employed in the current review. It is anticipated that the online version of the Guidelines will be updated as revised or new chapters are developed and that all topics will be reviewed within 5 years of publication.

B4 Clarity of presentation

Specific and unambiguous recommendations

The evidence-based and consensus-based recommendations were worded based on the following principles:

- recommendations are succinct and action-oriented
- the action recommended is clearly articulated and matches the strength of the body of evidence
- women to whom the recommendation relates are identified
- where relevant, timing of the action is included.

Management options

The Guidelines clearly state that information on management is beyond their scope and external resources providing guidance on management are listed for most topics.

Identifiable key recommendations

The evidence-based recommendations and consensus-based recommendations are clearly identified by colour coding and use of separate numbering systems. A summary of recommendations is included.

B5 Applicability

Facilitators and barriers

The broad membership of the EWG means that it is well-placed to identify barriers to implementation of the recommendations across a range of antenatal care settings. Potential barriers to implementation include:

- time required for providing women with additional information
- preferences for existing practices.

While potential barriers were considered, the final recommendations were based on the evidence for the optimal outcomes for women and babies.

The early involvement of key stakeholder organisations (eg RANZCOG and ACM) in the development process will facilitate uptake of the recommendations by their respective memberships.

The implications of implementing each recommendation are included in Appendix C.

Implementation advice/tools

For each topic in these Guidelines, a practice summary is provided, which outlines practical information on when to act, who should act and how to implement the advice provided. A list of resources (including information on management) is also provided. Each chapter lists specific topics to be discussed with women.

The new Guideline chapters will be incorporated into the online version of the Guidelines, which is available in a mobile-device friendly version.

Resource implications

The reviews identified some studies that reported on cost-effectiveness.

- *Calcium supplementation:* There is some evidence from the Netherlands that routine calcium supplementation in pregnancy is more cost-effective than selective supplementation.
- *Lifestyle counselling to prevent weight gain exceeding recommendations:* A systematic review that assessed cost-effectiveness analyses of lifestyle counselling interventions compared with usual care found that results were inconsistent and further research is required to determine the effective components of lifestyle interventions. Cost-effectiveness studies from overseas found that lifestyle interventions were cost-effective for gestational weight gain but not blood glucose levels, insulin resistance or infant weight, were inconsistent regarding quality-adjusted life years and a better understanding of the short- and long-term costs of large for gestational age and weight gain exceeding IOM recommendations is necessary.

These findings were reported in the Guidelines but did not influence the recommendations, which are based on the evidence for the optimal outcomes for women and babies.

Monitoring/auditing criteria

A process for evaluating uptake of the Guidelines is under development.

B6 Editorial independence

Funding body

The Australian Government Department of Health funded the updating of these guidelines. The Australian Government Department of Health also provided project management and secretariat services to support the review.

The content of the Guidelines was not influenced by the funding body.

Competing interests

At the outset of the Guideline development process, all representatives were informed of the importance of managing competing interests and ensuring that any potential conflicts of interest were identified in advance of any meeting (as evidenced in meeting minutes). Competing interests were considered to include authorship of evidence supporting proposed recommendations and financial interest in a company potentially profiting from a recommendation (eg producers of a specific screening test).

Processes put in place to manage any potential competing interests were as follows.

- All EWG members were required to complete a Declaration of Interest Form (as per the NHMRC requirements). These signed and scanned forms were reviewed and held by the Department.
- At the beginning of each meeting, EWG members were informed of the arising agenda items and asked to declare any potential competing interests. When competing interests were identified, the EWG member was asked to leave the room while the evidence was discussed.
- Any arising competing interests and strategies for managing these (if required) were adjudicated by the Co-Chairs and documented in meeting minutes. A competing interest held by a Co-Chair was managed by the other Co-Chair and the area of conflict clearly stated.

Table B.6: Expert Working Group competing interests

Name	Competing interest
Professor Caroline Homer	Nil
Professor Jeremy Oats	Nil
Dr Martin Byrne	Nil
Dr Marilyn Clarke	Nil
Ms Leah Hardiman	Nil
Ms Tracy Martin	Nil
Professor Sue McDonald	Nil
Associate Prof Philippa Middleton	Lead author of a Cochrane review of omega-3 fatty acid supplementation during pregnancy Co-author of Cochrane reviews of dietary interventions for preventing gestational diabetes, combined diet and exercise interventions for preventing gestational diabetes, exercise for preventing gestational diabetes and zinc supplementation for improving pregnancy and infant outcomes
Ms Natalija Nesvadba	Nil
Professor Michael Permezel	Nil
Ms Alecia Staines	Nil
Ms Cindy Turner	Nil

B7 Consultation

Public consultation

The draft guidelines were released for a 52-day public consultation. While a 30-day consultation is required in Section 14A of the *NHMRC Act 1992* and accompanying regulations, it was agreed to hold a longer consultation period due to the COVID-19 pandemic, which may affect the ability of some individuals to provide a submission. The public consultation began on 2 June 2020 and will formally end on 17 July 2020.

Key stakeholders were contacted via email and directed to the Department of Health Consultation Hub where papers could be accessed. Stakeholders were also asked to forward the information to other contacts who may be interested. The Department of Health also promoted the public consultation process via their Facebook posts and the Department's webpage hosting the guidelines.

Following public consultation, submissions will be combined into a single report and considered by the EWG. The Guidelines will be revised to incorporate comments and a summary of changes made will be included in this appendix.

B8 Dissemination and implementation

Dissemination

Following NHMRC approval of the new recommendations, the revised chapters will be incorporated into the Guidelines. The Guidelines are available online, including in a mobile-device friendly version. The Guidelines are also listed on the [NHMRC portal](#) and accessible by searching the portal.

Promotion

A number of activities were undertaken to promote the release of the previous review of the pregnancy care guidelines. It is anticipated that similar activities will be undertaken following approval of the recommendations in this review by the NHMRC. These activities include:

- Guidelines launch by the Minister for Health
- email notification about the release of the review to stakeholders
- development of summary sheets for health professionals and women
- promotion on social media
- presentations delivered by EWG members at relevant conferences and media opportunities
- summary article published in the *Medical Journal of Australia* highlighting changes in practice resulting from the revised recommendations
- inviting relevant stakeholders to provide a link or web icon to the Guidelines on their websites
- distribution of a general article for inclusion in newsletters of relevant organisations.

Implementation

The EWG considered methods of providing supporting materials related to the Guidelines. Development of summary documents for health professionals and consumers (which will be available from the Department of health's website) are among the strategies being considered. Discussions with the key professional colleges and funding will inform decisions relating to implementation.

C Summary of the literature reviews

This section includes research questions, search dates, evidence summaries and implications for implementation of recommendations. The search terms, full search strategies, evidence tables and GRADE summaries of the evidence are included in the Technical Reports, which will be available from the NHMRC and Department of Health websites when the guideline chapters have been approved.

Research questions

Nutrition advice	
Q1	What dietary advice should be provided to women in pregnancy, including population-specific groups?
Q2	Which foods should be promoted and which avoided during pregnancy?
Q3	What are the harms and benefits of vitamin and mineral supplementation in pregnancy?
Q4	What are the harms and benefits of nutritionally based complementary medicines in pregnancy?
Physical activity advice	
Q5	What are the harms and benefits of physical activity during pregnancy?
Q6	What physical activities are associated with adverse maternal and perinatal outcomes?
Weight assessment	
Q7	When should maternal weight and height be measured and BMI calculated in pregnant women?
Q8	What specific risk assessments are required for pregnant women with high or low BMI at the first antenatal visit?
Interventions	
Q9	What lifestyle interventions are effective in preventing excessive weight gain and other adverse outcomes in pregnant women?
Additional considerations	
Q10	What are the additional considerations for Aboriginal and Torres Strait Islander women?
Q11	What are the additional considerations for migrant and refugee women?

Table C1: Mapping of searches to research questions and type of review

Question	Search	Types of studies included	Review type
Question 1	Diet and pregnancy	Systematic reviews, RCTs, observational studies	Narrative review
Question 2	Diet and pregnancy	Systematic reviews, RCTs, observational studies	Narrative review
Question 3	Folic acid	Systematic reviews, RCTs, Australian observational studies	Narrative review
	B vitamins	Systematic reviews, RCTs, Australian observational studies	Narrative review
	Vitamin C	Systematic reviews, RCTs, Australian observational studies	Narrative review
	Vitamin E	Systematic reviews, RCTs, Australian observational studies	Narrative review
	Vitamin A	Systematic reviews, RCTs, Australian observational studies	Narrative review
	Multiple micronutrients	Systematic reviews, RCTs, Australian observational studies	Narrative review
	Iron	Systematic reviews, RCTs, Australian observational studies	Narrative review
	Calcium	Systematic reviews, RCTs, Australian observational studies	Narrative review
	Iodine	Systematic reviews, RCTs, Australian observational studies	Narrative review
	Zinc	Systematic reviews, RCTs, Australian observational studies	Narrative review
	Magnesium	Systematic reviews, RCTs, Australian observational studies	Narrative review

Question	Search	Types of studies included	Review type
	Selenium	Systematic reviews, RCTs, Australian observational studies	Narrative review
Question 4	Omega-3 fatty acids	Recent Cochrane review	Summary of Cochrane review
	Herbal preparations	Systematic reviews, RCTs, observational studies	Narrative review
	Probiotics	Systematic reviews of RCTs, RCTs	Meta-analysis
Question 5	Physical activity and pregnancy	Systematic reviews, RCTs, observational studies	Narrative review
Question 6	Physical activity and pregnancy	Systematic reviews, RCTs, observational studies	Narrative review
Question 7	Gestational weight gain	Determinants of gestational weight gain; women's and health professionals' views on gestational weight gain: Systematic reviews, observational studies Risks associated with low or high gestational weight gain: Systematic reviews, RCTs	Narrative review
	Weight monitoring	Systematic reviews of RCTs, RCTs	Meta-analysis
Question 8	Risk assessments	Systematic reviews of RCTs, RCTs	Narrative review
Question 9	Diet and pregnancy	Systematic reviews of RCTs, RCTs	Meta-analysis
	Physical activity and pregnancy		
Question 10	All searches	All identified studies relevant to Australian context	Narrative review
Question 11			

PICO criteria for inclusion of studies in meta-analyses

Probiotics

Population	Intervention	Comparator	Outcomes	Study designs
Pregnant women who are apparently healthy in early pregnancy	Probiotic supplement	Placebo or usual care	Health or clinical outcomes, including longer term outcomes for the mother and child	RCTs Systematic reviews of RCTs

Weight assessment

Population	Intervention	Comparator	Outcomes	Study designs
Pregnant women who are apparently healthy in early pregnancy	Regular weighing as part of antenatal care plus advice on weight gain	Usual care	Health or clinical outcomes, including longer term outcomes for the mother and child	RCTs Systematic reviews of RCTs

Interventions to prevent gestational weight gain

Population	Intervention	Comparator	Outcomes	Study designs
Pregnant women who are apparently healthy in early pregnancy	Intervention related to changes in diet	Usual care	Health or clinical outcomes, including longer term outcomes for the mother and child	RCTs Systematic reviews of RCTs
	Intervention to increase physical activity			
	Combined intervention with dietary and physical activity components			

Selection of outcomes for GRADE analysis

Table C2: Outcomes for meta-analysis of evidence on probiotics

Outcome – Maternal	Importance	Inclusion
Gestational diabetes	9	<input checked="" type="checkbox"/>
Gestational hypertension	9	<input checked="" type="checkbox"/>
Pre-eclampsia	5	<input checked="" type="checkbox"/>
Bacterial vaginosis	5	<input checked="" type="checkbox"/>
Group B streptococcus	7	<input checked="" type="checkbox"/>
Caesarean section	9	<input checked="" type="checkbox"/>
Outcome – Infant	Importance	Inclusion
Perinatal death	9	<input checked="" type="checkbox"/>
Preterm birth	9	<input checked="" type="checkbox"/>
Small for gestational age	9	<input checked="" type="checkbox"/>
Large for gestational age	9	<input checked="" type="checkbox"/>
Macrosomia	9	<input checked="" type="checkbox"/>

Table C3: Outcomes for meta-analysis of evidence on weight monitoring

Outcome – Maternal	Importance	Inclusion
Excess gestational weight gain	5	<input checked="" type="checkbox"/>
Mean gestational weight gain (weekly)	5	<input checked="" type="checkbox"/>
Gestational diabetes	9	<input checked="" type="checkbox"/>
Hypertensive disorders of pregnancy	5	<input checked="" type="checkbox"/>
Depression	7	<input checked="" type="checkbox"/>
Anxiety	5	<input checked="" type="checkbox"/>
Macrosomia	9	<input checked="" type="checkbox"/>

Table C4: Outcomes for meta-analysis of evidence on interventions to prevent weight gain

Outcome – Maternal	Importance	Inclusion
Mean gestational weight gain	5	<input checked="" type="checkbox"/>
Excess gestational weight gain	5	<input checked="" type="checkbox"/>
Gestational diabetes	9	<input checked="" type="checkbox"/>
Hypertensive disorders of pregnancy	5	<input checked="" type="checkbox"/>
Caesarean section	9	<input checked="" type="checkbox"/>
Depression (antenatal and postnatal)	7	<input checked="" type="checkbox"/>
Postnatal weight retention	5	<input checked="" type="checkbox"/>

Outcome – Infant	Importance	Inclusion
Preterm birth	9	☑
Low birthweight	9	☑
Macrosomia	9	☑
Large for gestational age	9	☑
Small for gestational age	9	☑
Apgar score <7 at 5 minutes	7	☑
Early childhood weight	5	☑

Key: 1 - 3 less important; 4 - 6 important but not critical for making a decision; 7 - 9 critical for making a decision

Linking evidence with recommendations

Diet and pregnancy

Q1 *What dietary advice should be provided to women in pregnancy, including population-specific groups?*

Search strategy
Publication date range: 01/01/2014 to 04/06/2019 Databases searched: Embase, Cinahl, PubMed, Informit: Indigenous peoples, Scopus, Cochrane
Evidence statements
<ul style="list-style-type: none"> • Australian cross-sectional studies have identified low levels of awareness of dietary guidelines during pregnancy among women and limited dietary counselling by health professionals. • Studies investigating outcomes associated with dietary patterns were heterogeneous in the patterns that they identified. However, dietary patterns associated with positive outcomes were generally characterised by high intake of fruits, vegetables, legumes, wholegrains, fish, seafood, lean meats, low-fat dairy and water. Dietary patterns associated with poorer outcomes included those high in sweetened foods and beverages, foods high in saturated fats (eg fried foods), red and processed meats and refined grains. • Outcomes positively affected by a healthy dietary pattern and negatively affected by an unhealthy dietary pattern included gestational diabetes, gestational hypertension and antenatal depression. The evidence was inconsistent on the association between dietary pattern in pregnancy and preterm birth, fetal and childhood growth, cardiometabolic health and childhood wheeze. • In systematic reviews of vegan-vegetarian diets, findings on birthweight were inconsistent, duration of pregnancy between vegan-vegetarian and omnivorous diets was similar and there was a suggestion of risk of iron, zinc and vitamin B₁₂ deficiency with vegan-vegetarian diets. • A systematic review found that fasting during Ramadan among well-nourished women did not increase the risk of preterm birth or low birth weight.
No recommendations developed

Q2 *Which foods should be promoted and which avoided during pregnancy?*

Search strategy
Publication date range: 01/01/2014 to 04/06/2019 Databases searched: Embase, Cinahl, PubMed, Informit: Indigenous peoples, Scopus, Cochrane
Evidence statements
The evidence on specific food components that should be promoted or avoided during pregnancy generally aligns with the findings for question 1. No evidence was identified that contradicts the findings of the systematic review undertaken to inform the <i>Australian Dietary Guidelines</i> .
Fruit, vegetables and legumes
<ul style="list-style-type: none"> • There is evidence from observational studies that eating vegetables, fruit and legumes during pregnancy is beneficial to both mother and baby. There are possible associations with improvements in glucose tolerance and fetal growth and reductions in risk of neural tube defects, pre-eclampsia, preterm birth, depression and anxiety, allergy or asthma in the child and some childhood cancers.
Meat
<ul style="list-style-type: none"> • There is evidence from observational studies that low meat consumption may be protective against wheeze in the child and that limiting intake of cured meats may reduce the risk of some childhood cancers.

Fish

- There is evidence from systematic reviews of observational studies that higher maternal fish intake may be associated with positive neurodevelopmental outcomes and a reduced risk of childhood leukaemia and does not appear to affect the risk of infant eczema, wheeze, allergic rhinitis or asthma. There is evidence from observational studies that high intake of seafood may be associated with reduced risk of antenatal depression and low birth weight but that high fetal exposure to mercury is associated with low birth weight, small-for-gestational age and delayed language and communication skills.
- The evidence on an association between maternal fish intake and preterm birth is insufficient for conclusions to be drawn and findings of observational studies on the effect of maternal seafood intake on child growth are inconsistent.

Dairy

- There is evidence from observational studies that higher maternal intake of all dairy products is associated with a reduced risk of infantile eczema, higher maternal milk intake is associated with reduced risk of neural tube defects, asthma, allergic rhinitis and cow's milk allergy in children, higher yoghurt intake is associated with lower prevalence of depressive symptoms during pregnancy, and daily butter intake may be associated with increased risk of infant eczema.

Carbohydrates

- There is evidence from analysis of RCT participants that, in obese women with impaired glucose tolerance, a moderate carbohydrate intake during pregnancy is associated with a lower fat mass in their baby at birth. There is evidence from cohort studies that high maternal carbohydrate consumption may be associated with increases in birth weight and with infant wheeze.

Protein

- There is evidence from observational studies that a higher maternal protein intake may be associated with a higher risk of gestational diabetes, may increase fat-free mass in the infant and reduce new born abdominal adipose tissue and the risk of rapid infant growth.

Fats

- There is evidence from observational studies that a higher daily fat intake is associated with increased risk of gestational diabetes and lower birth weight.

Sweetened foods and beverages

- There is evidence from an RCT that higher consumption of foods and drinks that contribute to intake of added sugars is associated with gestational weight gain. There is evidence from observational studies of an association between sugar-sweetened foods and drinks and impaired glucose tolerance and gestational diabetes, major depressive disorder, large for gestational age, increases in infant BMI z score and overweight at 1 year and 7 years of age, and infant atopy and asthma.

Fast foods

- There is evidence from cohort studies that fast food consumption is associated with an increased risk of gestational diabetes, infant dermatitis and asthma.

Caffeine

- There is insufficient evidence to confirm or refute the effectiveness of caffeine avoidance on birth weight or other pregnancy outcomes.

Potential allergens

- There is evidence from observational studies that maternal peanut consumption may reduce the risk of peanut allergy in the infant and higher maternal wheat intake during the second trimester may reduce atopic dermatitis in the infant.

No recommendations developed

Q3 What are the harms and benefits of vitamin and mineral supplementation in pregnancy?

Folic acid

Search strategy

Publication date range: 31/12/12 to 24/06/19

Databases searched: PubMed, Ovid Medline, Embase, CINAHL, Scopus, Health Infonet, Cochrane

Evidence statements

- There is high certainty evidence that folic acid supplementation in pregnancy is associated with a reduction in risk of neural tube defects and lower certainty evidence that it may also reduce the risk of orofacial clefts and congenital heart defects.
- There is evidence from systematic reviews of observational studies that folic acid supplementation during pregnancy may reduce the risk of acute myeloid leukaemia, brain and spinal cord tumours in the child and autism spectrum disorders.
- The evidence suggests that folic acid supplementation does not affect the risk of early or late miscarriage, stillbirth, fetal loss, preterm birth, low birth weight, perinatal death, or asthma or wheeze in the infant.
- The evidence is inconsistent on the effect of folic acid supplementation on gestational hypertension, pre-eclampsia and acute lymphoblastic leukaemia in the infant.

Evidence-based recommendation
Recommend dietary supplementation of 500 micrograms per day folic acid, from 12 weeks before conception and throughout the first 12 weeks of pregnancy to reduce the risk of neural tube defects.
Harms and health benefits associated with the recommendation
<i>Harms:</i> The evidence suggests that folic acid supplementation is not associated with adverse effects. <i>Health benefits:</i> Reduction in risk of neural tube defects.
Implications for implementation
This recommendation was included in the previous version of the chapter and will not change practice.
B vitamins
Search strategy
Publication date range: 2014 to 30/09/19 Databases searched: PubMed, Ovid Medline, Embase, CINAHL, Scopus, Health Infonet, Cochrane
Evidence statements
<ul style="list-style-type: none"> • There is insufficient evidence to detect clinical benefits of vitamin B₆ in pregnancy, although it appears to be of benefit in reducing nausea. • The evidence on vitamin B₁₂ supplementation in pregnancy is of insufficient quality to draw conclusions.
No recommendations developed
Vitamin C
Search strategy
Publication date range: 31/03/15 to 19/06/19 Databases searched: PubMed, Ovid Medline, Embase, CINAHL, Scopus, Health Infonet, Cochrane
Evidence statements
<ul style="list-style-type: none"> • The evidence does not support routine vitamin C supplementation for the prevention of fetal or neonatal death, poor fetal growth, preterm birth or pre-eclampsia. Further research is required to clarify the possible role of vitamin C in the prevention of placental abruption and prelabour rupture of membranes.
Vitamin E
Search strategy
Publication date range: 31/03/15 to 19/06/19 Databases searched: PubMed, Ovid Medline, Embase, CINAHL, Scopus, Health Infonet, Cochrane
Evidence statements
<ul style="list-style-type: none"> • The evidence on vitamin E supplementation is of insufficient quality to draw conclusions. • Supplementation with vitamins C and E during pregnancy appears to reduce the risk of placental abruption and increase the risk of term PROM. It does not appear to affect other perinatal outcomes. Combined vitamins C and E may reduce the risk of preterm birth and placental abruption in pregnant women who smoke.
Vitamin A
Search strategy
Publication date range: 31/03/15 to 20/06/19 Databases searched: PubMed, Ovid Medline, Embase, CINAHL, Scopus, Health Infonet, Cochrane
Evidence statement
<ul style="list-style-type: none"> • The evidence does not support vitamin A supplementation for the prevention of fetal loss, maternal mortality, perinatal mortality or preterm birth. The evidence on the role of vitamin A supplementation in reducing risk of maternal clinical infection and anaemia may not be generalisable to the Australian context.
Evidence-based recommendation
Advise women that taking vitamin A, C or E supplements is of little or no benefit in pregnancy and may cause harm.
Harms and health benefits associated with the recommendation
<i>Harms:</i> The evidence suggests that taking vitamin A, C or E supplements may be associated with adverse effects. <i>Health benefits:</i> Reduction in risk of adverse effects associated with vitamin A, C or E supplementation.
Implications for implementation
This recommendation was included in the previous version of the chapter and will not change practice.

Multiple micronutrients

Search strategy

Publication date range: 01/01/15 to 21/01/20

Databases searched: PubMed, Ovid Medline, Embase, CINAHL, Scopus, Health Infonet, Cochrane

Evidence statement

- There is high certainty evidence from studies conducted in low- to middle-income countries that multivitamin use during pregnancy reduces the risk of low birth weight and may reduce the risk of stillbirth but does not affect the risk of perinatal or neonatal mortality. There is moderate certainty evidence of a reduction in risk of small for gestational age and a possible reduction in risk of preterm birth (<37 weeks). There is evidence of unspecified certainty that multivitamin use is associated with a reduction in risk of very preterm birth (<34 weeks), a possible reduction in risk of miscarriage and has no effect on maternal mortality, maternal anaemia, caesarean section or congenital anomalies. These findings may not be generalisable to the Australian context.
- There is very low to low certainty evidence that prenatal multivitamin supplementation among women in high income countries is associated with a reduced risk of small for gestational age and some congenital anomalies and a possible reduced risk of preterm birth.

No recommendations developed

Iron

Search strategy

Publication date range: 10/01/15 to 01/07/19

Databases searched: PubMed, Ovid Medline, Embase, CINAHL, Scopus, Health Infonet, Cochrane

Evidence statement

- There is moderate certainty evidence that iron supplementation in pregnancy has no clear effect on the risk of preterm birth. There is low certainty evidence that iron supplementation in pregnancy reduces the risk of maternal anaemia and iron deficiency at term and has no clear effect on maternal infection, neonatal death, congenital anomalies or low birth weight. There is very low certainty evidence that iron supplementation in pregnancy has no clear effect on the risk of maternal death or maternal side effects. There is evidence from a systematic review of RCTs that iron supplementation has no clear effect on infant neurodevelopment.
- There is low certainty evidence that intermittent versus daily iron supplementation in pregnancy has no clear effect on preterm birth, birth weight or low birthweight. There is very low certainty evidence that maternal side effects are reduced with intermittent versus daily iron supplementation and that there is no clear difference in maternal anaemia at term, maternal iron-deficiency at term or neonatal death.

Evidence-based recommendations

Only advise iron supplementation to pregnant women if their dietary iron intake is low or they have iron-deficiency anaemia.

Advise pregnant women with low dietary iron intake that intermittent supplementation is as effective as daily supplementation in preventing iron-deficiency anaemia, with fewer adverse effects.

Harms and health benefits associated with the recommendation

Harms: If low dietary iron intake is not identified, women who could benefit from supplementation may not be advised to take a supplement (note that dietary sources of iron are discussed in the guidelines).

Health benefits: Reduction in risk of maternal anaemia and iron-deficiency at term and maternal side effects.

Implications for implementation

These recommendations were included in the previous version of the chapter and will not change practice.

Calcium

Search strategy

Publication date range: 30/09/14 to 02/07/19

Databases searched: PubMed, Ovid Medline, Embase, CINAHL, Scopus, Health Infonet, Cochrane

Evidence statement

- There is consistent evidence from systematic reviews that calcium supplementation reduces the risk of pre-eclampsia and gestational hypertension. Calcium supplements do not appear to be of benefit in preventing low birth weight and their role in preventing preterm birth is unclear. There is evidence that routine calcium supplementation is more cost-effective than selective supplementation.

Evidence-based recommendation

Advise pregnant women to take a low-dose calcium supplement.

Harms and health benefits associated with the recommendation

Harms: No harms identified.

Health benefits: Reduction in risk of pre-eclampsia and gestational hypertension.

Implications for implementation

There may be cost implications for women.

Iodine

Search strategy

Publication date range: 18/11/16 to 16/01/19

Top-up search date: 12 March 2020

Databases searched: PubMed, Ovid Medline, Embase, CINAHL, Scopus, Health Infonet, Cochrane

Evidence statement

- There is low certainty evidence that, in settings with mild to moderate iodine deficiency, iodine supplementation may reduce the risk of postpartum hyperthyroidism and very low certainty evidence of an increased likelihood of gastrointestinal intolerance during pregnancy. There is low certainty evidence that iodine supplementation does not appear to increase or decrease the likelihood of other outcomes or side effects for mothers or infants.

Consensus-based recommendation

Advise pregnant women to take an iodine supplement of 150 micrograms each day. Women with pre-existing thyroid conditions should seek advice from their medical practitioner before taking a supplement.

Harms and health benefits associated with the recommendation

Harms: No harms identified.

Health benefits: Reduction in risk of pre-eclampsia.

Implications for implementation

There may be cost implications for women.

Zinc

Search strategy

Publication date range: 01/11/14 to 16/01/19

Top-up search date: 12 March 2020

Databases searched: PubMed, Ovid Medline, Embase, CINAHL, Scopus, Health Infonet, Cochrane

Evidence statement

- There is moderate certainty evidence that zinc supplementation may play a role in reducing the risk of preterm birth but has no clear effect on low birthweight. Supplementation does not appear to increase or reduce the risk of other outcomes. There is insufficient evidence to support a recommendation on zinc supplementation.

No recommendations developed

Magnesium

Search strategy

Publication date range: 31/03/13 to 13/02/19

Top-up search date: 12 March 2020

Databases searched: PubMed, Ovid Medline, Embase, CINAHL, Scopus, Health Infonet, Cochrane, Psychinfo

Evidence statement

- There is insufficient evidence to draw conclusions on magnesium supplementation in pregnancy.

No recommendations developed

Selenium

Search strategy

Publication date range: 01/01/2000 to 28/02/19

Top-up search date: 12 March 2020

Databases searched: PubMed, Ovid Medline, Embase, CINAHL, Scopus, Health Infonet, Cochrane, Psychinfo

Evidence statement

- There is insufficient evidence to draw conclusions on selenium supplementation in pregnancy.

No recommendations developed

Q4 What are the harms and benefits of nutritionally based complementary medicines in pregnancy?

Omega-3 fatty acids
Search strategy
Summary of Cochrane review
Evidence statements
<ul style="list-style-type: none">There is high certainty evidence that rates of preterm birth <37 weeks and early preterm birth <34 weeks are lower in women receiving omega-3 LCPUFA compared with no omega-3. There is moderate-certainty evidence that prolonged pregnancy >42 weeks is probably increased with omega-3 fatty acid supplementation. There is high certainty evidence of a reduced risk of low birth weight and moderate certainty evidence for a possible reduced risk of perinatal death, neonatal care admission and a possible small increase in risk of large-for-gestational age babies with omega-3 LCPUFA.
Evidence-based recommendation
Advise pregnant women that supplementation with omega-3 long-chain polyunsaturated fatty acids may reduce their risk of preterm birth.
Harms and health benefits associated with the recommendation
<i>Harms:</i> Possible increase in risk of prolonged pregnancy and large for gestational age. <i>Health benefits:</i> Reduction in risk of preterm birth, low birthweight, perinatal death and neonatal care admission.
Implications for implementation
This recommendation may have cost implications for women
Probiotics
Search strategy
Publication date range: 2014 to 18/10/19 Databases searched: Embase, Cinahl, Scopus, Cochrane, Australian Indigenous HealthInfoNet
Evidence statements
<ul style="list-style-type: none">There is low certainty evidence that supplementation with probiotics may be associated with a possible reduction in caesarean section and very low certainty evidence of a reduction in Group B streptococcus colonisation and a possible reduction in risk of gestational diabetes. There is very low or low certainty evidence that probiotic supplementation has no effect on gestational hypertension, pre-eclampsia, bacterial vaginosis, perinatal death, preterm birth, small for gestational age, large for gestational age or macrosomia.
No recommendations developed
Herbal preparations
Search strategy
Publication date range: 2014 to 05/08/20 Databases searched: Embase, Cinahl, Scopus, Cochrane, Australian Indigenous HealthInfoNet
Evidence statements
<ul style="list-style-type: none">The evidence on the efficacy and safety of herbal preparations during pregnancy is limited.There is moderate certainty evidence that ginger reduces nausea, with a low risk of adverse effects. There is very low certainty evidence that chamomile is also effective in reducing nausea.There is evidence from a systematic review that garlic may reduce gestational hypertension but does not have an effect on pre-eclampsia or caesarean section, with a high likelihood of experiencing odour.There is insufficient evidence on the efficacy and safety of echinacea and elderberry during pregnancy.
No recommendations developed

Physical activity

Q5 What are the harms and benefits of physical activity during pregnancy?

Search strategy

Publication date range: 1998 to 06/07/18

Top-up search: 12 March 2020

Databases searched: Embase, Cinahl, PubMed, Cochrane, Australian Indigenous HealthInfoNet

Evidence statements

- There is a possible increase in physical fitness associated with exercise in pregnancy and rates of injury appear to be low. The evidence on the effect on quality of life suggests an improvement with physical activity.
- There is evidence from systematic reviews, an RCT and a cohort study of a possible reduction in risk of low back and lumbopelvic pain and a reduction in severity of pain during pregnancy. The evidence on the effect of exercise on pelvic girdle pain and pain in the postpartum period is unclear.
- Moderate to vigorous exercise during pregnancy appears to improve sleep quality but is not effective in treating insomnia in pregnancy.
- There is no clear difference in the duration of labour, pain during labour or perineal tears between women who exercise during pregnancy and those who don't, although some RCTs have reported a shorter duration of labour, fewer requests for analgesia and lower risk of perineal tears among women who exercised during pregnancy.
- There is no clear association between leisure-time exercise during pregnancy and congenital anomalies and it appears to be protective against macrosomia and low birth weight. It does not appear to affect childhood weight but cohort studies suggest a positive association between physical activity during pregnancy and offspring neurodevelopment.

Q6 What physical activities are associated with adverse maternal and perinatal outcomes?

Search strategy

Publication date range: 1998 to 06/07/18

Top-up search: 12 March 2020

Databases searched: Embase, Cinahl, PubMed, Cochrane, Australian Indigenous HealthInfoNet

Evidence statements

- No evidence was identified to support an association between adverse effects in the woman or fetus and exercise, vigorous exercise or swimming during pregnancy. There is insufficient evidence to ascertain whether maternal exercise in the supine position is safe or should be avoided during pregnancy. Bicycling and horseback riding may be associated with miscarriage at 11-14 weeks.
- The evidence on risks associated with occupational physical activity during pregnancy is unclear. Heavy lifting (eg >200 kg/day) may be associated with an increased risk of pelvic pain, stillbirth among women with a previous fetal loss and preterm birth among primigravid women but is not associated with small-for-gestational age or low birth weight. There is a possible association between occupational standing and increased risk of miscarriage (>6 hours a day) or preterm birth (>3 hours a day) but no clear difference in small-for-gestational age, birth weight or pelvic pain. There is insufficient evidence to draw conclusions on strenuous occupational physical exertion in pregnancy but it may be associated with preterm premature rupture of the membranes and pelvic pain.

Evidence-based recommendation

Advise women that regular moderate-intensity physical activity during pregnancy is associated with a range of health benefits and is generally not associated with adverse outcomes.

Harms and health benefits associated with the recommendation

Harms: Physical activity in pregnancy is not generally associated with adverse outcomes.

Health benefits: Regular moderate-intensity physical activity during pregnancy is associated with increased physical fitness and improved quality of life as well as a reduction in some adverse outcomes of pregnancy (see question 9; page 71)

Implications for implementation

This recommendation does not change the advice given in the previous version of the chapter. It may increase consultation time.

Gestational weight gain

Q7 When should maternal weight and height be measured and BMI calculated in pregnant women?

Search strategy

Publication date range: 2014 to 09/04/19

Top-up search: 12 March 2020

Databases searched: PubMed, Ovid Medline, Embase, CINAHL, Scopus, HealthInfoNet, Cochrane

Evidence statements

Women's and health professionals' views on gestational weight gain

- There is evidence from a systematic review that women are highly motivated to change their behaviour to improve fetal health, but may not recognise the link between excess gestational weight gain and negative fetal health outcomes. There is evidence from cross-sectional studies that women lack accurate knowledge on gestational weight gain and would welcome advice from health professionals.
- There is evidence from cross-sectional studies that health professionals would welcome more training in providing appropriate counselling and that resources and time are other barriers to discussing weight gain.

Weight monitoring

Search strategy

Publication date range: 01/01/14 to 02/12/19

Databases searched: PubMed, Ovid Medline, Embase, CINAHL, Scopus, Health Infonet, Cochrane

Evidence statements

- There is very low certainty evidence that regular weighing as part of antenatal care has no clear effect on mean weekly weight gain, total weight gain exceeding guidelines, gestational diabetes, hypertensive disorders of pregnancy or macrosomia but low certainty evidence that it may reduce the risk of depression and anxiety.

Consensus-based recommendation

Measure women's weight and height at the first antenatal visit and calculate their body mass index (BMI) and give them advice about the benefits of gaining weight within the recommended weight gain range for their BMI.

Harms and health benefits associated with the recommendation

Harms: No harms identified.

Health benefits: Optimising gestational weight gain reduces the risk of some adverse outcomes (see also research question 8; page 70).

Implications for implementation

This recommendation does not change the advice given in the previous version of the chapter. It may increase consultation time.

Q8 What specific risk assessments are required for pregnant women with high or low BMI at the first antenatal visit?

Search strategy
Publication date range: All to 28/02/20 Databases searched: PubMed, Ovid, Embase, Cinahl, Scopus, Cochrane, Australian Indigenous HealthInfoNet
Evidence statements
Determinants of gestational weight gain
<ul style="list-style-type: none">• There is evidence from systematic reviews of association between weight gain exceeding guidelines and body image dissatisfaction and lack of social support but not anxiety, stress, self-efficacy, self-esteem of parity. The evidence on depression was inconsistent.• There is evidence from cohort studies of association between weight gain exceeding guidelines and pre-pregnancy BMI and stopping smoking but not maternal age, household income, education level or country of birth or experience of hardship in childhood, adulthood or during pregnancy.
Risks associated with weight gain lower or higher than recommendations
<ul style="list-style-type: none">• There is high certainty evidence that, among women with any BMI, gestational weight gain lower than recommendations increases the risk of preterm birth and small-for gestational-age babies and weight gain higher than recommendations increases the risk of large for gestational age, macrosomia and caesarean section (high certainty).• There is RCT evidence that weight gain higher than recommendations in early pregnancy (15-18 weeks) increases the risk of total gestational weight gain exceeding recommendations, gestational diabetes, large-for-gestational-age babies and macrosomia.• There is evidence from meta-analysis of individual participant data that, among underweight women, low weight gain is associated with increased risk of preterm birth and small for gestational age.• There is evidence from meta-analysis of individual participant data that, among women with healthy pre-pregnancy weight, low weight gain is associated with increased risk of preterm birth and small for gestational age and high weight gain is associated with an increased risk of gestational diabetes, gestational hypertension, pre-eclampsia, preterm birth and large for gestational age.• There is evidence from meta-analysis of individual participant data that, among overweight women, low weight gain is associated with increased risk of gestational diabetes, gestational hypertension, pre-eclampsia, small for gestational age and preterm birth and high weight gain is associated with gestational diabetes, gestational hypertension, pre-eclampsia, preterm birth and large for gestational age.• There is evidence from meta-analysis of individual participant data that, among obese women, both low and high weight gain were associated with increased risk of gestational diabetes, gestational hypertension, pre-eclampsia and preterm birth. There is high-certainty evidence that, compared to weight gain within recommendations, gestational weight gain higher than recommendations increases the risk of large-for-gestational-age babies, macrosomia and caesarean section.• There is evidence from a systematic review of cohort studies that, while gestational weight loss among obese women decreased the risk of large-for-gestational-age babies, macrosomia and caesarean section, it increased the risk of small-for-gestational-age babies and low birth weight and no studies reported on preterm birth.
Consensus-based recommendation
At every antenatal visit, offer women the opportunity to be weighed so that low or high gestational weight gain is identified and risk of associated adverse outcomes monitored.
Harms and health benefits associated with the recommendation
<i>Harms:</i> No harms identified. <i>Health benefits:</i> Optimising gestational weight gain reduces the risk of some adverse outcomes.
Implications for implementation
This recommendation does not change the advice given in the previous version of the chapter. It may increase consultation time.

Q9 What lifestyle interventions are effective in preventing excessive weight gain and other adverse outcomes in pregnant women?

Search strategy: physical activity

Publication date range: 1998 to 06/07/18

Top-up search: 12 March 2020

Databases searched: Embase, Cinahl, PubMed, Cochrane, Australian Indigenous HealthInfoNet

Search strategy: diet

Publication date range: 01/01/2014 to 04/06/2019

Databases searched: Embase, Cinahl, PubMed, Informit: Indigenous peoples, Scopus, Cochrane

Evidence statements

- The evidence shows a lower mean gestational weight gain among women participating in a dietary intervention (very low certainty), exercise intervention (moderate certainty) or lifestyle counselling intervention (low certainty). These interventions also lowered the risk of weight gain exceeding guidelines (very low to low certainty). There was no clear difference in postnatal weight retention with a dietary intervention (very low certainty) or exercise intervention (single study) and a reduction with lifestyle counselling (moderate certainty).
- Dietary interventions showed no clear difference in risk of gestational diabetes (very low certainty), exercise interventions showed reduced risk (low certainty) and lifestyle counselling showed a probable reduction in risk (moderate certainty).
- There was a reduction in risk of gestational hypertension with dietary intervention or exercise intervention (moderate certainty) but no clear difference in risk with lifestyle counselling (low certainty). There was no clear difference in risk of pre-eclampsia with any type of intervention (low to moderate certainty).
- There was no clear difference in risk of caesarean section with a dietary intervention (very low certainty) but a reduction in risk with exercise intervention (moderate certainty) and a probable reduction in risk with lifestyle counselling (low certainty).
- There was a reduction in risk of antenatal depression with exercise intervention (moderate certainty) but not lifestyle counselling (low certainty). The risk of postnatal depression was reduced with exercise intervention.
- The risk of preterm birth was reduced with a dietary intervention (moderate certainty), probably reduced with lifestyle counselling (moderate certainty) but not exercise intervention (moderate certainty).
- There was no clear difference in risk of macrosomia >4,000g with dietary intervention (very low certainty) but a reduction in risk with exercise intervention (moderate certainty) and a probable reduction in risk with lifestyle counselling (low certainty). There was a reduction of risk of macrosomia >4,500 g with lifestyle counselling (moderate certainty). There was no clear difference in risk of low birth weight with an exercise intervention (moderate certainty) or lifestyle counselling (low certainty). There was a possible reduction in risk of large-for-gestational age with lifestyle counselling (moderate certainty) but no clear difference in risk with the other interventions.
- There was no clear difference in risk of small-for-gestational age, Apgar score <7 at 5 minutes or weight in early childhood with any intervention

Evidence-based recommendation

At every antenatal visit, give women tailored advice on weight gain, including the benefits of a healthy diet, regular physical activity and self-monitoring.

Harms and health benefits associated with the recommendation

Harms: No harms identified.

Health benefits: Physical activity and healthy diet reduce gestational weight gain, alone or in combination. There is also a range of other health benefits for woman and baby.

Implications for implementation

This recommendation may increase consultation time.

D Topics currently under review

Lifestyle considerations

Vaccines (including influenza, pertussis, varicella)

Clinical assessments

Pre-eclampsia

Maternal health testing

Diabetes

Anaemia

Group B streptococcus

Genetic carrier screening

Cervical abnormalities

Fetal chromosomal anomalies

Ultrasound assessment for women who have cell-free DNA testing for chromosomal anomalies

E Topics covered in the pregnancy care guidelines

OPTIMISING ANTENATAL CARE

- Principles of care
- Providing woman-centred care
- Antenatal care for Aboriginal and Torres Strait Islander women
- Antenatal care for migrant and refugee women
- Antenatal care for women with mental health disorders
- Population groups with specific care needs

CLINICAL CARE DURING PREGNANCY

- Core practices in antenatal care
- Antenatal visits
- Preparing for pregnancy, childbirth and parenthood
- Preparing for breastfeeding

Lifestyle considerations

- Nutrition
- Nutritional supplements
- Physical activity
- Tobacco smoking
- Alcohol
- Medicines
- Sexual activity
- Travel

Oral health

Clinical assessments

- Gestational age
- Weight and body mass index
- Blood pressure
- Proteinuria
- Psychosocial factors affecting mental health
- Depression and anxiety
- Domestic violence
- Fetal development and anatomy
- Fetal growth and wellbeing
- Risk of pre-eclampsia
- Risk of preterm birth

Maternal health screening

- Diabetes
- Human immunodeficiency virus
- Hepatitis B
- Hepatitis C
- Rubella
- Chlamydia
- Syphilis
- Gonorrhoea
- Trichomoniasis
- Asymptomatic bacteriuria
- Asymptomatic bacterial vaginosis
- Anaemia
- Haemoglobin disorders
- Vitamin D deficiency
- Group B streptococcus
- Toxoplasmosis
- Cytomegalovirus
- Cervical abnormalities
- Thyroid dysfunction
- Screening for fetal chromosomal abnormalities**
- Common conditions**
- Reflux (heartburn)
- Haemorrhoids
- Varicose veins
- Pelvic girdle pain
- Carpal tunnel syndrome
- Nausea and vomiting
- Constipation
- Clinical assessments in late pregnancy**
- Fetal presentation
- Prolonged pregnancy

Acronyms and abbreviations

AIHW	Australian Institute of Health and Welfare
aHR	adjusted hazard ratio
aOR	adjusted odds ratio
aPR	adjusted prevalence ratio
BMI	body mass index
CBR	consensus-based recommendation
CDC	US Centers for Disease Control and Prevention
CI	confidence interval
EBR	evidence-based recommendation
EWG	Expert Working Group
GP	general practitioner
IOM	US Institute of Medicine
NHMRC	National Health and Medical Research Council
OR	odds ratio
PP	practice point
QEBR	qualified evidence-based recommendation
RCT	randomised controlled trial
RR	relative risk
WHO	World Health Organization