

Dietary recommendations for pregnant women

To: the Minister of Health, Welfare and Sport,
the Minister for Medical Care and Sport and
the State Secretary of Health, Welfare and Sport
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Health Council of the Netherlands



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executive summary

The Minister of Health, Welfare and Sport has asked the Health Council of the Netherlands to evaluate the existing dietary recommendations for pregnant women in the light of the latest scientific knowledge. The Council has set up the Committee for Dietary Recommendations for Pregnant Women for this purpose.

The advisory report underlies the Netherlands Nutrition Centre's public information on nutrition for pregnant women, which also takes account of the dietary reference values for pregnant women. Pregnant women can use this public information: it gives the comprehensive picture. This advisory report can serve as a reference work, as it describes the scientific basis for the recommendations. This can also be valuable for professionals who provide nutritional advice to pregnant women. The committee based its recommendations on scientific research into the influence of dietary factors during pregnancy on health outcomes during and after pregnancy,

whether for the mother or the child. The recommendations concern a healthy diet and food safety.

A healthy, varied diet is essential

During pregnancy, eating a high-quality diet requires extra attention, which is why the recommendation to eat healthy, varied food is essential. A varied diet is linked to the intake of a wide array of nutrients and prevents overexposure to specific harmful substance. Many guidelines from the *Dutch dietary guidelines* published by the Health Council in 2015 also apply to pregnant women. They do need to be updated or fine-tuned in several areas, however, such as for fish, bread, dairy, coffee, tea and alcohol. In addition, there are several specific recommendations for pregnant women.

Pregnant women who consume little or no animal products have an increased risk of not getting enough fish (fish fatty acids), calcium, iron, vitamin B12 and iodine. Whether or not pregnant women need supplements with these nutrients and, if so, which supplements they should take depends on their food choices.

The committee considers that fasting or dieting while pregnant is unwise, as doing so makes it impossible to eat a healthy, complete diet.

Finally, hygiene measures and limiting exposure to certain harmful substances are especially important during pregnancy.

The committee believes that in the first trimester, preferably during the first obstetrical consultation, attention should be given to healthy eating habits.

Start early with folic acid and take vitamin D

The current recommendation to take folic acid tablets before conception and in early



pregnancy remains unchanged. Following this recommendation will reduce the risk of spina bifida and is associated with lower risks of preterm birth, low birth weight for gestational age and possibly cleft lip and palate in the child. The committee also recommends taking a vitamin D supplement throughout pregnancy. Taking vitamin D supplements appears to lower the risk of gestational diabetes, low birth weight for gestational age and asthmatic symptoms in the child.

The committee stresses that compliance with both supplement recommendations is still too uncommon and that special attention should be paid to improving this in implementing the recommendations.

The importance of good hygiene

Listeria or *Toxoplasma* infections can have serious consequences during pregnancy, such as premature birth or miscarriage. It is therefore especially important to pay extra attention to hygiene during this time. There is a lot of information and a lot of advice on this topic,

which may give the impression that pregnant women should avoid a large number of foods. The committee has shown that this is not always necessary. Pregnant women can consume products responsibly, but exercise extra caution with certain products, making sure to wash or cook them fully.

Do not consume alcohol, limit caffeine and watch out for other harmful substances

Several substances have negative effects during pregnancy. It is recommended to avoid alcohol completely during this time, as there is no safe intake level. It is also recommended to limit the intake of caffeine. Because of the risks associated with a high intake of vitamin A, the committee recommends avoiding liver, limiting the consumption of liver products and being careful with supplements that are not specifically intended for pregnant women, as they may contain too much vitamin A. Lead intake is also a health risk, especially for pregnant women and young children. This is an area of concern for people living in homes with lead plumbing or

new plumbing and taps. Women who eat a lot of soy products or who take supplements with phyto-oestrogens should take care not to over-consume isoflavones. Another recommendation concerns the risk posed by products containing liquorice root, including liquorice and tea, as well as tea or supplements made from certain plants or herbs. In addition, care should be taken to avoid that foods are coloured too brown or black when cooking it, as this can produce harmful substances.

Eat plenty of calcium-rich, iodine-rich and iron-rich products and fish

Sufficient calcium intake is important throughout pregnancy, but there is scientific evidence that, specifically during the second half of pregnancy, calcium reduces the risks of high blood pressure, preeclampsia and preterm birth. Furthermore, women need to consume more iodine throughout pregnancy for fetal growth and the development of the nervous system. It is also recommended that pregnant women eat fish twice a week, including one serving of fatty



fish and one serving of lean fish. This is more than what is recommended for the general population, due to the beneficial effects of fish and fish fatty acids on preventing preterm birth. It is important, however, to eat the right kind of fish, as some species contain more harmful substances than others. Sufficient intake of iron-rich products is also important, as iron deficiency can lead to anaemia, which is undesirable. As part of pregnancy care, women undergo several blood tests throughout their pregnancy in order to detect and treat iron deficiency.

In principle, pregnant women can get enough calcium, iodine and fish fatty acids through their diet alone. Supplements are recommended only for women who structurally fail to meet the reference intake values for these nutrients. For women who consume little or no dairy, it is more difficult to get enough calcium. For women who eat little or no bread or who eat bread without

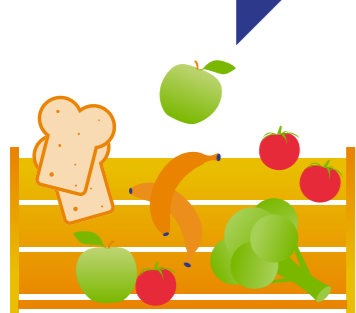
‘bakery salt’^a, consuming enough iodine may be more difficult. For these groups, it is especially important to monitor calcium and iodine intake during pregnancy. If supplementation with several vitamins and minerals is required, it may be practical to take a combination supplement.

^a In the Netherlands, bakery salt is a specific salt containing 50 tot 65 milligrams of iodine per kilogram salt, which is applied in bread, biscuits, cakes and pastries.



Overview of the dietary recommendations for pregnant women

Eat a healthy and varied diet



Calcium

Eat enough calcium-rich products to reach at least the dietary reference value of calcium. If the intake is consistently too low, take a supplement containing 1,000 milligrams of calcium a day, starting from the 20th week of pregnancy.



Alcohol

Avoid alcohol



Folic acid

Take a supplement containing **400 micrograms of folic acid a day**, starting from at least four weeks prior to conception up to the 10th week of pregnancy



Vitamin D

Take a supplement containing **10 micrograms of vitamin D** per day



Iodine

Eat enough iodine-rich products to meet the dietary reference value of **200 micrograms of iodine per day**. If you struggle to consistently get enough iodine, take a supplement. Do not take more than 200 micrograms of iodine a day.



Iron

Eat enough iron-rich products



Fish

Eat fish twice a week, including one serving of fatty fish and one serving of lean fish, picking fish species that do not contain excessively high levels of harmful substances. For women who cannot or do not want to eat this amount of fish: take a fish-fatty-acids supplement containing 250 to 450 milligrams of DHA per day.



Food-borne infections

Avoid food-borne infections with the bacteria *Listeria monocytogenes* and with the parasite *Toxoplasma gondii* by observing extra hygiene rules, in addition to the general rules to prevent food-borne infections.



Careful



Caffeine

Do not take more than **200 milligrams of caffeine** per day.



Careful



Lead

In buildings with leaded plumbing, use bottled water instead of tap water. In case of new plumbing and/or taps, follow the instructions for using tap water for the first three months.



Careful



Vitamin A (Liver products)

Avoid liver, limit consumption of liver products and watch the dosage of supplements not specifically intended for pregnant women.



Careful

Harmful substances

Points of attention (during and before/after pregnancy):

- Eat a varied diet and avoid having products turn too brown or black when cooking them.
- Limit the consumption of tea made from aniseed, tarragon, fennel, basil, allspice, nutmeg, cinnamon, sassafras, dong quai, mace and pepper. Do not take pills, capsules or other highly concentrated products intended for consumption made from these plants or herbs or their essential oils.
- Normal use of kitchen herbs is not a problem.
- Do not eat calabash chalk because of its high levels of lead and dioxin.



Careful



Soya

Avoid excessive intake of isoflavones from soya products and do not take supplements containing these phytoestrogens.



Careful

Liquorice root

Limit the intake of products containing liquorice root (liquorice, tea) if you have normal blood pressure and avoid them if you have high blood pressure.



Careful



Figure 1



01 introduction



1.1 Background of the advisory report

The Health Council's *Dutch Dietary Guidelines 2015* describe what a healthy diet entails for the general population. These guidelines were not tailored to pregnant women, breastfeeding women and infants up to the age of two. Recommendations for these groups have, however, been drawn up by the Netherlands Nutrition Centre and by pregnancy and childcare professionals. There are indications that a healthy diet in the first thousand days from conception (until the child's second birthday) is also important for the child's health in late adulthood.¹ The Minister of Health, Welfare and Sport (VWS) has therefore asked the Health Council of the Netherlands to advise on the extent to which new scientific developments give cause to adjust the dietary recommendations for these groups. The complete request for advice can be found on the Council's website.

This advisory report concerns dietary recommendations for pregnant women. Dietary recommendations for breastfeeding women and infants up to two years of age will be covered in a subsequent advisory report. This advisory report was prepared by the Committee on Dietary Recommendations for Pregnant Women, consisting of experts from various medical and nutritional disciplines. A list of the committee's members and other experts who were consulted once or a few times, can be found at the end of this advisory report. The advisory report has been presented to the Ministers and State Secretary of Health, Welfare and Sport by the chairman of the Health Council.

The Health Council has not previously issued dietary recommendations for pregnant women. However, various other organisations, including the Netherlands Nutrition Centre, and several nationwide and regional websites had already published recommendations. The National Institute for Public Health and the Environment (RIVM) collected and examined these recommendations for the purpose of this advisory report, concluding that there were substantial differences between these recommendations, see Appendix A of the background document on the committee's working method.² In this advisory report and the corresponding background documents, the state of scientific knowledge was evaluated, after which the dietary recommendations for pregnant women were modified where necessary. With this advisory report, the Health Council seeks to contribute to the scientific basis and uniformity of dietary recommendations for pregnant women in the Netherlands.

This advisory report is primarily intended to serve as a starting point for the nutritional information provided by the Netherlands Nutrition Centre. In addition, it is intended as a reference work, especially for professionals who work with pregnant women, such as obstetricians, gynaecologists, general practitioners and dieticians.



1.2 Dietary recommendations and dietary reference values complement each other

The recommendations for pregnant women featured in this advisory report are based on scientific research into the preventive effect of dietary factors against pregnancy complications or health risks in the child and into aspects of food safety.

This advisory report on dietary recommendations for pregnant women, and another advisory report by the Health Council of the Netherlands with the new dietary reference values for vitamins and minerals for pregnant women, are published simultaneously.^{3,4} These dietary reference values consist of the estimated intake of each vitamin and mineral the body needs for healthy functioning of the body, to maintain the female body and to enable the desired growth of the embryo/foetus, placenta, uterus, blood volume, fat mass and more.

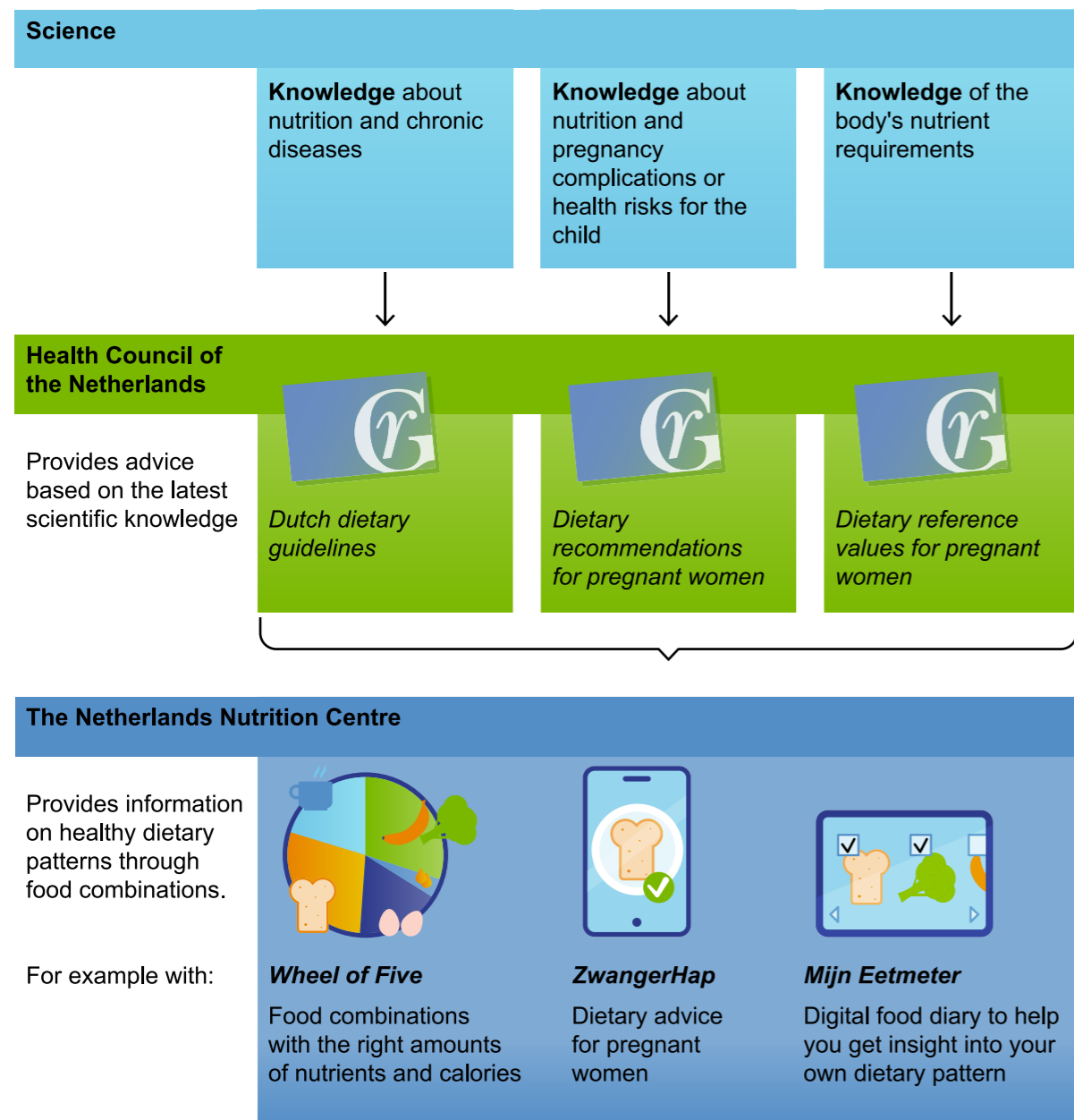
The two advisory reports on dietary reference values and dietary recommendations complement each other. The dietary reference values are based on the state of the scientific knowledge with regard to vitamin and mineral requirements and therefore concern total intakes.^{3,4} The dietary recommendations for pregnant women, insofar as vitamins and minerals are concerned, are based on the scientific evidence on the effects of taking supplements during pregnancy, in addition to the usual dietary intake.⁵

1.3 Division of labour between the Health Council of the Netherlands and the Netherlands Nutrition Centre

Dietary guidelines, dietary recommendations and dietary reference values are drawn up on the basis of the latest scientific knowledge, which is therefore the task of the Health Council of the Netherlands. In practice, however, pregnant women need dietary information that complies with guidelines as well as recommendations and dietary reference values. The Netherlands Nutrition Centre is responsible for translating the dietary reference values into recommended intake values of specific foods, within the limits of the *Dutch Dietary Guidelines and Dietary recommendations for pregnant women* (see Figure 2).



Figure 2 From science to information



In the Netherlands, the Netherlands Nutrition Centre is responsible for the developing and disseminating information about healthy and sustainable dietary patterns. The Netherlands Nutrition Centre combines foods into complete dietary patterns that are as close as possible to common dietary patterns in the Netherlands and that meet both the dietary recommendations and guidelines and the dietary reference values of the Dutch Health Council. In developing the current 'Wheel of Five', an optimisation model was used to determine which combinations provide sufficient nutrients and energy.⁶ For most nutrients a variety of foods are good sources, which means there are many different options to put together a diet that meets the *Dutch Dietary Guidelines* and dietary reference values. As such, dietary information and advice can be tailored to various dietary habits and the feasibility of dietary changes. For example, the Netherlands Nutrition Centre provides information and examples that are tailored to the diets and eating habits of people from different backgrounds (Dutch, Moroccan, Turkish, Surinamese) and with vegetarian or vegan diets. The food quantities in the guidelines and recommendations of the Health Council of the Netherlands may be not sufficient to comply with the dietary reference values of certain nutrients. Therefore, for some product groups, the nutrition information provided by the Netherlands Nutrition Centre may specify higher amounts than the Council's guidelines or recommendations. In practice, the quantities in the nutrition information provided by the Netherlands Nutrition Centre take precedence, because they comply with the dietary guidelines and recommendations, as well as



with the reference values for nutrient intake of the Dutch Health Council.^{3,7} Pregnant women should therefore follow the dietary information provided by the Netherlands Nutrition Centre in making food choices.

Pregnant women can rely on the Eetmeter to chart their own dietary pattern. This digital food diary is available as an app and online and indicates whether a person's diet complies with all the recommendations on food consumption and nutrient intakes.⁸ Women may also need personal advice and guidance from their obstetrician or a dietician. Furthermore, the Netherlands Nutrition Centre has an app (the so-called ZwangerHap) for pregnant women that lets users quickly check whether they can safely eat a certain product and what they can eat instead.

1.4 Scope

The dietary recommendations for pregnant women in this advisory report are supplementary to, and partly replace, the *Dutch Dietary Guidelines 2015* that were primarily drawn up for the general population.

The recommendations on food safety in this advisory report apply to all pregnant women (chapter 3, section 5.1.2 and chapter 6). The other recommendations in this advisory report are primarily based on research in healthy pregnant women (Figure 3). The committee has not examined or described the state of scientific knowledge for pregnant women who already developed complications in pregnancy or who have underlying diseases. Adjustments may be required for these groups. This also

includes women who suffer from severe nausea during pregnancy (*hyperemesis gravidarum*), because it is more difficult for them to follow dietary recommendations and because vomiting reduces the absorption of nutrients in the body. Furthermore, these recommendations are aimed at singleton pregnancies. Women expecting multiple births have higher energy and nutrient requirements, but there was insufficient research available to formulate specific recommendations for multiple pregnancies.

The main goal of this advisory report is to provide dietary recommendations and it therefore does not address other lifestyle factors such as exercise and smoking (Figure 4).

In the final chapter, the committee briefly highlights the recommendations that should preferably be followed prior to conception. These recommendations are (or are potentially) important in very early pregnancy, even if the pregnancy has not yet been confirmed. The committee also briefly discusses the influence of having an overly high or low *Body Mass Index* (BMI) prior to conception and the corresponding risks during pregnancy. The committee has not examined the state of scientific knowledge on the effects of nutrition on fertility.



Figure 3 Who are these recommendations for?

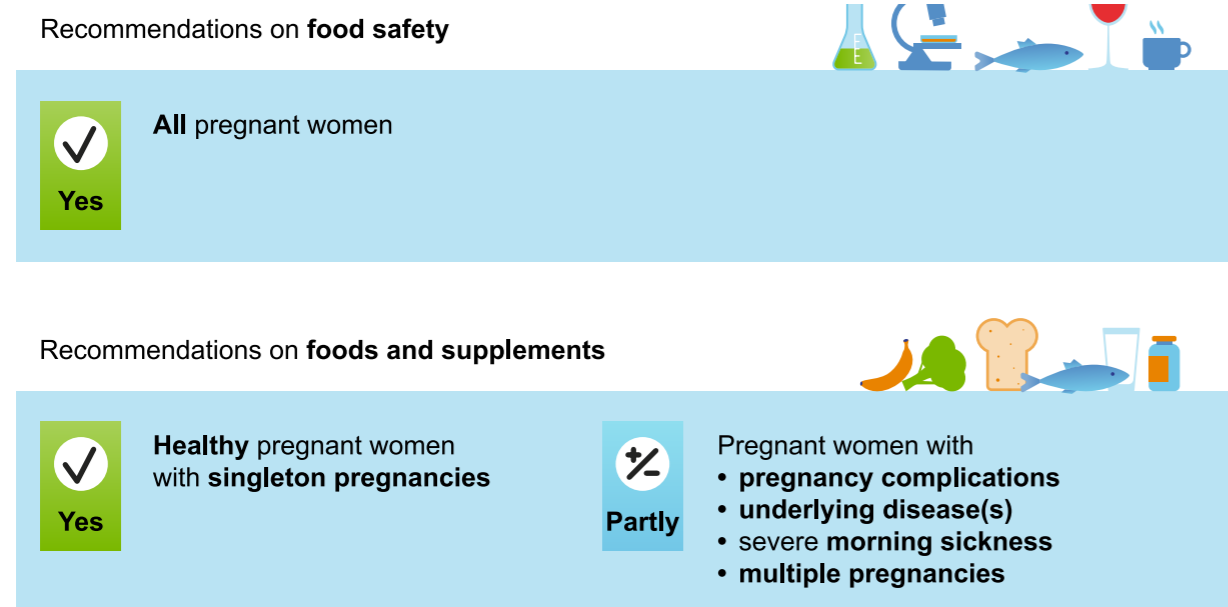
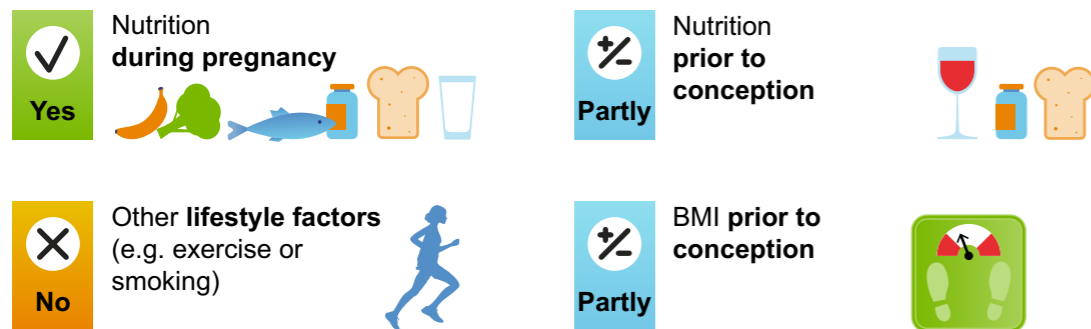


Figure 4 What is this advisory report about?



1.5 Methodology

In drawing up this advisory report, the committee followed a structured working method that is described in the background document *Working method for drawing up dietary recommendations for pregnant women*.² The working method is outlined in this section.

Literature research

The dietary factors from the *Dutch Dietary Guidelines 2015* and the dietary factors for which dietary recommendations for pregnant women already existed served as the basic topics for this report. Additional topics were put forward by the Netherlands Nutrition Centre, professionals from the field and committee members themselves. The evaluation covers the health effects of dietary patterns and foods, of supplements with vitamins, minerals or fish fatty acids, health effects related to weight changes during pregnancy, as well as the harmful effects of microorganisms and substances in the diet.^{5,9-11} The committee examined effects on the foetus, complications during pregnancy, and effects on the long-term health of the child. The committee described whether there are effects on mortality, morbidity, congenital defects, miscarriages and pregnancy complications such as pre-eclampsia and gestational diabetes. In addition, effects on outcomes associated with increased risks for the mother or child have also been described, such as preterm birth (birth after less than 37 weeks), low or high birth weight for gestational age (*small for gestational age; large for gestational age*) and effects on risk factors for chronic



diseases in the infant (blood pressure, glucose, triglycerides, BMI and fat percentage).

For the health effects of dietary patterns, foods, nutrient supplements and weight change during pregnancy, the committee conducted its own literature review. Meta-analyses and systematic reviews published up to July 2019 served as the committee's primary references. All findings are based on studies in which food intake was measured before diagnosis, as this allows for more reliable data on food intake than measuring food intake after diagnosis. Two types of studies were described and evaluated: randomised controlled trials (RCTs) and prospective cohort studies. Both types of studies have their own distinct advantages and disadvantages and complement each other. Where RCTs are available, the committee makes statements about effects; for findings based on cohort studies, the committee uses the term associations. In each case, the committee indicates whether the strength of evidence for an effect or association is strong or limited.

The committee has based its conclusions on food safety (risks posed by harmful substances and micro-organisms) on existing risk assessments carried out by the Council itself, by the European Food Safety Authority (EFSA) or by other organisations.

Public comments

The committee has described the findings of the aforementioned literature review in four background papers:

- *Health effects of food consumption and dietary patterns during pregnancy*⁹
- *Health effects of nutrient intake from supplements during pregnancy*⁵
- *Health effects related to weight change during pregnancy*¹⁰
- *Harmful effects of substances and microorganisms in the diet during pregnancy*¹¹

These background documents were temporarily put on the Council's website in draft form in 2019 to give stakeholders an opportunity to comment on their content. By doing so, the committee sought to answer two main questions:

1. Did the committee miss any important publications that fit within the method used?
2. Are there any errors in the background documents?

Like the background documents themselves, the comments received and the committee's responses to them have been published on the Health Council's website.



From findings to recommendations

The dietary recommendations for pregnant women are based on the conclusions from the background documents, taking the strength of the evidence and the relevance of the finding for the Netherlands into account. Conclusions about foods, dietary patterns and substances, and about interventions aimed at limiting weight gain during pregnancy are included in the advisory report if they are based on strong evidence. In those cases, the advisory report does not explicitly specify the level of evidence. Most conclusions based on limited evidence can only be found in the background documents and not in the advisory report. In several places, however, the committee found it relevant to mention them in the advisory report; in these cases, the report always specifies that the evidence is limited. The background document on the working method describes in detail how the committee made its assessment.

In the final phase, some experts in the field of food safety who were not on the committee, were consulted. They were experts from the National Institute for Public Health and the Environment (RIVM), the Netherlands Food and Consumer Product Safety Authority (NVWA), the Netherlands Nutrition Centre and the Wageningen Food Safety Research Institute (formerly known as Rikilt). One of the topics was the additional background document on the evaluation of fish species, which was established at that stage.¹²

The draft version of advisory report has been submitted to professional bodies whose members are involved in pregnancy counselling, in order to gauge whether the recommendations in the report are feasible in practice, namely the professional bodies of midwives, obstetricians and gynaecologists, dieticians, general practitioners, paediatricians and weight-loss counsellors. The advisory report has also been reviewed by the Standing Committee of the Health Council of the Netherlands.

1.6 The child's health in adult life

The request for advice mentioned that a healthy diet in the first thousand days from conception, until the child's second birthday, may influence the child's health in later life. The evidence for these long-term effects comes from research on children whose first 1000 days coincided with an extreme nutritional situation such as the Dutch famine of 1945¹³, from research on pregnancies after fertility treatments¹⁴⁻¹⁶ and on pregnancies complicated by diabetes¹⁷, and from animal testing¹⁸⁻²⁰.

When investigating very long-term effects, it is not possible to conduct RCTs for ethical reasons. No cohort studies were found that assessed mother's diet during pregnancy and followed their offspring through to late adulthood. The problem with any such cohort study would also be that the mother's diet during pregnancy is usually related to the diet she teaches her child. If an association were to be found in cohort studies, it would be



unclear whether it could be ascribed to the mother's diet during pregnancy, the child's diet after birth, or both.²¹

The committee reviewed the state of scientific knowledge on several risk factors for chronic diseases in the offspring: blood pressure, glucose, triglycerides, BMI and body fat percentage.² With regard to effects on blood pressure and BMI in children, some studies were available, which have been described in the background documents, but none provided conclusions relevant for making recommendations. It is clear, however, that an excessively low or high intake of certain nutrients during pregnancy can have lasting consequences for the child, for example a very low intake of iodine or an excess intake of vitamin A. The same applies to excessive exposure to certain harmful substances, such as lead. The committee also notes that some pregnancy outcomes that played an important role in drawing up the recommendations in this advisory report (preterm birth and low or high birth weight for gestational age) may be associated with the risk of subsequent chronic diseases in children.²²

1.7 Reading guide

In chapter 2, the committee addresses the importance of a healthy dietary pattern during pregnancy. Findings on dietary patterns are evaluated and the committee reflects on the applicability to pregnant women of the Dutch dietary guidelines for the general population. Chapter 3 deals with food

safety. Some of these issues are specific to pregnancy, while others are general hygiene rules that are particularly important in the vulnerable period of pregnancy. The following chapters then discuss the foods and products on which the committee makes recommendations specifically for pregnant women. In the final chapter, the committee briefly discusses the pre-conception period.



02 a healthy dietary pattern



Pregnant women must first of all have a healthy and varied diet. The *Dutch Dietary Guidelines* are a sound basis for this, supplemented with the specific product group changes for pregnant women explained in the other sections. During pregnancy, a high-quality diet is especially important. The committee believes that in the first trimester, preferably during the first obstetrical consultation, the importance of a healthy dietary pattern and food safety should be stressed. If necessary, obstetricians can also refer their patients to a dietician.

2.1 Healthy and varied food

2.1.1 Recommendation

Eat a healthy and varied diet in accordance with the *Dutch Dietary Guidelines* and the recommendations in this advisory report.

2.1.2 Explanation

Dutch Dietary Guidelines 2015

The *Dutch Dietary Guidelines* apply to pregnant women if in this advisory report no specific recommendation has been made about the particular product group. This is the case for the following guidelines:

- Eat plenty of vegetables (at least 200 grams), fruit (at least 200 grams) and unsalted nuts (at least 15 grams) every day.
- Eat legumes every week.

- Substitute refined cereal products with wholemeal products as much as possible.
- Substitute butter, hard margarine and cooking fats with soft margarine, liquid cooking fats and vegetable oils.
- Limit the consumption of red meat and especially processed meat
- Drink as few sugary drinks as possible.
- Limit the intake of table salt to a maximum of 6 grams per day.

Furthermore, the Health Council of the Netherlands noted in 2015 that a varied dietary pattern is important in order to achieve sufficient intakes of vitamins and minerals.²³

The other dietary guidelines for the general population²³, which cover fish, bread, dairy products, coffee, tea, nutrient supplements and alcoholic beverages, have to be adjusted or require extra attention for pregnant women.

Pregnant women who eat little or no animal products

The general recommendation given in the *Dutch Dietary Guidelines 2015* is: eat a more plant-based and less animal-based diet.²³ During pregnancy, limiting the consumption of animal products is more difficult for several reasons:

- The committee recommends that pregnant women eat more fish than non-pregnant women (section 5.1).
- Animal products are an important source of calcium (dairy), iron (meat)



and iodine^a (dairy and fish) in many diets. Especially during pregnancy, extra attention is required to achieve an adequate intake of calcium-rich, iodine-rich and iron-rich products (sections 5.2, 5.3 and 5.4).

- Animal products are a source of protein and the recommended protein intake for pregnant women is higher than for non-pregnant women. However, animal products are not essential to achieve a sufficient protein intake. This is also feasible with plant-based products. The committee advises exercising caution during pregnancy to avoid excessive intake of soya, a widely used source of vegetable protein, but moderate quantities do not pose a problem (section 3.5).
- Animal products are also a source of vitamin B12. The recommended vitamin B12 intake for pregnant women is higher than for non-pregnant women.^{3,4} Previously, the Council had already recommended that all people with a vegan diet should take a vitamin B12 supplement.^{23,24}

Pregnant women who consume little or no animal products are at greater risk of not consuming enough fish and fish fatty acids, calcium, iodine, iron and vitamin B12. The specific food choice ultimately determines whether nutrient intake from the diet is sufficient or whether supplements are needed, and if so, which ones. For example, some plant-based meat substitutes contain added iron and added vitamin B12 and some dairy substitutes contain added calcium and added vitamin B12.²⁵

^a In the Netherlands, bread is generally prepared with so called 'bakery salt'. This is a specific salt with a relatively high iodine content which is specifically used in bread, biscuits and pastries. Because of this, bread is usually the main source of iodine in the diet. However, dairy and fish can also make a substantial contribution to iodine intake.

Findings on healthy dietary patterns during pregnancy

The committee concludes, based on cohort studies, that a healthy diet is associated with a lower risk of preterm birth.⁹ In these studies, the diets of the participants were assigned a health score, based on several predefined characteristics of a healthy diet. Women with a diet in the top 33% of health scores had a 20% lower risk of preterm birth than those with a diet in the unhealthiest 33% of health scores. In addition, the committee found limited evidence for an association between a healthier diet and a lower risk of gestational diabetes, as well as gestational hypertension and pre-eclampsia.⁹

Dietary reference values requiring extra attention during pregnancy

There is sufficient scientific evidence that certain specific nutrients are important for the prevention of pregnancy complications or for the child's health. These specific nutrients are discussed in this advisory report: folic acid, vitamin D, calcium, iron, iodine and fish fatty acids. Excessive intake of vitamin A is to be avoided during pregnancy because of its undesirable effects on fetal development (see section 3.4).

Some nutrients are not discussed in this advisory report. Nevertheless, pregnant women must still achieve a sufficient intake of these nutrients for a healthy pregnancy, as described in the advisory report entitled *Dietary reference values for vitamins and minerals for pregnant women*.^{3,4} In this advisory report on *Dietary recommendations for pregnant women*,



however, the committee makes no recommendations on nutrients for which only dietary reference values are available (see also section 1.3). The advisory report on dietary reference values shows that for several vitamins and minerals, the dietary reference values (the recommended intake level) for pregnant women is higher than for non-pregnant women. This is the case for vitamin A, vitamin B1 (thiamine), vitamin B2 (riboflavin), vitamin B3 (niacin), vitamin B6, folate, vitamin B12, vitamin C, iodine, copper and zinc.^{3,4} Protein requirements also increase during pregnancy.²⁶

2.2 Weight gain and changing calorie requirements during pregnancy

2.2.1 Conclusion

The committee makes no recommendation on the optimal weight gain during pregnancy. It is impossible to give uniform, universally applicable advice for two reasons. Firstly, the optimal weight gain depends on many factors, including the BMI prior to pregnancy. In addition, weight gain can also be influenced by pregnancy complications. And the number of extra calories needed during pregnancy can also vary greatly between women.

Nevertheless, excessive or insufficient weight gain is associated with the risk of pregnancy complications. In overweight or obese women, this is especially the case with a relatively high weight gain, and in underweight women it is especially the case with a relatively low weight gain.

The committee considers fasting or dieting during pregnancy unwise, because this makes a complete, healthy dietary pattern impossible. Some research was available on Ramadan, but it does not provide a consistent picture and therefore did not allow the committee to draw conclusions.⁹

2.2.2 Explanation

Weight gain

Weight gain during pregnancy can be attributed to various factors, such as the weight of the foetus, the amniotic fluid, the placenta, the uterus, the blood volume and the mother's body fat. The increase of the mother's body fat only makes up a relatively small part of her overall weight gain. Several pregnancy complications, such as pre-eclampsia, cause the body to retain a lot of fluid (oedema), therefore leading to substantial weight gain. This could wrongly suggest that the body is storing a large or excessive amount of body fat.

Based on the available cohort studies, the committee concludes that the optimal weight gain during pregnancy depends on a woman's weight before she becomes pregnant.¹⁰ Weight gain exceeding or falling short of the optimal range is associated with a higher risk of adverse pregnancy outcomes. However, the nature of those risks differs between excessive and insufficient weight gain and also differs between the groups of underweight, healthy, overweight and obese women. It must be noted that



the risk of bias in these cohort studies is relatively high.¹⁰ The committee therefore considers the findings, which are summarised in the following section, to be indicative only and refrains from making a specific recommendation based on them.

The findings of the US National Academy of Medicine (the criteria of the former Institute of Medicine)²⁷ and of a recent meta-analysis based on cohort studies²⁸ suggest that underweight women need to gain at least 13 or 14 kilograms respectively for an optimal pregnancy, and that women with a healthy weight need to gain at least 10 or 11 kilograms, while 7 or 5 kilograms of weight gained, or perhaps even 2 kilograms, seems to be sufficient for overweight or obese women, respectively. The upper limits for optimal weight gain seem to be around 16 to 18 kilograms for underweight women or women with a healthy weight, around 11 or 16 kilograms for overweight women, and around 9 kilograms or possibly even 4 to 6 kilograms for obese women.^{10,27,28}

RCTs attempting to influence weight gain during pregnancy through dietary interventions have been conducted mainly with overweight and obese women. For that group, RCTs have produced limited evidence that this type of nutritional intervention reduces the risk of preterm birth. There are not enough RCTs with underweight women or women of a healthy weight to be able to say something about these groups.

Calorie requirement

The body needs calories and nutrients to gain weight. Because women with a low BMI need to gain more weight than women with a high BMI, women with a low BMI will, on average, need to consume relatively more calories than women with a high BMI. Other reasons for different calorie requirements and changes in said calorie requirements during pregnancy between women are, for example, the woman's height and activity level during pregnancy. Most women become slightly less active during pregnancy, which lowers the increase in calorie requirement.²⁹

Calorie requirement is a nutritional factor for which estimates at the group level have little relevance for the individual. The differences between women are too great to make recommendations on how much to increase one's energy intake during pregnancy.



03 food safety



For the most part, food safety recommendations are no different for pregnant women than for the general population. Several recommendations, however, apply specifically to pregnant women, because of possible effects on the pregnancy, the foetus or the offspring. Also, pregnancy, in general, is a more vulnerable period for food infections.

3.1 Food infections

3.1.1 Recommendation

During pregnancy, in addition to the hygiene measures for the general population, extra caution must be exercised to avoid food infections with the bacterium *Listeria monocytogenes* and with the parasite *Toxoplasma gondii*.

3.1.2 Explanation

Listeria and *Toxoplasma*

Two pathogens pose a serious risk specifically during pregnancy: the bacterium *Listeria monocytogenes* (hereinafter referred to as *Listeria*) and the parasite *Toxoplasma gondii* (hereinafter referred to as *Toxoplasma*). These pathogens can seriously harm the unborn child or cause a miscarriage, while the pregnant woman herself may experience few symptoms. It is therefore recommended to be careful with products that may contain these pathogens.

There are many different recommendations with regard to preventing *Listeria* and *Toxoplasma* infections, which can create the impression that pregnant women should avoid a great many foods. The committee will show that this is by no means always necessary, and explain how products can be consumed responsibly.

Risks and opportunities

Listeria and *Toxoplasma* can cause serious risks during pregnancy.

Consuming a product that has not been heated sufficiently can lead to *Listeria* or *Toxoplasma* infections, although this does not always happen. The risk of contracting such an infection is small, but the consequences can be severe if it does happen. Pregnant women who accidentally eat a product that has not been cooked properly need not be excessively worried, but doing so more often will necessarily increase the chances of infection. It is therefore important to follow the recommendations.

Listeria often ends up on products via cutting machines or knives or after contact with surfaces that were previously contaminated with the bacterium in what is called post-contamination. That is why *Listeria* can also end up in products where it does not occur naturally, such as cooked meat products. If raw milk is contaminated with *Listeria*, the bacteria will end up in the milk and in the products made of said milk. The presence of *Listeria* in a foodstuff becomes particularly risky if there are circumstances that have allowed the bacteria in the foodstuff to grow.³⁰ *Listeria* survives in freezers and can multiply at low temperatures and in moist



environments (i.e. in the fridge). However, the lower the temperature, the slower the bacteria multiply. All products that can contain *Listeria* should therefore be kept well chilled and put in the refrigerator as soon as possible after purchase. The committee recommends pregnant women to eat these products within their best-before date and to eat products in which *Listeria* can grow within two to three days of opening the packaging. Modified Atmosphere Packaging (MAP) with increased CO₂ concentration reduces the rate of multiplication of *Listeria* and other micro-organisms.³¹ After opening such packaging, the protective atmosphere has disappeared and the product should be consumed within a short time. The bacteria can be rendered harmless by heat.

Toxoplasma reproduces in cats and felines and is found in their faeces. This parasite can therefore be found in soil (garden soil, cat litter boxes and sandpits). Through the contaminated soil, *Toxoplasma* can occur on fruit and vegetables. *Toxoplasma* can occur in meat of animals that have eaten the parasite. The parasite does not multiply in food, but can lead to disease in humans at low quantities. It can be rendered harmless by freezing or heating.

The various recommendations are listed in Table 1. This table consists of the products with a risk of *Listeria* or *Toxoplasma* infection.

The recommendations for reducing the risk of infection with these pathogens also help to reduce the risk of infection with other pathogens. Below this table the committee describes the standard hygiene rules intended to prevent food infections in general. Food infections other than those caused by *Listeria* or *Toxoplasma* pose no obvious additional risks to pregnant woman or their unborn child compared to the general population.



Table 1 Specific recommendations to prevent food-borne infections with *Listeria* and *Toxoplasma*

Products	Recommendations
<ul style="list-style-type: none"> Raw milk cheese^a Raw milk^b Ready-to-heat or ready-to-cook products^c Minced meat, chicken and other meat that must always be cooked all the way through Steak, pork tenderloin and other meat suitable for cooking techniques that leave the meat partially raw^d Raw meat including meat products that have only been dried, smoked and/or salted Crustaceans and molluscs^e Raw fish^f and smoked fish^g 	<ul style="list-style-type: none"> heat all the way through to a core temperature of 75°C put in the refrigerator as soon as possible after purchase store well chilled (at 4°C) products packed in a protective atmosphere: after opening the package, eat within two (when stored at 7°C) or three (when stored at 4°C) days all other products: eat by the best-before dateⁱ
<ul style="list-style-type: none"> Meat or fish without a best-by date that has been cooked all the way through (boiled, fried or grilled, e.g. from a butcher's shop, deli counter, fish shop or fish stand) Leftovers 	<ul style="list-style-type: none"> eat immediately or else keep well refrigerated (at 4°C) and covered on the first day after it has been cooked, the product can be eaten cold provided it was cooled down quickly after cooking (below 10°C within 2 hours and below 7° within 5 hours) on the second or third day after it has been cooked, the product should be heated all the way through up to a core temperature of 75°C prior to consumption eat the product within two days (when stored at 7°C) or three days (when stored at 4°C)
<ul style="list-style-type: none"> Soft cheese made from pasteurised milk^j Ready-to-eat products^k Meat products that have been cooked all the way through 	<ul style="list-style-type: none"> put in the refrigerator as soon as possible after purchase store well chilled (at 4°C) products packed in a protective atmosphere: after opening the package, eat within two (when stored at 7°C) or three (when stored at 4°C) days^h all other products: eat by the best-before dateⁱ

Products	Recommendations
<ul style="list-style-type: none"> Washed and sliced pre-packaged raw vegetables intended to be cooked at home 	<ul style="list-style-type: none"> cook on all sides before consumption put in the refrigerator as soon as possible after purchase store well chilled (at 4°C) products packed in a protective atmosphere: after opening the package, eat within two (when stored at 7°C) or three (when stored at 4°C) days^h all other products: eat by the best-before dateⁱ
<ul style="list-style-type: none"> Uncut raw fruit and vegetables 	<ul style="list-style-type: none"> wash well before consumption to remove soil residue

^a With raw-milk cheeses, made from milk that can contain *Listeria* and *Toxoplasma*, there is a difference between hard and soft cheeses. *Listeria* can grow and multiply relatively easily in soft raw-milk cheeses, which means the risk of infection is greatest with these cheeses. Hard raw-milk cheeses pose only a limited risk of *Listeria* and *Toxoplasma* infection.³² *Listeria* cannot grow and multiply easily in hard cheese made from raw and pasteurised milk because of the low moisture content, which means that these types of cheeses pose an acceptable risk as far as *Listeria* is concerned.^{33,34}

^b The recommendations on raw milk apply to raw milk from all farmed animals. Raw milk is listed in this table because of the risks of *Listeria* and *Toxoplasma* infection, but the committee notes that raw milk can also cause other food-borne infections.

^c Ready-to-heat products are chilled products that have already been cooked and only need to be heated before consumption, such as ready-made fresh soups and microwave meals. Ready-to-cook products are chilled products that have not yet been cooked, but have been pre-cut and portioned, for example. These products must be cooked before consumption. Examples include ready-made fresh meal kits and washed and sliced pre-packaged raw vegetables intended to be stir-fried, boiled or cooked at home.

^d With steak, pork tenderloin and other meat suitable for cooking techniques that leave the meat partially raw, a choice can be made between 'certainty' or taking an 'acceptable risk'. Cooking meat all the way through up to a core temperature of 75°C is the only way to completely avoid the risks of *Listeria* and *Toxoplasma*. However, meat that is stored at -12°C for at least four days (or at -20°C for 3 days) is free of *Toxoplasma*. *Listeria* can only be found on the outside of meat, so frozen meat needs only to be cooked on all sides to avoid the risks posed by *Listeria*. Please note that this does not apply to 'composite meat' and so-called plumped meat, which must always be cooked all the way through. 'Composite meat' looks like a single cut of meat but is actually composed of several smaller pieces of meat, which means *Listeria* may also be present within. In some cases, meat is injected with a fluid, so-called plumped meat, which can cause it to become contaminated with *Listeria*. When you are unsure about whether you are dealing with composite meat or plumped meat, the best course of action is to cook the meat all the way through.

^e The risks of *Listeria* and *Toxoplasma* are greater with crustaceans than with fish, and crustaceans must always be cooked all the way through.

^f With raw fish, a choice can be made between 'certainty' or taking an 'acceptable risk'. To be on the safe side, fish should be cooked all the way through up to a core temperature of 75°C, as this is the only way to completely avoid the risks of *Listeria* and *Toxoplasma*. Anyone opting to take an acceptable risk should cook the fish on all sides prior to consumption, because *Listeria* is mainly found on the surface of fish. *Toxoplasma* is much less common in fish than in meat, for example, so this risk may already be considered acceptable. The risk of *Toxoplasma* can be safely avoided by freezing the fish for at least four days at -12°C (or three days at -20°C)



before consumption. It is clear from the above that eating raw fish always carries risks (*Toxoplasma*, *Listeria* and possibly other micro-organisms), but the risk posed by *Listeria* is small when eating fresh raw fish within one day after it has been caught, as any *Listeria* present will hardly have had a chance to multiply into risky quantities. Eat raw fish only if you are sure that it was caught on the same day or at least no more than one day ago.

^g With smoked fish, a distinction can be made between cold-smoked and hot-smoked fish. It is best to assume that a fish has been cold-smoked, unless it is certain that the fish has been hot-smoked. For cold-smoked fish, the same recommendations apply as for raw fish, as fish are not heated during cold-smoking. However, if it is certain that the fish has been hot-smoked, it can be treated as fish that has been cooked all the way through.

^h Some perishable products are pre-packaged under a protective atmosphere (modified atmosphere packaging or MAP) and may have a best-before date instead of a use-by date. The growth of *Listeria* is inhibited by an increased concentration of CO₂ (Note: the growth of this bacterium is not inhibited by an increased concentration of N₂, nor by vacuum packaging³¹). Opening the packaging compromises the protective atmosphere and invalidates the best-before/use-by date, which means the product must be consumed within two (when stored at 7°C) to three (when stored at 4°C) days. Therefore, the shelf life of these products after opening the packaging is usually shorter than the expiry date on the packaging.

ⁱ The expiry date on perishable products that require refrigeration is normally a use-by date. Products that do not spoil quickly and some perishable products that are packaged in a protective atmosphere have a best-before date. The storage guide published by the Netherlands Nutrition Centre contains storage advice for more than 2,000 products.³⁵

^j In soft cheese made from pasteurised milk, *Listeria* can occur in the whole product, but this risk is lower than for soft raw-milk cheese. There is no risk of *Toxoplasma*.

^k By *ready-to-eat* products, the committee means pre-packaged or ready-to-eat refrigerated products that can be eaten without being cooked first and in which *Listeria* can grow. These include meal salads, raw vegetable salads, fruit salads, washed salad leaves, sandwiches, wraps and fresh pastries with, for example, whipped cream or cream. The committee does not mean products such as yoghurt, tomato ketchup, gherkins, etc. More information can be found in the storage guide published by the Netherlands Nutrition Centre.³⁵

Hygiene rules for the entire population, including pregnant women

The hygiene rules for the entire population are aimed at preventing food infections in general. These general hygiene rules are:

- Wash your hands thoroughly (at least after toilet breaks, before and during cooking, before eating, after touching raw meat or fish, after cleaning the cat litter box, and after gardening).
- Keep products that need to be cooked or washed before they can be eaten separate from products that are ready to eat.
- Put chilled products in the refrigerator as soon as possible after

purchase.

- Keep refrigerated products and leftovers covered and at the right temperature (in the fridge at 4°C).
- Defrost frozen products in the refrigerator and/or in the microwave immediately before use.
- Use clean kitchen utensils and change dishcloths daily.
- Wash dishcloths, tea towels, towels, dishwashing sponges and dishwashing brushes at a minimum temperature of 60°C.
- Clean counters thoroughly.
- Strictly observe the use-by date.

These hygiene rules are intended to protect people not only from *Listeria* and *Toxoplasma*, but also, for example, from *Salmonella*, *E. coli* and *Campylobacter*. These rules should always be followed, but even more so during pregnancy. Pregnancy is a sensitive period during which a woman's immune system works differently than when she is not pregnant.¹¹ Potentially, pregnant women therefore have a higher chance of becoming ill after contracting certain infections and also a higher chance of developing more severe symptoms.³⁶ In addition, treatment can be more difficult because various medications are not considered suitable for pregnant women.

Finally, there are additional rules for young children, the elderly, pregnant women and people with compromised immune systems for two specific



products. These rules are intended to reduce the risk of food-borne infections (other than *Listeria* and *Toxoplasma*). The rules are as follows:

- Boil or fry eggs before consumption until the egg has completely hardened.
- Heat raw sprouts before consumption.

3.2 Harmful substances including dioxins and acrylamide

3.2.1 Introduction

This section concerns harmful substances that may be present in many different products as a result of environmental pollution or food preparation. In most cases, laws and legislation ensure that exposure to harmful substances remains within certain limits at which they pose an acceptable health risk for the entire population.

For harmful substances, so-called risk assessments are drawn up, which determine the tolerable daily or weekly intake of a particular substance. At exposure levels below that limit, there is no reason for concern. In case of exposure above the tolerable intake, harmful effects cannot be ruled out. For some substances, such as dioxins, it is difficult to keep exposure below the limit value. In that case, the so-called *ALARA* principle is applied, which means striving to keep the intake as low as reasonably achievable. This *ALARA* principle also applies to certain carcinogenic substances, the genotoxic carcinogens, because exposure to these substances always contributes to the risk of adverse effects. This group of

carcinogens contains acrylamide, furans and PAHs, which are formed when the colour of a product turns very brown or black as a result of heating.

The recommendations in sections 3.2 to 3.7 (harmful substances), section 5.1 (fish species) and chapter 6 (beverages) contribute to reducing exposure to harmful substances in general. During pregnancy, harmful substances are of extra concern if there are indications of possible adverse effects on the health of the pregnant woman and/or the developing child. This is mentioned by the committee where applicable.

In this section, the committee discusses various findings on dioxins and acrylamide relevant to pregnancy. The section on acrylamide also mentions other harmful substances that can be formed when cooking products at high temperatures, but for which there are no specific findings for pregnant women.

Some harmful substances occur naturally in food, such as herbs containing pyrrolizidine alkaloids and allylalkoxybenzenes, discussed in section 3.6, and products containing liquorice root or glycyrrhizin, discussed in section 3.7.



Methylmercury is almost exclusively found in fish. Overexposure can be prevented by avoiding certain types of fish, which is why this substance is discussed in the section on fish (section 5.1).¹²

In September 2020, EFSA published a report on the risks arising from the presence of PFAS.³⁷ With this report, the tolerable weekly intake of PFAS was reduced substantially. PFAS compounds are found in various foods, but for now, the limit value seems to be exceeded only when consuming certain types of fish. This can be prevented by avoiding certain types of fish (section 5.1).¹²

3.2.2 Recommendation

For the general population, and certainly for pregnant women, it is important to limit exposure to harmful substances by eating a varied diet and by not allowing products to turn too brown or black when cooked.

3.2.3 Explanation

In addition to nutrients, food may also contain substances that are potentially harmful, including products found in the *Dutch Dietary Guidelines 2015* and the Wheel of Five. A varied diet prevents or reduces the daily intake of excess amounts of a particular harmful substance.

Dioxins

Dioxins are mainly found in animal products, such as fish, meat, dairy products and eggs, but they are also found in vegetable oils and fats³⁸ Exposure to dioxins cannot be avoided, even with a healthy dietary pattern.

The body stores dioxins in adipose tissue. The half-life of dioxins in the body spans many years, with estimates ranging from 3 to 10 years. The amount of dioxins stored in adipose tissue therefore increases with age until a balance is reached between intake and excretion. During pregnancy some dioxins are transferred from mother to foetus. Breastfeeding women excrete part of the dioxins stored in their body through their breast milk.³⁸

In 2018, EFSA significantly reduced the tolerable weekly intake of dioxins from 14 to 2 picograms per kilogram of body weight per week. The 'critical effect' of dioxins (the first adverse effect caused by dioxins that occurs with increasing exposure; this is the effect on which the tolerable intake level is based) concerns the sperm quality of male offspring. The committee notes that the possible effects of dioxins on the child are not specifically related to exposure during pregnancy, but to the total exposure before and after birth, only a small part of which occurs during pregnancy.^{12,38}



The aim is to keep dioxine intake as low as reasonably achievable (section 3.2.1). Some fish species can contain such high levels of dioxins that their consumption is not recommended (section 5.1).¹² In meat, dairy and vegetable oils, the levels of dioxins are lower, but - based on the products^a and amounts recommended by the Netherlands Nutrition Centre - meat, dairy and oil together amount to an exposure of about the tolerable intake of dioxines.¹²⁶ Calabash chalk can also contain high levels of dioxins, as well as high levels of lead, see section 3.3.2. Therefore, the committee advises against eating this product.³⁹

Acrylamide and other harmful substances that can be formed when cooking food

Several cohort studies have reported an association between higher exposure to acrylamide and a higher risk of having a child that is small for gestational age. Acrylamide is formed when starchy foods are baked, roasted and fried at high temperatures. The main dietary sources of acrylamide are coffee, gingerbread, toasted cereals, bread (especially toasted), cakes and biscuits, crackers and fried potato products such as chips and crisps.¹¹

Furans are also formed when food is heated and cooked. The risks posed by furans are - as far as is known - no different for pregnant women than

^a This calculation is based on lean meat, semi-skimmed milk and milk products, “30+” cheese (this is Dutch cheese with 18-20 grams of fat per 100 grams of cheese). If products with a higher fat content are eaten, the exposure to dioxins will be higher.

for the general population. This also applies to the risks of exposure to harmful substances through smoking techniques, including barbecuing, and through excessive discolouration of cooked food, namely polycyclic aromatic hydrocarbons (PAHs) and heterocyclic amines. The committee has not investigated whether the latter two groups of substances have specific effects on pregnant women. Exposure to acrylamide and other harmful substances that can be formed when foods are cooked at high temperatures is limited if care is taken not to allow products to turn excessively brown or black.

3.3 Lead

3.3.1 Recommendation

- In buildings with lead plumbing, use bottled water instead of tap water. For buildings with newly installed plumbing and/or taps, specific instructions on the use of tap water must be followed for the first three months after installation.
- Avoid calabash chalk.

3.3.2 Explanation

In general, Dutch tap water is high-quality potable water. However, in a small number of houses, tap water contains excessive levels of lead, which can be harmful to the health of unborn children. This concerns older houses with lead plumbing. In homes with new plumbing or taps, tap water may also contain excess levels of lead for the first few months, as



the new materials temporarily release lead into the water. There is strong evidence that lead exposure in young children leads to a lower IQ.⁴⁰

In November 2019, the Health Council recommended for buildings with lead plumbing that people belonging to risk groups use bottled water instead of tap water until the lead plumbing is replaced. Lead plumbing may still be found in houses built before 1960. Pregnant women were identified as a risk group. Young families in homes with new plumbing or taps were recommended to flush the tap after several hours of inactivity in the first few months after installation.⁴⁰ The Netherlands Nutrition Centre has drawn up concrete instructions for the use of tap water with new plumbing and taps, which have been coordinated with various parties.⁴¹ The committee takes the previously published advisory report from the Health Council as its starting point and endorses the practical instructions drawn up by the Netherlands Nutrition Centre on new plumbing or taps. The Netherlands Nutrition Centre recommends using bottled water to prepare water-based drinks, soups and sauces, as well as products that absorb a lot of water such as pasta, rice and couscous when living in a home with lead plumbing.⁴²

Calabash chalk can also contain high levels of lead, in addition to high levels of dioxins (see section 3.2.2). Pregnant women are therefore advised to avoid calabash chalk.⁴³ Calabash chalk is also known as white dirt, *white clay*, mabele, or pimba and is sometimes used to treat nausea.

3.4 Vitamin A

3.4.1 Recommendation

Avoid liver and eat liver products in moderation. Supplements that are not specifically intended for pregnant women may contain too much vitamin A.

3.4.2 Explanation

Liver and liver products such as pâté and liver sausage contain high amounts of vitamin A (retinol). Maternal intake of more than 3,000 micrograms of vitamin A in one or a few days increases the risk of malformations of the skull, face, central nervous system, thymus or cardiovascular system in the unborn child.⁴⁴ Beef liver contains almost 30,000 micrograms of vitamin A per 100 grams and pork liver over 20,000 micrograms. Liver is therefore best avoided entirely. One serving of spreadable sausage or pate (averaging 15 to 22 grams) contains, depending on the type, between 1,100 and 1,700 micrograms of vitamin A.^{45,46}

This advice is particularly important in the first trimester of pregnancy, as this is the time that the developing child is most susceptible to the aforementioned abnormalities.¹¹ Furthermore, the committee points out that supplements that are not specifically intended for pregnant women can potentially contain excess levels of vitamin A.



3.5 Isoflavones from soya

3.5.1 Recommendation

Avoid excessive intake of isoflavones from soya products and do not take supplements containing these phytoestrogens.

3.5.2 Explanation

Soya beans and products made from soya beans contain relatively high amounts of isoflavones. These substances have a weak oestrogenic effect and can cross the placenta. No European upper limit has been set for the general population or specifically for pregnant women. In France, an upper limit of 1 milligram per kilogram of body weight per day has been set for the general population. As a precaution, the committee has adopted this French upper intake level for pregnant women.

The aforementioned upper limit is based on animal studies showing associations of regular high exposures during pregnancy or after birth with changes in the development and maturation of the genitalia and sometimes also in fertility.¹¹

The upper limit can only be reached or exceeded by eating large quantities of soya beans or soya products. For example, to reach the limit of 64 milligrams of isoflavones per day for a 64 kg woman, this woman must consume 310 grams of tofu, 340 grams of tempeh, 230 grams of soya beans (edamame), 610 millilitres of soya milk, 610 millilitres of soya yoghurt, or 1.2 kilograms of soya burgers. Soy sauce has a very limited

contribution to isoflavone intake. Based on partly obsolete data, it seems that the upper intake limit may be exceeded by some people with a vegan diet (about 75 milligrams of isoflavones per day), with a traditional South Asian diet (about 25 to 100 milligrams of isoflavones per day) and people with lactose intolerance who consume soy-based dairy substitutes. In an omnivorous or vegetarian diet, isoflavone intake is generally much lower (between 1 and 12 milligrams per day).¹¹

Using supplements containing phytoestrogens puts one at greater risk of exceeding the upper intake level, as they may contain higher levels of these substances. Pregnant women are therefore advised to avoid these supplements.

3.6 Herbs with pyrrolizidine alkaloids or allylalkoxybenzenes

3.6.1 Recommendations

- As for the general population, the normal use of kitchen herbs during pregnancy is not a problem.
- Avoid pills, capsules or other highly concentrated products made from plants or herbs containing pyrrolizidine alkaloids or allylalkoxybenzenes, or from the essential oils of these plants.



3.6.2 Explanation

Some plants or herbs contain allylalkoxybenzenes and pyrrolizidine alkaloids, so-called genotoxic carcinogens, which can increase the risk of cancer. Because it is impossible to rule out that such substances may have harmful effects, the *ALARA* principle should be followed. The risks posed by these substances increase as exposure increases. At low doses, the risks are small.

In principle, the risks associated with these substances are no different for pregnant women than for the general population. However, cases of poisoning have been reported following exposure to pyrrolizidine alkaloids in pregnancy, resulting in liver damage to the foetus or newborn. No such case reports have been found for allylalkoxybenzenes in pregnancy.¹¹

Allylalkoxybenzenes are aromatics found in certain herbs and spices: aniseed, tarragon, fennel, basil, allspice, nutmeg, cinnamon, sassafras, dong quai, mace and pepper. If these herbs and spices are used as regular seasonings, the intake of allylalkoxybenzenes will remain very limited. Therefore, the normal use of these herbs and spices for cooking is not a problem for the general population or for pregnant women.

In practice, herbs are often recommended to reduce salt intake.

The committee endorses this recommendation.

Pills, capsules or other highly concentrated products intended for consumption made from or containing these herbs or essential oils derived from these herbs may contain higher doses of

allylalkoxybenzenes and it is therefore recommended that they be avoided.

Pyrrolizidine alkaloids can be found in certain plants, such as borage, coltsfoot, common comfrey, ragworts and rattlepods.¹¹ Pills, capsules or other highly concentrated products intended for consumption made from or containing these herbs or essential oils derived from these herbs may contain higher doses of pyrrolizidine alkaloids and it is therefore recommended that they be avoided.

With regard to herbal remedies in the broader sense, the committee notes that risks have been reported in connection with unintentionally mistaking herbs for others, in addition to the possible presence of harmful substances in the aforementioned herbs. The composition of these herbal remedies is not always checked or analysed, especially if they are sold online.⁴⁷⁻⁴⁹

3.7 Products containing liquorice root or glycyrrhizin, such as liquorice

3.7.1 Recommendation

Limited consumption of products containing liquorice root or glycyrrhizin (such as liquorice) is safe for pregnant women with normal blood pressure. Pregnant women with high blood pressure should avoid using products containing liquorice root or glycyrrhizin.



3.7.2 Explanation

Glycyrrhizin is a constituent of liquorice root that gives liquorice its taste and is the main ingredient of liquorice. Glycyrrhizin leads to a temporary increase in blood pressure. Data is scarce on the effects of glycyrrhizin in pregnant women, but because these women are more susceptible to the harmful effects of high blood pressure, the committee advises pregnant women to limit their intake of glycyrrhizin as a precaution. All available research involving pregnant women is from a single study group from Finland and comprises a cohort study and a case-control study. They reported that high versus low glycyrrhizin intake (at limit values of 70 and 35 milligrams per day) was associated with an increased risk of preterm birth under 34 weeks, worsened mental development of the offspring, and more rapid height and weight development during puberty.¹¹ Based on these limited data, the limit value of 100 milligrams of glycyrrhizin per day set by EFSA for the general population seems too high for pregnant women. However, the available research is insufficient to derive a well-founded limit value for pregnant women.

It is the committee's opinion that pregnant women who already have elevated blood pressure should avoid taking products containing glycyrrhizin as a precaution. Blood pressure is checked regularly during pregnancy. Healthcare providers can choose to discuss the use of liquorice and other products containing glycyrrhizin with women with high blood pressure. In addition to liquorice, teas containing liquorice root also

contain glycyrrhizin. A recommendation on such teas has been included in the section on beverages (section 6.3).

Liquorice contains approximately 830 milligrams of glycyrrhizin per kilogram. Products that are high in glycyrrhizine must be labelled accordingly. Products containing more than 100 milligrams per kilogram (food) or 10 milligrams per litre (beverages) must be accompanied with the following message on the label: 'contains liquorice root'. Products containing more than 4,000 milligrams per kilogram or 50 milligrams per litre must be accompanied with the following message: 'contains liquorice - people with high blood pressure should avoid excessive use'.¹¹

Limited data are available on liquorice consumption in women of child-bearing age. At the 95th percentile, intake was 30 grams of liquorice a day. This means that 95% of women ate 30 grams of liquorice or less per day.¹¹ This amount is below the 42 grams per day required to achieve an intake of 35 milligrams of glycyrrhizin per day. Based on these data, the committee is of the opinion that the current consumption of liquorice by most women of childbearing age does not give cause for concern. There are no data available on the total intake of glycyrrhizin.



04 nutrient supplements



The recommendation to take folic acid prior to and during early pregnancy is particularly important. Pregnant women are also advised to take vitamin D. These recommendations are not new, but their importance has been stressed by recent studies.

4.1 Folic acid

4.1.1 Recommendation

Take a supplement with 400 micrograms of folic acid per day from at least four weeks before conception until the tenth week of pregnancy.

4.1.2 Explanation

Folate plays a role in the production of vital compounds in the body, including DNA, RNA, hormones, proteins, neurotransmitters and the phospholipids in cell membranes, which is why folate is especially important during pregnancy.

The committee endorses the recommendations made by the Health Council of the Netherlands on folic acid supplements since 1993.⁵⁰ The recommended supplementation of 400 micrograms of folic acid is to be added to the dietary reference value, which concerns the desired intake of folate through food. The dietary reference value for folate is 300 micrograms per day prior to conception and 400 micrograms per day from conception onwards.^{3,4,51}

Folate and folic acid

Folate occurs in food, but this B vitamin can also be taken as synthetic folic acid. One microgram of folate is not the same as one microgram of folic acid, which is why the dietary reference value is expressed in dietary folates equivalents. The body absorbs less folate than it does folic acid. As such, a 400 microgram supplement of folic acid provides 800 micrograms of dietary folate equivalents when taken on an empty stomach and 665 micrograms of dietary folate equivalents when taken with food.⁵¹ In the Netherlands, dietary folate intake probably averages about 280 micrograms a day.⁵² Total intake from food and supplements combined will come down to anywhere between 945 and 1080 micrograms of dietary folate equivalents per day during the period covered by the supplementation recommendation.

Taking a supplement containing 400 micrograms of folic acid per day in the period from at least four weeks prior to conception until the tenth week of pregnancy^a (hereinafter referred to briefly as ‘around conception’) leads to a substantial reduction in the risk of neural tube defects (spina bifida and anencephaly), as has been confirmed by recent studies.⁵ The neural tube closes in the first month after conception, which is why it is very important to start supplementing folic acid on time.

In addition to protecting against neural tube defects, the recommended use of folic acid supplements in cohort studies is associated with a lower

^a Due to the way in which pregnancy weeks are typically counted, namely from the first day of the last menstruation, the first two weeks, on average, are still before conception. It is therefore recommended to take folic acid supplements from at least two weeks before the date considered the first day of pregnancy until the tenth week of pregnancy. This effectively covers the same period as four weeks prior to conception until eight weeks after conception.



risk of preterm birth and a lower risk of the child being small for gestational age at birth. There is also limited evidence from cohort studies that supplementing folic acid is associated with a lower risk of cleft lip and palate.⁵

Although the recommendation on folic acid supplements has been around for a long time, it is poorly followed. The percentage of women who start taking folic acid before conception has been estimated at 40% and 33% in two Dutch studies.^{53,54} In one of these studies, only 25% of women complied fully with the recommendation.⁵⁴ The committee notes that considerable improvement is still needed in following this recommendation, and expresses its concern. In implementing these recommendations, attention should be paid to improving this situation.

The committee found no prospective study on the effects of continuing to take folic acid supplements in the second and third trimesters of pregnancy. An adequate folate supply remains important at those stages of pregnancy.^{3,4} Following the advice to take a folic acid supplement in addition to the dietary reference values for folate around the time of conception will prompt the body to build up folate reserves. If from the tenth week of pregnancy onwards the intake of folate is lower than the folate requirement (i.e. after the period in which pregnant women are advised to take folic acid supplements) these reserves can at least partly replenish the deficit. Most pregnant women's dietary folate intake is

considerably lower than the adequate intake (the dietary reference value). Although folate intake is higher in dietary patterns based on the 'Wheel of five', it will still be somewhat lower on average than the adequate intake. For women whose diets meet the recommendations of the 'Wheel of five' and who fully complied with the folic acid recommendation, it is likely that folate intake can be adequately supplemented from the body's store of folate later in pregnancy. However, there are no studies on the combined effect of the recommended use of folic acid supplements around conception and diet on blood folate concentrations in late pregnancy.

4.2 Vitamin D

4.2.1 Recommendation

During pregnancy, take a supplement containing 10 micrograms of vitamin D per day.

4.2.2 Explanation

Vitamin D is obtained from food and is produced in the skin during exposure to sunlight. Dietary sources of vitamin D are spreadable fats and cooking fats (in the Netherlands, vitamin D is added to these fats), fish, meat and eggs.⁵⁵ In light-skinned people, about two-thirds of the total vitamin D intake - averaged over the whole year - comes from production in the skin and one-third from food. In winter, the vitamin D status in the Netherlands drops because there is not enough sun. People with darker skin produce less vitamin D in the skin.⁵⁶



In 2012, the Health Council recommended that pregnant women and several other risk groups take a supplement containing 10 micrograms of vitamin D per day. The advice for pregnant women at the time was precautionary, motivated by the role of vitamin D in bone development in children. The advice was prompted in part by case reports of epileptic seizures in newborns born to mothers with severe vitamin D deficiency and intervention studies showing that supplementing vitamin D reduced the risk of giving birth to a child with low birth weight.⁵⁶

New scientific findings based on RCTs strengthen the rationale for the advice to pregnant women to supplement vitamin D, with beneficial effects being found on the risk of gestational diabetes, and on the risks of a child being small for gestational age at birth or developing asthma-like symptoms or wheezing.⁵ Although the evidence for these findings was limited, the committee considers that taking the three findings together, there is sufficient efficient evidence that vitamin D supplements are beneficial during pregnancy. The dosages in the RCTs were inconclusive. Recent data on the vitamin D status of pregnant women, although limited, show desirable blood values (calcidiol at least 30 nanomoles per litre).^{52,57} Because these data were collected while the vitamin D supplementation recommendation was already in force in the Netherlands, the committee sees this as an indirect indication that the existing recommendation of supplementing 10 micrograms per day is adequate. In studies conducted before the supplementation recommendation was issued, the average

vitamin D status was adequate but not high.^{58,59-61} In these older studies, approximately half of all pregnant women had an inadequate vitamin D status (calcidiol levels below 30 nanomoles per litre). Pregnant women's vitamin D status was lowest in winter and among women of non-European origin.^{59,60}

A small study has shed light on the intake of dietary vitamin D among pregnant women in the Netherlands, showing that these women get around 3.5 micrograms of vitamin D per day (excluding supplements). The average intake of vitamin D from supplements in these pregnant women was between 6 and 7 micrograms per day during pregnancy.⁵² Non-pregnant women of childbearing age have a slightly lower intake of dietary vitamin D (excluding supplements) of around 2.5 micrograms per day, according to the Dutch National Food Consumption Survey 2012-2016.⁶²

The dietary intake of vitamin D is therefore lower than the dietary reference value of 10 micrograms per day, which means that pregnant women must either produce additional vitamin D themselves or take supplements to meet the daily reference values. The RCTs that found supplementation to have beneficial effects, did not perform subgroup analyses for women who spent a lot of or little time in the sun or for women with different skin colours. Therefore, the committee recommends that all pregnant women supplement their dietary intake with a supplement



of 10 micrograms per day, regardless of the time of year, sun exposure or skin colour.

4.3 Multi-vitamin and multi-mineral supplements

4.3.1 Conclusion

There is no scientific basis for recommending the use of multi-vitamin and multi-mineral supplements during pregnancy, but there are situations in which a combined supplement may be useful.

4.3.2 Explanation

In the available RCTs on the effects of supplements with various vitamins and minerals, the composition of both the supplements studied and the control tablet taken is variable (for example, the placebo does sometimes contain some nutrients). The findings therefore only give an approximate idea of the effects of these supplements. The cohort studies, too, combine supplements with very different compositions.⁵

The available evidence from RCTs on multi-vitamin and multi-mineral supplements is not relevant to the Dutch situation, as the vast majority of RCTs were conducted in countries characterised by medium or low incomes.⁵ The circumstances of the pregnancies, the overall situation and the dietary situation of the participants in those RCTs cannot be compared with the Netherlands. Only a limited number of cohort studies were conducted in Western countries. Because these only resulted in findings

with limited evidence and this type of research always carries a risk of confounding (bias), the committee concludes that there is no scientific basis for a recommendation on the use of such supplements during pregnancy in the Netherlands.

Sometimes, women are unable to optimise their dietary pattern because they are not able to adjust their food choices. Chapter 5 indicates which food choices are necessary to achieve adequate intakes of various nutrients. If these choices are not feasible, the committee recommends taking a supplement (with fish fatty acids including a specified dose of docosahexaenoic acid (DHA) and/or calcium and/or iodine) to compensate. In addition, the recommendations for folic acid and vitamin D supplements apply to all pregnant women. If the diet appears inadequate on several fronts, a combination supplement may be a practical alternative. In that case, however, it is important to choose a supplement with dosages that are suitable for pregnancy. The required dosage depends on a woman's individual situation, but a supplement containing once the recommended amount or adequate intake will be neither too low nor too high. Higher doses are neither necessary nor desirable.



05 foods



Some foods require extra attention during pregnancy. For example, pregnant women are recommended to eat more fish than the general population, and it is also important for this group to consume enough products that are rich in calcium, iron and iodine.

5.1 Fish and fish fatty acids

5.1.1 Recommendation

Eat fish twice a week, including one serving of fatty fish and one serving of lean fish, taking into account the recommendations on fish species in this section.

For women who cannot or do not want to eat this amount of fish: take a fish-fatty-acids supplement that provides an intake of 250 to 450 milligrams of docosahexaenoic acid (DHA) per day.

5.1.2 Explanation

Fish contains “fish fatty acids”: the very-long-chain polyunsaturated fatty acids eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA). Our bodies cannot produce these fish fatty acids in sufficient quantities, which is why they must be obtained mainly from our diet.⁶³⁻⁶⁶ Fish is also a source of essential nutrients such as vitamin D, iodine and selenium. In the *Dutch Dietary Guidelines 2015*, the Health Council of the Netherlands advised the general population to eat fish once a week, preferably fatty fish, in order to reduce the risk of fatal coronary heart disease. Fatty fish

include salmon, trout and herring. Lean fish species include pangasius, plaice, tilapia and whiting.⁴⁶

Fish in general

To arrive at a recommendation on the quantity of fish for pregnant women, the committee has three main considerations. First, the evidence for a protective effect of both fish and fish fatty acids on the risk of preterm birth. Secondly, exposure to harmful substances through fish consumption and its potential negative effects. And finally, the fact that eating large quantities of fish is not a very sustainable choice.

In pregnant women, eating fish two to three times a week is associated with a 10% lower risk of preterm birth; eating fish even more often is associated with an effect of about the same order of magnitude. An effect on preterm birth in the same order of magnitude has also been found in meta-analyses of RCTs with fish-fatty-acids supplements. Based on these findings, pregnant women are recommended to eat more fish than the general population.

The meta-analyses of RCTs did not investigate whether the fish-fatty-acid status (the levels in the blood) at the start of the RCT played a role in the effects on preterm birth.⁵ The committee finds it plausible, based on the results of a few individual RCTs, that fish-fatty-acids supplements mainly have an effect in women who eat little fish.^{5,67-72} Fish also contains other



healthy substances in addition to fish fatty acids, and fish is part of a healthy dietary pattern. Therefore, the committee recommends eating enough fish. If that is not feasible for any reason, it is recommended to take a fish-fatty-acids supplement.

In addition to many healthy substances, fish can also contain potentially harmful substances. Since these substances cannot be completely eliminated from the diet, it is important to limit their intake as much as possible whilst staying within the confines of a healthy diet. In other words: do not eat more fish than is necessary to achieve the beneficial effects. Moreover, eating more fish is not a sustainable choice. For the above reasons, the committee has opted to recommend eating two servings of fish per week, rather than two to three servings.

The National Institute for Public Health and the Environment (RIVM) has compiled data on fish consumption by pregnant women in the Netherlands.⁵⁸ Half of all pregnant women eat fish slightly less than once a week.⁷³⁻⁸² About 30% of pregnant women eat no fish or almost no fish.⁸³ It is estimated that no more than 20% of pregnant women eat at least two servings of fish per week.⁸⁴

Based on these data, the committee concludes that few women in the Netherlands currently meet the committee's recommendation. If that percentage increases, the committee expects to see it translated into health gains.

When eating fish and fish products, it is important for everyone, but especially for pregnant women, to observe hygiene rules in order to reduce the risk of contamination with *Listeria*. *Toxoplasma* can also occur in crustaceans and molluscs that live near the coast, and in fish that eat them. Both micro-organisms can be rendered harmless by cooking the fish properly. The hygiene rules are described in section 3.1.

Fatty versus lean fish

Several considerations play a role in arriving at a recommendation on fatty and lean fish species. Given the evidence from RCTs on the effect of fish-fatty-acids supplements on preterm birth, the link between eating fish and the risk of preterm birth is at least partly caused by fish fatty acids. In the available cohort studies, in which a favourable association was found between eating two to three servings of fish per week and a lower risk of preterm birth, the pregnant women's fish consumption consisted on average of one-third fatty fish and two-thirds lean fish. Thus, if they ate fish three times a week, they averaged one serving of fatty fish per week; if they ate fish twice a week, they averaged two-thirds of a serving of fatty fish per week, which the committee rounded up to one serving per week. Therefore, the committee recommends eating fatty fish once a week.

In the limited data available, the researchers found no difference between fatty and lean fish with regard to the link with preterm birth. Therefore, it cannot yet be ruled out that lean fish also contributes to a reduction in the



risk of preterm birth. Because the favourable effect on preterm birth was found for two to three servings of fish per week and the committee recommends one serving of fatty fish per week, the committee also recommends eating lean fish once a week.

It should also be noted here that fatty fish such as mackerel and eel is relatively high in dioxins, as dioxins are stored in adipose tissue. In order to achieve an adequate intake of fish and fish fatty acids without unnecessarily increasing exposure to dioxins, the committee recommends eating one serving of fatty fish and one serving of lean fish per week.

Specific fish species

As mentioned before, one of the reasons for only recommending two weekly servings of fish is that eating fish also may exposes people to potentially harmful substances. Before the start of this advisory process, the Netherlands Nutrition Centre already advised against eating certain types of fish because of the exposure to harmful substances during pregnancy. The committee has elaborated on this assessment of fish species and examined more recent analysis data in its considerations. The fish species were assessed based on the available information on the levels of methylmercury, dioxins and PFAS. This is described in the background document *Assessment of fish species and dosage of fish-fatty-acids supplements for pregnant women*.¹²

Risks of small quantities

Exposure to methylmercury, dioxins and PFAS through fish consumption depends on the levels in the specific fish species and the quantities consumed. The fish species have been assessed on the basis of one or two servings, as these quantities are in line with the committee's recommendation. Pregnant women need not worry if they sporadically eat a small quantity of fish that is best avoided. They can still eat a cracker with mackerel or eel, for instance, without exceeding the upper intake level. Of course, this does depend on the species. Some fish species and fish products - such as cod liver and mitten crab - contain such high levels that eating even a very small amount results in overexposure.¹²



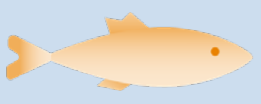

In Table 2, the committee indicates which fish species can be eaten without excessive exposure to methylmercury, dioxins and PFAS. In the background document, the committee also provides information on other fish species, some of which are common and some of which are less common or uncommon in the Netherlands.¹² For these other species, there is less information available and the assessment is therefore less reliable.

The committee considers it important that adequate information on the levels of methylmercury, dioxins and PFAS should be made available for all fish species commonly consumed in the Netherlands in the short term, at which point the assessment should be updated.

The committee recommends to eat one serving of fatty fish and one serving of lean fish per week. The exposure to harmful substances is limited when eating fish species according to Table 2.



Table 2 Recommendations on fish species in order to limit the exposure to harmful substances through fish, based on one serving of fatty fish and one serving of lean fish a week*.

	Lean fish	Fatty fish
 Section from which you can eat two servings per week	Lean fish Hake Catfish from aquaculture Pangasius from aquaculture Dab Haddock Plaice Turbot from aquaculture Tilapia from aquaculture Sole Whiting	Trout from aquaculture Salmon from aquaculture
 Section from which you can eat one serving per week	Mussels	Wild trout Herring Wild salmon
 Section from which you can occasionally eat one serving, but not every week	Cod	
 These species are best avoided	Perch Flounder Shrimps Halibut Whitefish Carp Crab Tuna Sea bass Lophiiformes Sea catfish	Liver of hake, cod, etc. Mackerel Eel Sardine Sprat

* Fish with a fat content of less than 5 grams per 100 grams are classified as lean fish; fish with a fat content of 5 grams per 100 grams or more are classified as fatty fish.

^a For trout and sea bass, reported fat contents vary above and below five grams per 100 grams. According to most sources, trout is a fatty fish. For sea bass, fat contents of 3 and 9.8 grams per 100 grams have been reported (respectively www.voedingswaardetabel.nl and www.gov.uk/government/publications/composition-of-foods-integrated-dataset-cofid)



Fish-fatty-acids supplements (docosahexaenoic acid)

Some women will not be able to eat one serving of fatty fish and one serving of lean fish per week, e.g. because of food allergies to fish, a vegetarian or vegan diet or simply because of a dislike for fish. In this case, they can choose to take a fish-fatty-acids supplement based on fish oil, algae or other sources as a substitute. These supplements are not a perfect substitute for all the healthy substances found in fish, but they can replace the fish fatty acids. The committee has evidence that fish-fatty-acids supplements reduce the risk of preterm birth, although it is not entirely clear whether that effect is statistically significant.⁵ Particularly in women with low fish-fatty-acid status in the blood^{67,68,72} or low intake of fish^{70,71} or fish fatty acids⁶⁹, these supplements seem to have a beneficial effect.

Both eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) are present in fish. In most RCTs, the supplement studied contained both EPA and DHA. When taking a fish-fatty-acids supplement, the committee therefore recommends opting for a supplement that - like fish - contains both EPA and DHA. The meta-analyses reviewed by the committee present no clear conclusion as to the optimal dose for preventing preterm birth. No dose-response relationship has been found. This indicates that the lower doses in the RCTs are already sufficient for the effect on preterm birth.

According to the committee, the dosage of supplements should be aimed at achieving an adequate intake of DHA. Indeed, EFSA describes indications that the conversion of alpha-linolenic acid (ALA) to eicosapentaenoic acid (EPA) to docosahexaenoic acid (DHA) does not always take place efficiently. Because these conversion processes seem to occur more efficiently in young women than in young men^{85,86}, ALA intake could potentially contribute to DHA levels in pregnant women. However, the committee considers the available research on this subject insufficient to establish whether the effect on preterm birth can also be achieved by taking ALA (or EPA).

EFSA has concluded that the body needs more DHA for the development of the foetus's retina and brain during pregnancy,⁸⁷ arriving at a figure of 100 to 200 milligrams of DHA in addition to the dietary reference value (adequate intake) of 250 milligrams of fish fatty acids (EPA and DHA combined) per day.^{87,88} Based on both this EFSA recommendation and the average DHA content of 100 grams of fatty fish and 100 grams of lean fish⁴⁶, after rounding down to the nearest hundred, the committee recommends that women who do not eat fish take a supplement with a dosage of 250 to 450 mg of DHA per day.¹² The recommendation to take fish-fatty-acids supplements only applies to pregnant women who structurally fail to eat two servings of fish a week. Pregnant women who eat two servings of fish a week, including one serving of fatty fish, meet



the recommended weekly intake of fish, even their DHA intake were to be lower than 250 mg per day.¹²

5.2 Calcium-rich products

5.2.1 Recommendation

Eat enough calcium-rich products to meet the dietary reference value of calcium at the very least. If your dietary calcium intake is consistently low, start supplementing 1,000 milligrams of calcium a day from the 20th week of pregnancy onwards.

5.2.2 Explanation

Calcium is a mineral that helps strengthen bones and teeth and plays a role in various bodily functions. For many Dutch people, dairy (including cheese) is the main source of dietary calcium. Other products also contribute to a person's calcium intake, such as vegetables, nuts, legumes and vegetable protein drinks intended as dairy substitutes with added calcium. From figures on calcium intake, the committee concludes that it is not self-evident that pregnant women in the Netherlands consumes sufficient calcium and that this requires attention.

During the second half of pregnancy (from 20 weeks onwards), sufficient calcium intake reduces the risk of preterm birth, gestational hypertension (high blood pressure during the second half of pregnancy) and pre-eclampsia.⁵ The strength of evidence for this comes from RCTs in

which the intervention (calcium supplementation or placebo) was typically started around or after the 20th week of pregnancy, therefore the recommendation relates to the second half of pregnancy. The beneficial effects of calcium supplements occur mainly in women with low dietary calcium intake. The committee therefore considers the findings relevant for pregnant women in the Netherlands who do not meet the dietary reference value for calcium. From 20 weeks of pregnancy onwards, the dietary reference value for calcium is 1,000 milligrams per day.

The Netherlands Nutrition Centre's dietary information shows which foods to eat, and in what quantities, to achieve the desired intake. With a diet according to the 'Wheel of Five' for pregnant women, the average calcium intake is well above the dietary reference value: the calcium intake from milk, milk products and cheese amounts to 800 milligrams of calcium per day, and the calcium intake from all other product groups taken together amounts to 435 milligrams per day.¹²⁶ Women can check whether they are getting enough calcium with the Eetmeter tool developed by the Netherlands Nutrition Centre or by consulting their obstetrician or dietitian.

It is important to ensure an adequate calcium intake throughout pregnancy, preferably through a healthy dietary pattern. From the 20th week of pregnancy onwards, the committee recommends taking a calcium supplement in cases of consistently insufficient dietary intake.

Rounded off to the nearest hundred, the committee recommends a daily



supplement dose of 1,000 milligrams; this dose is partly based on the doses in RCTs. It is important to avoid taking supplements with a higher dosage, as there is evidence, although very limited, that taking higher-dose calcium supplements (1,500 to 2,000 milligrams per day) may increase the risk of HELLP syndrome (a serious pregnancy complication).⁵ Furthermore, it is important that the total intake of calcium from food and supplements does not exceed the tolerable upper intake level of 2,500 milligrams per day.⁸⁹ Because the recommendation to take a 1,000-milligram calcium supplement only applies to pregnant women whose dietary calcium intake is too low, the tolerable upper intake level will not be exceeded.

This recommendation was coordinated with the various professional associations who also developed simultaneously the module on hypertensive disorders during pregnancy. The ‘basic recommendation’ for pregnant women in that module corresponds to the Health Council’s recommendation. The module also gives an adapted recommendation for women at high risk of hypertensive disorders.⁹⁰

Studies with dietary data of Dutch pregnant women have been identified and analysed by the National Institute for Public Health and the Environment (RIVM).⁵⁸ Two of these Dutch studies determined dietary calcium intake, with one finding an average intake of around 1,100 milligrams per day and the other a median intake of around 900

milligrams per day.^{91,92} Both estimates are near the dietary reference value. As such, the committee expects that about half of all pregnant women get less calcium than the dietary reference value.

For some calcium-rich products (e.g. raw-milk dairy products and vegetables), it is important for everyone, but especially for pregnant women, to observe hygiene rules to reduce the risk of contamination with *Listeria* and *Toxoplasma*.¹¹ These rules are described in section 3.1.

5.3 Iron-rich products

5.3.1 Recommendation

Eat plenty of iron-rich products.

5.3.2 Explanation

Iron

The body needs iron for many bodily processes, such as transporting oxygen in red blood cells. Insufficient iron intake causes iron-deficiency anaemia.

RCTs show convincingly - and as expected - that the use of iron supplements during pregnancy leads to a lower risk of iron-deficiency anaemia around delivery. Iron supplements may have a minor effect on birth weight⁹³, but there is no evidence for an effect on the risk of low birth weight (small for gestational age).⁵



The main dietary sources of iron are meat, fish, meat substitutes enriched with iron, bread, cereals and cereal products. Other products, such as eggs, nuts and legumes can also contribute to the body's iron supply, but the heme iron found in meat and fish is the easiest for the body to absorb. In addition, certain iron-rich plant-based products such as cereals and legumes contain phytate, which reduces the absorption of iron. Iron intake is a concern for people who eat little or no animal products, but even for them, specific food choices will determine whether their iron intake is adequate or not.

Iron status can be determined by measuring blood ferritin levels, and the majority of Dutch pregnant women appear to have an adequate iron status. However, low iron status is estimated to occur in 10-15% of pregnant women in the Netherlands.^{94,95} Data on the iron intake of Dutch pregnant women^{52,96} compared to the dietary reference values for iron^{3,4} also show that the majority of pregnant women get enough iron, but some do not. It is difficult to achieve the recommended daily intake of iron through the diet alone; therefore, dietary advice is aimed at a slightly lower intake (12 rather than 16 milligrams per day) which is sufficient for the majority of women.

Determining the haemoglobin levels of pregnant women is standard practice in the Dutch healthcare system. The Care Standard for Integrated Birth Care indicates that haemoglobin levels are determined during the

first session, but does not mention any subsequent haemoglobin tests.⁹⁷ In practice, the test is often repeated around the 30th week of pregnancy, and in the 20th week of pregnancy in risk groups. A low haemoglobin level is a sign of anaemia, but is not specific for iron deficiency anaemia and is therefore followed up by further testing.^{98,99} Thanks to this initial test and potential follow-up tests, women who need extra iron during pregnancy are identified at an individual level and can be treated specifically. Because of this individual approach, a general recommendation on taking iron supplements is not necessary.

5.4 Iodine-rich products

5.4.1 Recommendation

Eat enough iodine-rich products to meet the dietary reference value of 200 micrograms of iodine per day. If you do not succeed in consistently meeting the dietary reference value of iodine, take a supplement with up to 200 micrograms of iodine.

5.4.2 Explanation

The body needs iodine in order for the thyroid gland to function properly. A (very) low iodine intake leads to an increased size of the thyroid gland (goiter). In pregnancy, proper thyroid function is important for the growth and brain development of the unborn child. An adequate iodine intake is important throughout pregnancy.



There is limited evidence that taking iodine supplements can result in a reduced thyroid volume in the newborn^{5,100-102} and the pregnant woman^{100,102-105}. However, the RCTs that found this evidence were conducted in populations with a lower iodine supply than in the Netherlands. Compared to other European countries, the iodine supply in the Netherlands is relatively good.¹⁰⁶ The Generation R study determined the iodine status of pregnant women from the Rotterdam region.¹⁰⁷ The findings show that iodine supply is adequate at the group level. The committee does not consider the data from this study suitable for determining the percentage of pregnant women whose intake of iodine is too low, as this requires a determination method that also provides reliable data on an individual level.

For pregnant women, such data are provided only by a small pilot study.¹⁰⁸ These limited data suggest that, for part of the women whose intake is structurally too low, supplementing 100 micrograms of iodine per day will be sufficient to get their intake up to the dietary reference level. A very low dietary intake of iodine requires a higher dose. It is important to avoid taking more than 200 micrograms of iodine through supplements. Currently, a larger study is being conducted in Nijmegen and Maastricht, and more insight into the iodine intake of pregnant women in the Netherlands will soon be available.

Based on data from non-pregnant women¹⁰⁹, it seems plausible that a substantial subgroup of pregnant women in the Netherlands does not

meet the daily reference value for pregnant women of 200 micrograms of iodine per day. It is not known how many Dutch women have an excessively low intake (around 50 micrograms per day; the average intake at which effects of iodine supplements on thyroid volume have been found). There is insufficient research available on the consequences of an iodine intake that is below the dietary standard, but not extremely low.

Because of the currently available Dutch data on iodine intake, the findings based on the RCTs do not lead to supplementation recommendations for all Dutch pregnant women. In the near future, the new status data will provide more insight. However, the findings of the RCTs are relevant to Dutch pregnant women whose iodine intake is too low. If dietary iodine intake is lower than the dietary reference value of 200 micrograms per day and it is not possible to make the necessary dietary adjustments, the committee recommends taking an iodine supplement with a maximal dose of 200 micrograms per day to meet the dietary reference value. It is important not to exceed the tolerable upper intake level for iodine of 600 micrograms per day. Just like low iodine intake, excessive iodine intake also harms the functioning of the thyroid gland.

Bread

To meet the dietary reference value of iodine, it is important for pregnant women in the Netherlands to eat enough bread. In the Netherlands, bread is the most important source of dietary iodine, as Dutch bakers and bread



factories use salt with a high iodine content in their bread, so-called 'bakery salt'.¹¹⁰

Bread itself contains little iodine, which means that bread that is not prepared with 'bakery salt' is not a good source of iodine. Examples include home-baked bread (if not prepared with 'bakery salt'), bread from some artisan organic bakers, bread from some Turkish or Moroccan bakers, and possibly some types of gluten-free bread.

The average bread consumption of non-pregnant women in the Netherlands is just over 100 grams per day (3-4 slices). During pregnancy, eating more bread is an important way to achieve an adequate iodine intake. It is estimated that around 5% of women eat one slice of bread or less per day. A 30-gram slice of bread contains around 25 micrograms of iodine.¹¹¹ Apart from bread, many types of fish are also a source of iodine. Dairy products and iodised table salt also contribute to iodine intake.

Like various other products, bread can contain furans and, especially if toasted, acrylamide. These substances are also found in other products and are discussed in the section on food safety (section 3.2).



06 beverages



During pregnancy it is advisable to avoid alcohol and to limit the intake of caffeine and certain types of tea.

6.1 Alcohol

6.1.1 Recommendation

Avoid alcohol during pregnancy.

6.1.2 Explanation

Alcohol consumption during pregnancy is associated with an elevated risk of unfavourable pregnancy outcomes. Those risks become greater, more severe and more diverse as alcohol consumption increases. There is no safe intake level for alcohol consumption during pregnancy. The highest alcohol intakes are known to lead to foetal alcohol syndrome.¹¹²

In 2005, the Health Council of the Netherlands drew several conclusions about alcohol consumption during pregnancy (a standard measure contains 10 g ethanol, regardless of the type of alcoholic drink):

- Drinking one to two standard measures of an alcoholic beverage per day was likely to have a negative impact on the child's psychomotor development, in addition to possibly leading to a greater risk of miscarriage, foetal death, preterm birth and low birth weight.
- For the very lowest intake levels of less than a glass a day, there was a possible link to higher risks of miscarriage, foetal death and preterm birth, as well as a possible negative impact on the child's psychomotor development.

The Health Council did not consider it possible to indicate a level at which it can be said with certainty that alcohol consumption has no effect on the foetus.¹¹²

Intake up to one glass of alcohol per day

As there was already evidence for the harmful effects of drinking more than a glass of alcohol a day in 2005, the committee has only listed the new scientific findings on the very lowest intake levels of less than one glass per day. Although inconsistent, this research does provide evidence that drinking a few glasses per week (less than one glass per day) is associated with a higher risk of miscarriage and stillbirth (foetal death), a higher risk of low birth weight for gestational age, less favourable cognitive development of the child in terms of lower IQ and a lower behavioural score of the child. The committee therefore stands by its earlier conclusion that any reduction in alcohol consumption reduces the risks and that it is not possible to set a safe intake level for alcohol consumption.¹¹

6.2 Caffeine

6.2.1 Recommendation

Do not exceed 200 milligrams of caffeine per day.

6.2.2 Explanation

A caffeine intake of more than 200 milligrams per day is associated with a higher risk of reduced growth of the unborn child, as well as of miscarriage



or stillbirth. At intake levels of up to 200 milligrams of caffeine per day, there is no reason for concern about the condition of the foetus.¹¹

Ter Borg et al. have identified publications that describe the consumption of caffeine in Dutch pregnant women.⁵⁸ These publications show that between 30-60% of Dutch pregnant women drink less caffeine than the amount found in two standard cups of coffee. A substantial percentage of pregnant women therefore consume more caffeine than the committee recommends.¹¹³⁻¹¹⁷ Publications on the intake of specific caffeinated drinks (e.g. coffee, tea, cola) or their decaffeinated counterparts among this target group are not known to the committee.

Sources of caffeine

Coffee and tea are the main sources of caffeine (see below). Caffeine is also found in some soft drinks and other products such as chocolate. The recommendation to avoid consuming more than 200 milligrams of caffeine per day applies to all products containing caffeine. As a guideline, cola contains 10 to 15 milligrams of caffeine per 100 millilitres, whereas energy drinks contain 15 to 35 milligrams; dark chocolate contains 35 to 65 milligrams of caffeine, while milk chocolate contains 15 to 20 milligrams.¹¹⁸

Coffee

Coffee is a major source of caffeine, but its caffeine content can vary considerably. In addition to differences in strength (on average, espresso

contains 130 milligrams of caffeine per 100 millilitres, but caffeine levels can be considerably higher in strong espresso), the type of coffee also influences the caffeine content (instant coffee, for example, contains an average of 50 milligrams of caffeine per 100 millilitres).¹¹⁸ With a maximum of two cups of coffee per day, caffeine intake generally remains below 200 milligrams per day, if no other caffeinated products are consumed that day.

The findings on coffee support the conclusion on caffeine. Indeed, cohort studies show that there is limited evidence that a high coffee intake is associated with a higher risk of miscarriage or stillbirth.⁹

The committee found only one cohort study on decaffeinated coffee, which showed that drinking three or more cups of decaffeinated coffee a day, just like caffeinated coffee, was associated with an increased risk of miscarriage compared to drinking no coffee at all. A single study is too little research to reach a conclusion on decaffeinated coffee, but on the basis of that study, it also seems unwise to consume more than two cups of decaffeinated coffee.

When consuming a maximum of two cups of coffee per day, the exposure to acrylamide and furans through coffee is limited (see section 3.2). For people with lead plumbing, new plumbing or new taps, specific recommendations on water use apply, which are relevant for making coffee (section 3.3).



Tea

Green and black tea also contain caffeine. In the *Dutch Dietary Guidelines 2015*, the Health Council of the Netherlands recommended that the general population drink three cups of green or black tea a day, as this reduces the risk of stroke.²³ These teas contain an average of 15 to 25 milligrams of caffeine per 100 millilitres.¹¹⁹ Three cups of this tea (at 125 millilitres per cup) therefore contain an average of around 60 to 100 milligrams of caffeine. The committee considers green and black tea (without sugar) to be a healthy drink, including for pregnant women. However, because pregnancies cover a relatively short period of time, the committee assumes that temporarily avoiding green and black tea will have little effect on the long-term risk of chronic disease. Therefore, for pregnant women, the committee deviates from its recommendation of drinking three cups of tea a day and leaves it to the discretion of the women themselves to decide which caffeinated beverages to consume.

For people with lead plumbing, new plumbing or new taps, specific recommendations on water use apply, which are relevant for making tea (section 3.3).

6.3 Herbal tea

6.3.1 Recommendations

- Limit the consumption of tea made from plants or herbs containing allylalkoxybenzenes and avoid tea made from plants with high levels of

pyrrolizidine alkaloids.

- Limited consumption of tea with liquorice root (glycyrrhizin) is safe for pregnant women with normal blood pressure. Pregnant women with high blood pressure should avoid drinking tea containing liquorice root.

6.3.2 Explanation

The effects of allylalkoxybenzenes and pyrrolizidine alkaloids are described in section 3.6, and the effects of products containing liquorice root or glycyrrhizin in section 3.7.

Allylalkoxybenzenes are found in certain herbs and spices: aniseed, tarragon, fennel, basil, allspice, nutmeg, cinnamon, sassafras, dong quai, mace and pepper. Some of these herbs are not often used to make tea, such as basil, while others do feature in common teas (such as aniseed or fennel). Tea made from these herbs can lead to undesirably high exposure, depending on the concentration of allylalkoxybenzenes in the beverage and the amount consumed. Therefore, the committee considers it wise for pregnant women, as for the general population, to limit the consumption of tea based on these herbs.

Pyrrolizidine alkaloids can be found in certain plants, such as borage, coltsfoot, common comfrey, ragwort, and rattlepods. Tea from these plants is not common in the Netherlands, but may occur. Tea made from said



plants can contain high concentrations of pyrrolizidine alkaloids and are not recommended for the general population, including pregnant women. Glycyrrhizin is a constituent of liquorice root extract that is responsible for giving liquorice its taste. Liquorice root tea contains an average of 200 milligrams of glycyrrhizin per litre. Products that are high in glycyrrhizine must be labelled accordingly. Products containing more than 10 milligrams per litre must be accompanied with the following message on the label: 'contains liquorice root'. Products containing more than 50 milligrams per litre must state the following: 'contains liquorice - people with high blood pressure should avoid excessive use'.¹¹

Because pregnant women are more susceptible to the harmful effects of elevated blood pressure, the committee recommends that, as a precaution, an upper intake level of 35 milligrams of glycyrrhizin per day be observed by this group, which is equivalent to about a cup of liquorice root tea. In the committee's opinion, pregnant women who already have high blood pressure should avoid drinking teas containing liquorice root as a precaution.

Furthermore, for people with lead plumbing, new plumbing or new taps, specific recommendations on water use apply, which are relevant for making tea (section 3.3).



07 before conception



Some of the recommendations given in this advisory report should preferably be followed before conception. This applies at least to the recommendation to take folic acid. In addition, it also applies to the general advice to eat a healthy and varied diet and to a number of specific recommendations relating to early pregnancy.

Previous Health Council advisory report on preconception care

The Health Council of the Netherlands' 2007 advisory report on preconception care comprised, among other things, dietary recommendations.¹²⁰ For the recommendations in that advisory report, the Council considered effects on conception itself as well as on effects in early pregnancy. This earlier advisory report concludes that eating a healthy, varied diet is also important for women who are trying to get pregnant, and that several nutrients deserve extra attention: folic acid supplements, vitamin D, vitamin A (liver products) and alcohol.

Reflection by the committee

The committee subscribes to the choice made in the earlier Health Council advisory report that dietary recommendations relevant to (potential) effects in early pregnancy should preferably be followed before conception.¹²⁰ After all, the pregnancy is not detected until the first weeks of pregnancy have already passed. This applies broadly to the recommendation to eat a healthy and varied diet to ensure a sufficient intake of vitamins and minerals.¹²¹

As described in section 4.1, there is now additional scientific support for the recommendation to take folic acid supplements. This recommendation applies from at least four weeks prior to conception. There is also evidence that the recommendation to avoid alcohol has effects in the preconception period and early pregnancy. It is not known to the committee whether consuming excess amounts of vitamin A (liver) or caffeine can be harmful in the first few weeks after conception. As such, women trying to get pregnant could follow these recommendations as a precaution prior to conception.

Of the other recommendations in this advisory report that relate to early pregnancy, the committee also considers the iodine recommendation relevant to the preconception period. It believes meeting the daily reference value for iodine is important even before pregnancy, because it may take some time to fully replenish low iodine levels. Iodine is important throughout pregnancy for the growth and brain development of the embryo and foetus. *Listeria* and *Toxoplasma* infections may also have effects that can occur in early pregnancy. However, the risk of these infections is very small and following the measures for an extended period of time can be quite difficult. Therefore, the committee does not consider it proportionate to recommend these measures as a precautionary measure before conception.



The committee did not investigate effects that occur in the period before conception, such as on fertility, as this was beyond the scope of the request for advice. A previous Health Council advisory report described indications that drinking alcohol is associated with decreased fertility.^{112,120} Research has been done on couples trying to conceive via in vitro fertilisation or ICSI, which indicates an association between a healthier diet and higher fertility.¹²²⁻¹²⁴ If desired, the Council could describe the state of scientific knowledge on the fertility outcome measure in the future.

Furthermore, women's body weight at the start of pregnancy is also a relevant factor. Cohort studies show that being overweight or obese prior to pregnancy (a BMI of 25.0 to 29.9 or more than 30.0 kg/m², respectively), as well as being underweight (a BMI lower than 18.5 kg/m²) compared to a normal BMI (a BMI between 18.5 and 24.9 kg/m²) is associated with a higher risk of pregnancy complications. Overweight and obesity are associated with higher risks of gestational diabetes, pre-eclampsia, gestational hypertension, *high* birth weight for gestational age (large for gestational age) and preterm birth. Underweight is associated with a higher risk of *low* birth weight for gestational age (small for gestational age) and preterm birth, but these risk estimates are lower than for overweight and obesity.¹²⁵

The committee has not investigated whether weight reduction *prior to conception* could improve the unfavourable risk profile of overweight or

obese women, and if so, what extent of weight reduction would be required for this. A meta-analysis of RCTs, especially among women with reduced fertility, shows an improvement in fertility but no effect on pregnancy outcomes.¹²⁴ *During pregnancy*, weight reduction is not desirable, which is why the committee stresses the importance of preventing overweight and obesity.



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- prof. dr. J.B. Goudoever, professor of paediatrics, Amsterdam UMC, *chairperson*
- prof. dr. G.J. Bonsel, maternity care and birth care expert, UMC Utrecht (until July 1st, 2018)
- dr. E. Corpeleijn, lifestyle epidemiologist, UMCG Groningen
- dr. J.S. Gubbels, health promotion expert, Maastricht University (from November 6th, 2018)
- prof. dr. J.C. Kieft, professor of population health, LUMC Leiden
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- dr. ir. A. Melse-Boonstra, nutritionist, Wageningen UR
- dr. R.C. Painter, gynaecologist-perinatologist, Amsterdam UMC
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Observers:

- dr. E. Brink, Netherlands Nutrition Centre, The Hague
- N.L. Gras, MSc, Minister of Health, Welfare and Sport, The Hague (from March 1st, 2021)
- A. Sellis, MSc, Minister of Health, Welfare and Sport, The Hague (until March 1st, 2021)

Scientific Secretaries:

- dr. K.G. van der Mark-Reeuwijk, Health Council of the Netherlands, The Hague
- dr. C.J.K. Spaaij, Health Council of the Netherlands, The Hague (from January 1st, 2019)
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Incidentally consulted experts:

The following experts were consulted incidentally on specific food safety topics:

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