ANSES Opinion
Request No 2017-SA-0141

The Director General

Maisons-Alfort, 23 December 2019

OPINION
of the French Agency for Food, Environmental and Occupational Health & Safety

on the updating of the PNNS dietary guidelines for pregnant or breastfeeding women

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ANSES primarily ensures environmental, occupational and food safety as well as assessing the potential health risks they may entail.

It also contributes to the protection of the health and welfare of animals, the protection of plant health and the evaluation of the nutritional characteristics of food.

It provides the competent authorities with all necessary information concerning these risks as well as the requisite expertise and scientific and technical support for drafting legislative and statutory provisions and implementing risk management strategies (Article L.1313-1 of the French Public Health Code).

Its opinions are published on its website. This opinion is a translation of the original French version. In the event of any discrepancy or ambiguity the French language text dated 23 December 2019 shall prevail.

On 12 July 2016, ANSES received a formal request from the Directorate General for Health to conduct an expert appraisal aimed at updating the French National Nutrition and Health Programme (PNNS) dietary guidelines for pregnant and breastfeeding women.

On 28 March 2017, ANSES also received a formal request regarding the impact of early childhood exposure to nutritional and environmental factors through food during the so-called "1000-day window", corresponding to the period from conception to around two years of age.

This opinion presents the results of the expert appraisal aimed at updating the French National Nutrition and Health Programme (PNNS) dietary guidelines for pregnant and breastfeeding women. A separate opinion (2017-SA-0145) supplements this expert appraisal by considering the diet of children from birth to three years of age.

1. BACKGROUND AND PURPOSE OF THE REQUEST

The scientific basis for establishing the guidelines of the French National Nutrition and Health Programme (PNNS) was updated by ANSES for the general adult population in 2016, on the basis of new dietary reference values and recent data on food consumption and composition (Anses 2016b). In addition, physical activity was addressed in the report "Updating of the PNNS guidelines

– Revisions to the guidelines relating to physical activity and sedentarity", Request No. 2012-SA-0155, published in 2016 (Anses 2016c).

The updating of the dietary guidelines in force under the previous PNNS (2011-2015) for the population of pregnant or breastfeeding women was based on an analysis of the existing recommendations in other countries and on the epidemiological relationships between the consumption of food groups and the health of pregnant or breastfeeding women and their children. This opinion focuses on pregnant and breastfeeding women whose pregnancy does not present a particular risk and is not qualified as pathological.

The risks associated with alcohol consumption by pregnant or breastfeeding women are not covered in this opinion because this is a specific issue, independent of other dietary factors, that has been addressed by a recent assessment and management procedure (Santé publique France 2017).

2. ORGANISATION OF THE EXPERT APPRAISAL

The expert appraisal was carried out in accordance with French standard NF X 50-110 "Quality in Expert Appraisals – General requirements of Competence for Expert Appraisals (May 2003)".

Two rapporteurs were appointed to conduct a literature search on the existence of epidemiological links between the consumption of food groups during pregnancy or breastfeeding and the health of the child or mother.

ANSES also consulted its European counterparts in order to take into account the recommendations in force in the other Member States of the European Union.

The results of the literature search, along with existing recommendations from other countries, were presented to the CES on "Human Nutrition" at its meeting on 5 October 2017. Following the rapporteurs' analysis of the epidemiological links, based on an assessment of the weight of evidence, specific recommendations for pregnant and breastfeeding women underwent a collective expert appraisal by the CES at its meetings on 7 December 2017, and 8 February, 12 April and 24 May 2018. A hearing took place with the French College of Gynaecologists and Obstetricians (CNGOF) on 13 April 2018. The work was adopted by the CES on "Human Nutrition" on 5 July 2018.

In parallel, the CES on "Assessment of the biological risks in foods" (BIORISK) was asked to summarise the recommendations on the prevention of foodborne microbiological risks for pregnant or breastfeeding women. This collective expert appraisal was carried out during the meetings of 30 January and 10 April 2018. The expert appraisal was based on previous Agency opinions and reports, as well as knowledge of the hazards, summarised in the foodborne biological hazard data sheets.

ANSES analyses interests declared by experts before they are appointed and throughout their work in order to prevent risks of conflicts of interest in relation to the points addressed in expert appraisals.

The experts' declarations of conflicts of interests are made public via the ANSES website (www.anses.fr).

3. ANALYSIS AND CONCLUSIONS OF THE CES

3.1. Specificities of the population

The energy requirements of pregnant and breastfeeding women increase during pregnancy (by an average of 70, 260 and 500 kcal/d in the first, second and third trimesters, respectively) and breastfeeding (by 500 kcal/d) (EFSA 2017). Certain micronutrient deficiencies can lead to risks of foetal birth defects or obstetric complications (Molloy *et al.* 2008). Although the absorption coefficient

of some nutrients, such as zinc and iron, increases with pregnancy (Hambidge *et al.* 2017), EFSA (2017) reports an increase in the nutritional requirement for copper, iodine, selenium, zinc, vitamins A, B2, B5, B6, B8, B9, B12 and C, and choline for pregnant or breastfeeding women.
When a pregnancy is being considered, a "preconception" consultation aims to recommend early changes in risky behaviour and prevent certain risks – particularly infectious risks – and possibly metabolic disorders, for the future pregnancy. To reduce the risk of failure to close the neural tube, the French National Authority for Health (HAS) recommends folic acid supplementation of 400 µg per day, from the moment the woman expresses a desire to become pregnant (HAS 2009).
As the foetus is highly sensitive to the influence of the environment, the mother is recommended to exclude foods posing a microbiological risk during pregnancy. The main diseases or complications of importance to foetal and child health that can occur during pregnancy are listeriosis, congenital toxoplasmosis, fulminant hepatitis related to hepatitis E virus and trichinellosis (Annex 2).

According to the 2016 report of the national perinatal survey (Institut National de la Santé et de la Recherche Médicale et Ministère des Affaires Sociales du Travail et de la Solidarité. Direction de la Recherche des Etudes de l'Evaluation et des Statistiques 2017):

- Weight gain averages 13 kg during pregnancy, with 10% of women gaining more than 20 kg. Weight gain greater than the recommendations of the Institute of Medicine (IOM, see Table 1) is associated with a higher risk of high birth weight and overweight children (Nehring, Lehmann et von Kries 2013). Conversely, lower than recommended weight gain is associated with an increased risk of low birth weight and premature delivery (Stotland *et al.* 2006, Yan 2015, Sharma *et al.* 2015). This risk is greater when the mother's body mass index is low before pregnancy.

  Table 1: Recommended weight gain based on body mass index
  Source: IOM Pregnancy Weight Guidelines (Rasmussen, Catalano et Yaktine 2009)

	BMI before pregnancy	Recommended weight gain during pregnancy
Thinness	BMI < 18.5 kg/m^2	12.5 - 18 kg
Normal weight	18.5 kg/m^2 < BMI ≤ 25.0 kg/m^2	11.5 - 16 kg
Overweight	25.0 kg/m^2 < BMI ≤ 30.0 kg/m^2	7 - 11.5 kg
Obesity	BMI ≥ 30.0 kg/m^2	5 - 9 kg

- In 2016, gestational diabetes affected 11% of pregnant women, compared to 7% of women in 2010. This diabetes, which occurs in the late second and third trimesters of pregnancy, can lead to maternal hypertension and, for the baby, a risk of higher weight than normal and a risk of hypoglycaemia at birth. Women who have developed gestational diabetes during pregnancy are at higher risk of developing type-2 diabetes later in life (Dodd *et al.* 2007, Bellamy *et al.* 2009, Rayanagoudar *et al.* 2016, Bernstein *et al.* 2018, Casagrande, Linder et Cowie 2018, Di Cianni *et al.* 2018).

- Similarly, high blood pressure was diagnosed during pregnancy in 4% of women in 2016, 98% of them with no prior history, with this rate being stable between 2010 and 2016 (Institut National de la Santé et de la Recherche Médicale et Ministère des Affaires Sociales du Travail et de la Solidarité. Direction de la Recherche des Etudes de l'Evaluation et des Statistiques 2017).

Nausea and vomiting occur in the early stages of pregnancy in a large majority of women (60-80%). The severe form, combining weight loss and the risk of dehydration, affects 0.3% to 2% of pregnancies depending on the studies (Festin 2014).

The current PNNS recommends a sufficient, balanced and diversified diet. This varied diet is even more crucial for breastfeeding women, as it is linked to the development of taste in the child

(Mennella, Jagnow et Beauchamp 2001). The energy expenditure during breastfeeding is such that a low-calorie diet is not recommended during this period.

3.2. Dietary reference values

3.2.1. Energy and macronutrients with a specific dietary reference value for pregnant or breastfeeding women

EFSA proposes that energy intake be increased during pregnancy (by 70, 260 and 500 kcal/d in the first, second and third trimesters) and breastfeeding (500 kcal/d). As part of pregnancy care, women's weight gain is monitored very regularly and an energy intake that may be too low or too high can be identified.

Macronutrient guideline values as a proportion of total energy intake (TEI) are identical to those of the general adult population, except for the lower protein limit. Indeed, because of the additional protein-energy costs of foetal growth and breastfeeding, a minimum intake of 12% protein is required in the third trimester of pregnancy and for breastfeeding women, whereas it is only 10% for adult women, including during the first two trimesters of pregnancy. According to the current state of knowledge, the maximum values for fat, protein and carbohydrates established for the general adult population are consistent with no increased risk of gestational diabetes and metabolic disorders that could affect the long-term health of the mother and child (Anses 2016a).

The polyunsaturated fatty acid guideline values are unchanged in pregnant or breastfeeding women (Anses 2011a). The upper limit of the reference intake of lipids enables polyunsaturated fatty acid requirements to be met, as for the general adult population. However, a recent meta-analysis stressed the importance of n-3 polyunsaturated fatty acid intake during pregnancy and the first two years of a child's life for his cognitive and motor development (Shulkin *et al.* 2018). In addition, an excessively high n-6/n-3 series fatty acid ratio (>5), mainly due to a very inadequate intake of n-3 polyunsaturated fatty acids, has been associated with poorer cognitive development in children (Bernard *et al.* 2017).

Fibre guideline values for pregnant and breastfeeding women are identical to those of the general adult population (Anses 2016a). They are at least 25 g/day, with an adequate intake (AI) of 30 g of total dietary fibre per day. At this level of intake, fibre limits the effects of constipation, which are exacerbated during pregnancy (Champ et Hoebler 2009).

3.2.2. Specific water intake for pregnant and breastfeeding women

EFSA recommends increasing water consumption from 2 litres for the adult population to 2.3 litres for pregnant women and 2.7 litres for breastfeeding women (EFSA 2017). About one litre is provided by food and the rest should therefore be provided by beverages. Insufficient water consumption increases the risk of constipation (Markland *et al.* 2013).

3.2.3. Vitamins and minerals with a specific dietary reference value for pregnant and breastfeeding women

Nutritional requirements increase: the dietary reference values of many nutrients are therefore higher during pregnancy or breastfeeding (Table 2). The dietary reference values are different for pregnant or breastfeeding women, with the exception of copper, iodine and iron, for which the values are identical during pregnancy and breastfeeding, and higher than those of adult women.

Table 2: Dietary reference values for pregnant and breastfeeding women (EFSA 2017)

	ANSES, 2016 *Adult women* *(>18 years)*	EFSA, 2017 **Pregnant women**	EFSA, 2017 **Breastfeeding women**
Cu (mg/d)	*1.0 (PRI)*	1.5 (AI)	1.5 (AI)
Fe (mg/d)	11 and 16 (PRI)*	16 (PRI)	16 (PRI)
I (µg/d)	*150 (AI)*	200 (AI)	200 (AI)
Se (µg/d)	*70 (AI)*	70 (AI)	85 (AI)
Zn (mg/d)	*7.5; 9.3; 11 (PRI) if 300, 600 or 900 mg/day of phytates*	+ 1.6 (PRI)	+ 2.9 (PRI)
Vitamin A (µg/d)**	*650 (PRI)*	700 (PRI)	1300 (PRI)
Vitamin B2 (mg/d)	*1.5 (AI)*	1.9 (PRI)	2.0 (PRI)
Vitamin B5 (mg/d)	*4.7 (AI)*	5 (AI)	7 (AI)
Vitamin B6 (mg/d)	*1.5 (AI)*	1.8 (PRI)	1.7 (PRI)
Vitamin B9 (µg dietary folate equivalent/day)	*330 (PRI)*	600 (AI)	500 (PRI)
Vitamin B12 (µg/d)	*4.0 (AI)*	4.5 (AI)	5.0 (AI)
Vitamin C (mg/d)	*110 (PRI)*	105 (PRI)	155 (PRI)

Note: PRI, population reference intake (daily intake that covers the needs of 97.5% of the population in question, as estimated from experimental data); AI, adequate intake (average daily intake for a population or subgroup whose nutritional status is considered satisfactory).
* PRI for women with low or normal menstrual losses (80% of the population): 11 mg/d; PRI for women with high menstrual losses: 16 mg/d.
** RE: retinol equivalent (1 µg RE = 1 µg retinol = 12 µg beta-carotene).

3.2.4. Vitamins and minerals with a dietary reference value identical to that of the adult population

Table 3 lists the nutrients whose dietary reference values remain unchanged between the general adult population and the pregnant or breastfeeding women population.

Table 3: Dietary reference values for adult women (Anses 2016a, EFSA 2017)

	ANSES, 2016 Adult women		EFSA, 2017
Ca (mg/d)	18-24 years 1000 (PRI)	≥25 years 950 (PRI)	
Mg (mg/d)	360 (AI)		
Mn (mg/d)	2.5 (AI)		
Vitamin B1 (mg/d)	1.2 (AI)		
Vitamin B3 (mg/d)	14 (PRI)		
Vitamin D (µg/d)	15 (PRI)		
Vitamin E (mg/d)	9.9 (AI)		
Phosphorus (mg/d)			550

However, it should be mentioned that inadequate intakes of some of these nutrients during pregnancy expose the mother or child to specific hazards:
- for vitamin D, although the data in the literature are not very consistent, EFSA noted the existence of an association between a plasma 25(OH)D concentration below 50 nmol/L and an increased risk of pre-eclampsia, premature birth and/or low weight for gestational age (EFSA Panel on Dietetic Products et Allergies 2016);

- an adequate calcium intake would reduce the risk of hypertensive disorders (such as pre-eclampsia and eclampsia) during pregnancy (Hofmeyr *et al.* 2010).

3.3. ANSES opinions on other substances

Recent ANSES publications mention specific recommendations for pregnant and breastfeeding women on phyto-oestrogens, phytosterols, caffeine, intense sweeteners and certain chemical contaminants. These recommendations replace those mentioned in the guides to nutrition during and after pregnancy (INPES 2007a, b, c).

3.3.1. Phyto-oestrogens

The report on "Safety and benefits of dietary phyto-oestrogens – Recommendations" (AFSSA 2005) advocates limiting consumption of phyto-oestrogens by pregnant women, and providing iodine supplementation for women taking phyto-oestrogens as these can reduce iodine absorption. These recommendations were reinforced by the ANSES opinion (Anses 2011b) assessing the risk associated with substances for nutritional or physiological purposes, with the aim of restricting or prohibiting their use in foodstuffs.

The limit of 1 mg/kg body weight/day of phyto-oestrogens, which may have adverse effects on the foetus (increased risk of testicular or breast cancer), must not be exceeded (Anses 2011b). For pregnant women taking phyto-oestrogens, the "Phyto-oestrogens" Working Group proposed systematically adding an iodine supplement of around 125 µg/day in the form of iodised salt or a multivitamin complex to avoid goitre development in children but also severe impairment or delays to the child's psycho-neuro-intellectual development (AFSSA 2005). This is because even a slight iodine deficiency before pregnancy (urine iodine levels <100 µg/L) can cause hypothyroxinaemia in the mother during pregnancy, and have harmful effects on foetal thyroid development and irreversibly affect foetal neurological development.

3.3.2. Phytosterols or phytostanols

The Agency's opinion on the assessment of the risk and benefit of consuming food products fortified with phytosterols or phytostanols recommends that pregnant or breastfeeding women should refrain from consuming products with added phytosterols/stanols unless medically indicated, as these lead to a decrease in the concentration of β-carotene in breast milk and infant blood (Anses 2014).

3.3.3. Caffeine

In its opinion on the assessment of the risks associated with the consumption of so-called "energy drinks", ANSES recommends that pregnant and breastfeeding women should avoid consuming so-called "energy drinks" because of the risk of delayed growth of the foetus due to caffeine and its secretion into breast milk (Anses 2013b).

3.3.4. Intense sweeteners

The opinion on the nutritional benefits and risks of intense sweeteners for pregnant women states: *"based on the available data, it is not possible to identify any benefits or draw any conclusions regarding the risk related to the consumption of intense sweeteners during pregnancy, in terms of maternal health, obstetrical parameters or newborn health*" (Anses 2015).

3.3.5. Chemical contaminants

The opinion on "Recommendations on the benefits and risks associated with the consumption of fishery products as part of updating the PNNS dietary guidelines" (Anses 2013a) takes into account contamination by dioxins, methylmercury and polychlorinated biphenyls, whose toxic action on the central nervous system has particular importance during the perinatal period (Ren *et al.* 2011).

The Agency recommends varying fish species, sources and supply channels (wild, farmed, fishing grounds, etc.). Consumption of freshwater fish that are highly bioaccumulative (eel, barbel, freshwater bream, carp, catfish) should be limited to once every two months for pregnant or breastfeeding women. Consumption of wild predatory fish (monkfish or angler fish, sea bass, bonito, eel, orange roughy, grenadier, halibut, pike, sea bream, skate, cutlassfish, tuna, etc.) should be limited, and that of swordfish, marlin, siki shark, shark and sea lamprey avoided for pregnant or breastfeeding women.

3.4. Microbiological risks

In order to reduce the risk of foodborne infection, general hygiene measures should be applied and the consumption of certain foods should be avoided (see Annex 2 for additional information on preparation and storage methods):

- all raw or undercooked meats;
- cooked delicatessen meat products requiring cold storage (e.g. rillettes, pâtés, jellied products);
- delicatessen meat products containing raw pork liver (e.g. figatelli, liver sausage), raw or undercooked pork liver;
- raw milk;
- cheeses made from raw milk with the exception of hard pressed cheeses such as gruyère or comté);
- soft cheeses with a surface mould (such as camembert or brie) or washed rind (such as munster or pont l'évêque), cheeses sold grated;
- raw eggs and products containing raw or undercooked eggs;
- raw shellfish, raw fish (sushi, sashimi, taramasalata), smoked fish.
- shelled crustaceans sold cooked and requiring cold storage.

3.5. Existing guidelines

For the revision of the dietary guidelines for pregnant or breastfeeding women, the CES on "Human Nutrition" took into account the existing guidelines:

- At national level, the dietary guidelines for the adult population (Anses 2016b) and the guides specific to pregnant or breastfeeding women of the National Institute for Prevention and Health Education (INPES 2007a, b, c, 2009);
- At international level, European guidelines.

3.5.1. At national level

3.5.1.1. Dietary guidelines for the adult population (Anses 2016b)

In 2016, ANSES published dietary guidelines for the adult population (Table 4).

Table 4: Dietary guidelines for the adult population in France

Group	Dietary guidelines
Fruits and vegetables	Current average consumption of the "fruits and vegetables" group should be increased considerably, giving preference to the "fresh fruits" and "vegetables" sub-groups.
Starches	Current average consumption of refined starches should be reduced. Conversely, consumption of wholegrain starches should be increased considerably, to become daily, which would result in an increase in total starch consumption.
Pulses	Current average consumption of pulses should be increased considerably. They should be consumed several times a week.
Fats	Current average consumption of vegetable oils and margarines poor in ALA (alpha-linolenic acid) should be reduced. Conversely, consumption of vegetable oils rich in ALA should be increased considerably, which would result in an increase in the total consumption of vegetable oils. Consumption of vegetable oils rich in ALA (such as walnut or rapeseed oils) should be daily.
Red meat	Consumption of red meat must remain below 500 g/week.
Delicatessen meats	Current average consumption of delicatessen meats should be reduced considerably. It must remain below 25 g/day.
Oily fish	Current average consumption of oily fish should be increased. Eat two servings of fish per week, one of which is high in eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), varying species and supply locations.
Sugar-sweetened beverages	Current average consumption of the "sugar-sweetened beverages such as soda" sub-group should be reduced considerably. Consumption of the "sugar-sweetened beverages" group must remain below one glass per day, including fruit juices.

Some food groups for which ANSES had not made specific recommendations were addressed by dietary guidelines from the HCSP (Haut Conseil de la Santé Publique 2017):

- for oilseeds: a small handful of unsalted nuts per day (almonds, walnuts, hazelnuts, pistachios, etc.);
- for meat and poultry: give preference to poultry consumption;
- for fruits and vegetables, pulses and cereal products: give preference to production methods that reduce exposure to pesticides (according to the precautionary principle).

3.5.1.2. Pregnancy nutrition guides (INPES 2007a, b, c)

The INPES guides include dietary guidelines and management recommendations for pregnant women. Only the dietary guidelines have been extracted and restrictions specific to pregnant women are shown in bold (Table 5).

Table 5: Dietary guidelines for pregnant women (INPES 2007a, b, c)

Group	Dietary guidelines
Fruits and vegetables	At least five per day. **During pregnancy, ensure they are thoroughly washed and remove all traces of soil.**
Starches	At each meal and according to appetite. Opt for wholegrain cereal foods or brown bread. Preferably choose a variety of starchy foods: rice, pasta, semolina, wheat, potatoes, lentils, dried beans, chickpeas, etc.[1]
Pulses	**During pregnancy and breastfeeding, limit consumption of soy-based foods (no more than one per day).** The recommendation for the general population not to exceed consumption of 1 mg/kg/day of phyto-oestrogens must especially be complied with during pregnancy and breastfeeding. Consumption of food supplements containing phyto-oestrogens should be avoided during pregnancy and breastfeeding.
Red meat	In smaller quantities than vegetables and starches. Choose a variety from the leanest species and cuts (veal cutlet, chicken, minced beef with 5% fat). **Eliminate raw, smoked or marinated meat.**
Delicatessen meats	**Eliminate certain delicatessen meats such as rillettes, pâté, foie gras and jellied products.**
Fish	Two servings per week, including at least one oily fish. Diversify fish species (oily fish: salmon, mackerel, sardines, etc.) and supply locations. **Eliminate raw shellfish and raw or smoked fish.**
Eggs	**Consume preparations containing raw eggs immediately.**
Fats	Preferably choose vegetable fats (olive oil, rapeseed oil, etc.) and vary the types. Limit animal fats (butter, cream, etc.). **During pregnancy and breastfeeding, consumption of margarine fortified with phytosterols is not recommended.**
Dairy products	Three a day (milk, yoghurt, cheese). Choose plain products, products with the highest calcium content, the lowest fat and the least salt: milk, yoghurts, *fromage blanc*, etc. **During pregnancy, eat only hard pressed cheeses and processed cheese spreads.**
Water	2.5 litres of water per day. During and outside meals, tap water and bottled water. One litre is provided by food and 1.5 litres by beverages (water, herbal teas, semi-skimmed milk, etc.). Water contains minerals in varying amounts. Tap water is highly recommended. If drinking bottled water, opt for water rich in minerals (calcium, magnesium) and low in sodium.
Sugar-sweetened beverages	Limit sugar-sweetened beverages (syrups, sodas, sweetened fruit drinks and nectars). **No alcoholic beverages.**

[1] In the PNNS classification (ANSES, 2016), lentils, dried beans and chickpeas are classified as pulses, and sweetcorn as a vegetable.

	Avoid tea in large quantities (over 1 litre) as it can reduce the absorption of iron from plant sources. Prefer herbal teas instead. Avoid consuming too many drinks containing caffeine (no more than three cups of light coffee per day).
Sweetened products	Limit fatty and sweet foods (pastries, croissant-like pastries, cream desserts, ice creams, chocolate bars, etc.)
Salt	Use **iodised** salt. Limit the consumption of salt and salted products: salted snacks, crisps, etc.

3.5.2. At international level

The recommendations for pregnant or breastfeeding women mainly concern the structuring of meals, weight gain, hygiene, risks associated with contaminants, and the consumption of certain plants or plant extracts.

The following table summarises the recommendations developed in Germany, the Netherlands, Sweden and Austria (Koletzko *et al.* 2013, The Swedish National Food Administration 2008b, a, Austrian Agency for Health and Food Safety 2017b, a, Netherlands Nutrition Centre 2015):

Table 6: Summary of European recommendations by food group

Foods to be avoided	**Foods to be limited**	**Preferred foods**
Products high in saturated fatty acids, confectionery, salted and sweet snacks, cold non-alcoholic beverages, raw foods (milk, meat, fish, eggs), smoked foods, offal, predatory animals (shark, tuna), ready-to-eat packaged vegetables, plants (fennel, cinnamon, liquorice, ginseng, essential oils), seaweed, alcohol	Coffee (limit of two to three cups per day for pregnant women), delicatessen meats	Fruits and vegetables (500 g/day), vegetable-based products, pulses (such as lentils, beans or peas), wholegrain cereal products, skimmed or semi-skimmed milk and milk products, lean meat, fish (two to three times a week, depending on the country, including one oily fish, [the Netherlands: +25 g/adult of the meat-fish-eggs category]), water (one additional litre) or "low-calorie" drinks

3.6. Transposition of the results from food optimisation scenarios in adults

The CES on "Human Nutrition" assessed whether the guideline values proposed by ANSES in 2016 for the adult population were in line with the dietary reference values for pregnant or breastfeeding women, in proportion to their energy needs. The scenarios correspond to the parameters of an optimisation model chosen in order to obtain the quantities of each food group needed to cover the dietary reference values of a population while integrating different constraints. In food optimisation Scenario B for the adult population (Anses 2016b), consumption habits were taken into account in order to achieve the dietary reference values (while introducing flexibility for vitamin D). The "B2 low iron" scenario corresponds to women with a low iron requirement and fibre intakes above 25 g/d. This is the optimisation scenario that takes dietary habits and all nutritional constraints (with the exception of vitamin D) into account in adult women.

Transposing food optimisation Scenario B for adult women enables the dietary reference values to be achieved for pregnant or breastfeeding women for the majority of nutrients (Table 7), with the exception of vitamins B9 and D, iron and iodine, and except for vitamins A and C during breastfeeding only. This is because the recommended 500 kcal/day increase in energy intake for pregnant women in the third trimester or for breastfeeding women only partially closes the gap in

nutritional needs, which highlights the need for special monitoring of women's status for these nutrients.

The following table presents the results of the simulation in proportion to the energy ingested, taking into account the recommendation to increase the energy intake of pregnant (third trimester) or breastfeeding women by 500 kcal/day.

Table 7: Dietary reference values for adult women, pregnant women and breastfeeding women, amount of nutrients provided by the diet for adult women from Scenario B2, and transposition of these intakes for an energy intake increased by 500 kcal[1]

		Dietary reference values			Optimised diet	
		Adult	Pregnancy	Breast-feeding	Adult woman	Adult woman + 500 kcal
Energy intake	kcal				2039	2539
EPA + DHA	mg	500	500	500	500	623
Vitamin A	µg	650	700	1300	822	1024
Vit B1	mg	1.2	1.2	1.2	1.2	1.5
	mg/kcal	0.00059				
Vit B2	mg	1.5	1.9	2	2.0	2.4
	mg/kcal	0.00096				
Vit B3	mg	14	14	14	18	22
	mg/kcal	0.0088				
Vit B5	mg	4.7	5	7	5.9	7.3
Vit B6	mg	1.5	1.8	1.7	2.1	2.6
Vit B9	µg	330	600	500	379	472
Vit B12	µg	4	4.5	5	6.5	8.1
Vit C	mg	110	105	155	110	137
Vit D	µg	15	15	15	3.4	4.2
Vit E	mg	9.9	9.9	9.9	14	17.4
Magnesium	mg	360	360	360	378	471
Phosphorus	mg	550	550	550	1526	1900
Calcium	mg	1000*	1000	1000	1058	1317
Manganese	mg	2.5	2.5	2.5	4.6	5.7
Iron	mg	11**	16	16	11	14
Copper	mg	1	1.5	1.5	2	2.5
Zinc	mg	9.3***	10.9	12.2	11	13.7
Selenium	µg	70	70	85	83	103
Iodine	µg	150	200	200	150	187
Fibre	g	25	25	25	26	32

[1] *The shaded lines correspond to nutrients for which the intake during transposition of the optimised diet in adults in proportion to the excess consumption is below the reference value for pregnancy or breastfeeding.*

* there are two dietary reference values depending on age: the most restrictive value was selected

** value selected for optimisation because it is able to meet the needs for 80% of adult women

*** on the basis of a phytate intake of about 600 mg/d

3.7. Epidemiological data

3.7.1. Results of the literature search

The literature search focused on the links between foods or food groups (*dairy products, dietary fats, eggs, fruit, meat, nuts, vegetables, whole grains, starchy foods, snack, sweet, beverages*) and maternal and child health (*growth, allergy and immunology, pregnancy complications, child development*). Studies published between 1 January 1990 and 31 August 2017 and included in the PubMed database were identified.

Of the 625 articles identified, those dealing only with dietary profiles of nutrients (including alcohol and caffeine) or contaminants, as well as those dealing only with fish oil supplementation, were excluded from the analysis. In all, 84 articles were selected, only two of which dealt with breastfeeding women.

3.7.2. Analysis of epidemiological relationships for food groups

The 84 articles selected were classified according to the food group concerned (cereal and starch products, eggs, fish, red meat and delicatessen meats, fruits and vegetables, milk and dairy products, sugar-sweetened beverages) and the health parameters studied in mothers and children.

The WCRF (World Cancer Research Fund) has defined five levels of evidence for qualifying the relationships. These were used for the analysis of the literature data as recommended in the report of the Working Group on "Risk assessment methodology" (Anses 2016d):

- "Convincing" level of evidence: evidence from more than one study type, at least two independent cohort studies, low heterogeneity in meta-analyses, good quality epidemiological studies that can confirm the result is not due to confounding, selection or ranking biases, or Type I error risk, presence of a plausible dose-response gradient, linear or not, high mechanistic plausibility. This is the level that gives rise to recommendations.

- "Probable" level of evidence: at least two independent cohort studies or at least five case-control studies, low heterogeneity, good quality epidemiological studies, satisfactory mechanistic plausibility.

- "Limited – Suggestive" level of evidence: at least two independent cohort studies or at least five case-control studies, possible heterogeneity, mechanistic plausibility.

- "Limited – No conclusion" level of evidence: few studies available or different effects between studies or studies with methodological flaws. Further research is needed to reach any conclusions.

- "Substantial effect on risk unlikely" level of evidence: same requirements as for the "Convincing" level of evidence but showing no association.

The results below are reported by food group, presenting the health parameters studied first in the mother (gestational diabetes, maternal depression, premature delivery, pre-eclampsia and allergy) and then in the child (cognitive development, foetal growth, postnatal growth, cancer, asthma, eczema and allergy).

3.7.2.1. Cereal and starchy products

Only five studies reported results on the association between cereal consumption during pregnancy and maternal or child health (Sausenthaler *et al.* 2007, Radesky *et al.* 2008, Nwaru *et al.* 2010, Bunyavanich *et al.* 2014, Zhu *et al.* 2017). Since comparison of the available data is not feasible due to the heterogeneity of the exposure measurements and health parameters, **the level of evidence was graded "limited – no conclusion"**.

Only one analysis examined the relationship between potato consumption before pregnancy and the risk of gestational diabetes (Bao *et al.* 2016). **The level of evidence was therefore graded "limited – no conclusion".**

3.7.2.2. Eggs

- **Gestational diabetes**

One systematic review of the association between dietary intakes before and during pregnancy and the risk of gestational diabetes was identified (Schoenaker *et al.* 2016). It included 21 prospective studies, six cross-sectional studies and five case-control studies, but only three studies concerned egg consumption.

A positive association between egg consumption during pregnancy and the risk of gestational diabetes was found in two studies: the prospective Omega cohort and the Alpha case-control study (for consumption of at least seven eggs per week compared to a lower consumption, OR = 1.77 [1.19-2.63] in the Omega study and OR = 2.65 [1.48-4.72] in the Alpha study) (Qiu *et al.* 2011). Conversely, there was no significant association between egg consumption during pregnancy and the risk of diabetes in the prospective Nurses' Health Study (Bao *et al.* 2013).

As the positive association between egg consumption and risk of gestational diabetes was only found in one of two prospective studies and one case-control study, the level of evidence was graded "limited – no conclusion".

- **Maternal depression**

Only one study investigated the relationship between egg consumption during pregnancy and maternal depression during pregnancy (Miyake *et al.* 2006). **The level of evidence was therefore graded "limited – no conclusion".**

- **Mother's allergy**

Only one study investigated the relationship between egg consumption during pregnancy and the risk of allergic rhinitis during pregnancy (Miyake *et al.* 2007). **The level of evidence was therefore graded "limited – no conclusion".**

- **Eczema**

Two prospective studies on the links between egg consumption during pregnancy and the risk of eczema in children were identified (Saito *et al.* 2010, Sausenthaler *et al.* 2007). These two birth cohorts found no link between egg consumption during pregnancy and the risk of eczema at 3-4 months (Saito *et al.* 2010) or two years of age (Sausenthaler *et al.* 2007).

As only two studies had analysed the relationship between egg consumption during pregnancy and eczema risk at 3-4 months or two years of age, **the level of evidence was graded "limited – no conclusion"**.

- **Child's allergy**

Two prospective studies on the links between egg consumption during pregnancy and allergy risk in children were identified (Nwaru *et al.* 2010, Sausenthaler *et al.* 2007). Neither study showed an association between egg consumption and children's sensitisation to food or airborne allergens.

As only two studies had analysed the relationship between egg consumption during pregnancy and allergy risk in children, **the level of evidence was graded "limited – no conclusion"**.

3.7.2.3. Fish

- **Gestational diabetes**

One systematic review of the association between dietary intakes before and during pregnancy and the risk of gestational diabetes was identified (Schoenaker *et al.* 2016). It included 21 prospective studies, six cross-sectional studies and five case-control studies, but only two prospective studies

and one cross-sectional study concerned maternal fish intake. They did not reveal any link between fish consumption before or during pregnancy and the risk of gestational diabetes.

None of the studies showed an association between fish consumption and the risk of gestational diabetes. **As only three studies had analysed this relationship, the level of evidence was graded "limited – no conclusion".**

- **Maternal depression**

Two cross-sectional studies analysing the links between fish consumption during pregnancy and maternal depression during pregnancy were identified (Miyake *et al.* 2013, Sontrop *et al.* 2008). The Japanese Kyushu Okinawa Maternal and Child Health Study found a negative association between fish consumption and maternal depression during pregnancy, after adjusting for potential confounding factors (Miyake *et al.* 2013). This association was not found after adjusting for potential confounding factors in the Canadian Prenatal Health Project cohort (Sontrop *et al.* 2008).

Two other prospective studies analysing the links between fish consumption during pregnancy and postpartum depression were identified (Miyake *et al.* 2006, Strom *et al.* 2009). No association between fish consumption and depressive symptoms two to nine months after delivery was found in the Japanese Osaka Maternal and Child Health Study (Miyake *et al.* 2006). Similarly, analyses conducted in the Danish National Birth Cohort found no link between fish consumption during pregnancy and the risk of hospital admission for depression in the year following delivery (Strom *et al.* 2009). On the other hand, in this cohort, fish consumption during pregnancy was negatively associated with the prescription of antidepressants in the year following delivery.

As only two cross-sectional studies had examined the relationship between fish consumption during pregnancy and the risk of maternal depression during pregnancy, the level of evidence was graded "limited – no conclusion".

Regarding maternal depression in the year following pregnancy, no studies have shown an association with fish consumption. Nevertheless, as only three studies had analysed this relationship, the level of evidence was graded "limited – no conclusion".

- **Premature delivery**

A meta-analysis including data from nineteen European birth cohorts (n = 151,880) examined associations between fish consumption during pregnancy and birth outcomes (Leventakou *et al.* 2014). This study showed that women who consume fish more than once a week have a lower risk of premature delivery than women who consume fish less than once a week. However, the association with fish consumption is not linear, as the risk estimates are similar for high and intermediate consumption (]1-3 times/week[: the adjusted RR = 0.87 [0.82-0.92]; ≥ 3 times/week: the adjusted RR = 0.89 [0.84-0.96]). The potential benefits of fish consumption regarding the risk of prematurity could be attributed to their n-3 long-chain PUFA content (Leventakou *et al.* 2014).

Five other studies on the association between fish consumption during pregnancy and risk of prematurity were identified: four prospective studies and one cross-sectional study. Of these studies, four did not find any link between fish consumption and the risk of prematurity (Olsen *et al.* 1993, Oken *et al.* 2004, Heppe, Steegers*, et al.* 2011, Canda, Sezer et Demir 2011), and one prospective study published in two papers found an increased risk of prematurity in women who do not consume fish during pregnancy (Olsen *et al.* 2006, Olsen et Secher 2002).

Among the studies that examined fish consumption and the risk of prematurity, some reported either no relationship or an increased risk among women who do not consume fish. As a post-study meta-analysis with low heterogeneity concluded that there was a decreased risk of prematurity associated with fish consumption during pregnancy, with no dose-response relationship, and identifying a potential mechanism, the level of evidence was graded "probable".

- **Cognitive development**

One systematic review of the links between fish consumption during pregnancy and foetal neurodevelopment was identified (Starling *et al.* 2015). It included eight papers based on six cohort studies. Although the review highlighted the heterogeneity between studies in terms of method used and measurement of cognitive development, it concluded that there is a positive association between the consumption of one or more servings of fish per week during pregnancy and measures of cognitive development in children. Of the six studies included, only one did not find an association with neurodevelopment, but the infants were only three days old in this study.

Since publication of the systematic review, another prospective study has examined the links between fish consumption during pregnancy and children's cognitive development (Julvez *et al.* 2016). Analyses conducted in the INMA cohort, characterised by high fish intakes, indicate that seafood consumption is moderately positively associated with cognitive development in children at five years of age and is also associated with a reduction in autistic traits at this same age.

The New Bedford birth cohort also demonstrated a protective effect of consuming more than two servings of fish per day during pregnancy against attention disorders (impulsivity/hyperactivity) in children eight years of age (Sagiv *et al.* 2012).

The potential benefits of fish consumption on children's cognitive development could be attributed to their n-3 long-chain PUFA content, but also iodine and vitamin D (Leventakou *et al.* 2014).

The majority of studies that have examined fish consumption and children's cognitive development show a positive association. As a potential mechanism was identified, the level of evidence was graded "probable".

- **Foetal growth**

A meta-analysis including data from nineteen European birth cohorts (n = 151,880) examined the associations between fish consumption during pregnancy and birth weight (Leventakou *et al.* 2014). Although most individual studies did not find a significant association, this meta-analysis showed that women who consume fish more than once a week have children with higher birth weights. The association is found for intermediate fish consumption but also for frequent consumption (]1-3 times/week[: beta = 8.93 g [3.31-14.56]; ≥ 3 times/week: beta = 15.2 g [8.86-21.54]).

In the Eden birth cohort, the association between fish consumption and birth weight was only found in overweight or obese women (Drouillet *et al.* 2009).

Several prospective studies conducted in Turkey, India and Japan have shown an increased risk of having a child with a low birth weight among women who do not consume fish during pregnancy (Canda, Sezer et Demir 2011, Mohanty *et al.* 2015, Muthayya *et al.* 2009).

Some studies suggest that the positive association between fish consumption and birth weight is specific to lean fish (Brantsaeter *et al.* 2012, Mohanty *et al.* 2015). Nevertheless, in the INMA cohort (Ramon, Ballester, Aguinagalde*, et al.* 2009), high consumption of canned tuna (at least twice a week) was associated with higher birth weight and a lower risk of low birth weight for gestational age.

Lastly, the prospective studies Project Viva and Generation R found no association between fish consumption during pregnancy and birth weight (Heppe, Steegers*, et al.* 2011, Oken *et al.* 2004).

The potential benefits of fish consumption on foetal growth could be attributed to their n-3 long-chain PUFA content (Leventakou *et al.* 2014).

Studies that examined total fish consumption and foetal growth reported either no relationship or a positive association with birth weight. A recent meta-analysis showing slightly heterogeneous results concluded that there is a positive association between total fish consumption during pregnancy and birth weight, with a dose-response relationship. In

addition, as a potential mechanism had been identified, the level of evidence was graded "probable".

- **Postnatal growth**

A pooled study including data from fifteen European and American birth cohorts (n = 26,184) examined the associations between maternal fish consumption during pregnancy and postnatal growth (Stratakis *et al.* 2016). This study reported a positive association between high fish consumption during pregnancy (>3 times/week) and body mass index in children at two and four years of age. In addition, although most individual studies did not show significant associations, this meta-analysis showed that women who consume fish more than three times a week have children with faster growth between birth and two years of age and a higher risk of being overweight at six years of age.

Another prospective study, conducted in Tasmania, found no association between fish consumption during pregnancy and body composition in adolescence (Yin *et al.* 2012). Nevertheless, this study focused on a relatively small number of subjects (<300).

A meta-analysis revealed a higher body mass index in young children and a higher risk of overweight associated with high fish consumption during pregnancy. In the absence of an identified mechanism, the level of evidence was graded "limited – no conclusion".

- **Eczema**

Seven studies on the links between fish consumption and eczema in children were identified (Romieu *et al.* 2007, Willers *et al.* 2007, Sausenthaler *et al.* 2007, Saito *et al.* 2010, Jedrychowski *et al.* 2011, Pele *et al.* 2013, Leermakers *et al.* 2013).

Regarding childhood eczema, four prospective studies indicated a decrease in the risk of eczema in young children (before the age of five years) associated with fish consumption during pregnancy (Romieu *et al.* 2007, Willers *et al.* 2007, Sausenthaler *et al.* 2007, Jedrychowski *et al.* 2011), while three studies found no link between fish consumption during pregnancy and the risk of eczema at 3-4 months (Saito *et al.* 2010), before the age of two years (Pele *et al.* 2013) or before the age of four years (Leermakers *et al.* 2013).

The potential benefits of fish consumption regarding the risk of eczema in children could be attributed to their n-3 long-chain PUFA content that can modulate immune responses affecting the production of inflammatory cytokines (Romieu *et al.* 2007, Leventakou *et al.* 2014).

The inverse association between fish consumption during pregnancy and the risk of eczema in children under five years of age was found in four out of seven prospective studies and a potential mechanism was identified. Due to the heterogeneity of the data, the level of evidence was graded "limited – suggestive".

- **Child's allergy**

In addition, several studies found no association between fish consumption during pregnancy and children's sensitisation to food or airborne allergens (Nwaru *et al.* 2010, Sausenthaler *et al.* 2007, Calvani *et al.* 2006). In Calvani's retrospective study, fish consumption during pregnancy was not associated with children's sensitisation to food or airborne allergens in women with a history of allergy and was only associated with lower food-allergen sensitisation in women with no history of allergy (OR = 0.23 [0.08-0.69] for consumption > once/week compared to consumption < once/month).

In the French Pélagie cohort (Pele *et al.* 2013), fish consumption was not associated with wheezing or food allergies before the age of two years, while consumption of crustaceans at least once a month during pregnancy was associated with an increased risk of food allergy in the first two years of life (OR = 1.62 [1.11-2.37]).

Due to their heterogeneity, the data were considered insufficient for analysing the relationship between fish consumption and allergic manifestations in children. The level of evidence was therefore graded "limited – no conclusion".

3.7.2.4. Red meat and delicatessen meats

- **Gestational diabetes**

One systematic review of the association between dietary intakes before and during pregnancy and the risk of gestational diabetes was identified (Schoenaker *et al.* 2016). It included 21 prospective studies, six cross-sectional studies and five case-control studies, but only two studies concerned meat consumption. A positive association between total pre-pregnancy consumption of red meat or processed meat and risk of gestational diabetes was found in two studies: the prospective Nurses' Health Study II cohort (for an additional serving of around 85 grams per day, OR = 1.66 [1.36-2.02] for total red meat and 1.47 [0.98-2.20] for processed meat (Bao *et al.* 2013)) and the Alpha case-control study (Schoenaker *et al.* 2016). The Project Viva prospective study found no significant association between the consumption of red meat or processed meat during pregnancy and the risk of gestational diabetes (Radesky *et al.* 2008).

As only one out of two prospective studies had found an increased risk of gestational diabetes associated with red meat consumption during pregnancy, the level of evidence was graded "limited – no conclusion".

- **Maternal depression**

Only one study on the association between dietary meat intakes during pregnancy and *postpartum* depression was identified (Miyake *et al.* 2006). **The level of evidence was therefore graded "limited – no conclusion".**

- **Mother's allergy**

Only one study on the association between dietary meat intakes during pregnancy and the prevalence of allergic rhinitis in the mother was identified (Miyake *et al.* 2005). **The level of evidence was therefore graded "limited – no conclusion".**

- **Foetal growth**

Only one study on the association between dietary meat intakes during pregnancy and children's birth weight was identified (Jedrychowski *et al.* 2012). **The level of evidence was therefore graded "limited – no conclusion".**

- **Postnatal growth**

Only one study on the association between dietary meat intakes during pregnancy and adolescent body fat was identified (Yin *et al.* 2012). **The level of evidence was therefore graded "limited – no conclusion".**

- **Cancer**

One meta-analysis on the association between cured meat consumption during pregnancy and brain tumour risk in children was identified (Huncharek et Kupelnick 2004). It included seven case-control studies and concluded that there is an increased risk of brain tumour in children associated with the consumption of cured meat (RR = 1.68 [1.30-2.17]; Q homogeneity = 3.75, p = 0.59).

This meta-analysis was supplemented by a case-control study published in 2011. This study suggested that the association between maternal consumption of cured meat and brain tumour risk is only found in children without the GSTT1 and GSTM3 genes, which can inactivate nitroso compounds (Searles Nielsen *et al.* 2011). The suggested biological mechanism is based on the presence in these meats of N-nitroso compounds, which are recognised as neurocarcinogens in animal models, particularly when administered *in utero*, and are suspected of also being

carcinogenic in humans (IARC Working Group on the Evaluation of Carcinogenic Risks to Humans 2018, 2010).

As a meta-analysis of seven case-control studies had demonstrated an increased risk of brain tumour in children associated with the consumption of cured meat during pregnancy, and a potential mechanism was proposed, the level of evidence was graded "limited – suggestive".

- **Eczema**

Only one study on the association between dietary meat intakes during pregnancy and the risk of atopic eczema in infants 3-4 months of age was identified (Saito *et al.* 2010). **The level of evidence was therefore graded "limited – no conclusion".**

3.7.2.5. Fruits and vegetables

- **Gestational diabetes**

One intervention study explored the impact of increased consumption of fruits and green leafy vegetables before and during pregnancy on the risk of gestational diabetes (Sahariah *et al.* 2016). The prevalence of gestational diabetes decreased in the exposed group (7.3% versus 12.4% in the control group; OR = 0.56 [0.36, 0.86]). This study was conducted among very low-income women in the suburbs of Mumbai, India (average BMI = 20 kg/m^2).

A study conducted in the Nurses' Health Study II cohort examined fibre consumption associated with fruits, vegetables and cereals (Zhang *et al.* 2006). Each 10 g/day increase in total fibre intake was associated with a 26% reduction in the risk of gestational diabetes [9%-49%]. Each 5 g/day increase in cereal or fruit fibre intake was associated with a reduction in the risk of gestational diabetes of 23% [9%-36%] or 26% [5%-42%], respectively. On the other hand, no significant association was observed between vegetable fibre consumption and the risk of gestational diabetes, although a reduction in risk in the highest quintile was observed.

The potential mechanism may be linked to improved blood glucose control through the presence of fibre, vitamins and minerals provided by fruits and vegetables (especially green leafy vegetables).

As an intervention study and a cohort study had shown a beneficial effect on the risk of gestational diabetes, and a mechanism was identified, the level of evidence was graded "limited – suggestive".

- **Premature delivery**

Only one study explored the association between garlic and dried fruit consumption during pregnancy and the risk of premature delivery (Myhre *et al.* 2013). **The level of evidence was therefore graded "limited – no conclusion".**

- **Pre-eclampsia**

Only one case-control study (Atkinson *et al.* 1998) conducted in Zimbabwe examined the association between fruit and vegetable consumption and the risk of eclampsia. **The level of evidence was therefore graded "limited – no conclusion".**

- **Cognitive development**

Only one study examined the relationship between maternal fruit consumption and children's cognitive development (Bolduc *et al.* 2016). **The level of evidence was therefore graded "limited – no conclusion".**

- **Foetal growth**

In a cross-sectional study of 121 pregnant women at 28 to 38 weeks gestation recruited at Universiti Sains Malaysia Hospital (Malaysia) (Loy *et al.* 2011), a 10 g per day increase in leafy vegetable consumption was associated with a 1.78 cm increase in head circumference, and tuber consumption

was associated with birth length and head circumference. Fruit intake was associated with birth weight, birth length and head circumference.

In 787 infants in a mother-child cohort in Valencia, Spain (Ramon, Ballester, Iniguez*, et al.* 2009), an inverse linear relationship was found between maternal vegetable consumption and the presence of a low weight or length for gestational age. Women in the lowest quintile of vegetable consumption in the first trimester were at higher risk of having a baby that was small for gestational age in weight compared to women in the highest quintile (OR = 3.7 [1.5-8.9]) and of having a baby that was small for gestational age in length in the third trimester (OR = 5.5 [1.7-17.7]). In addition, newborns in the two lowest intake quintiles had significantly lower weight and length than those in the fourth quintile. These associations were not found for fruit consumption.

In 43,585 Danish women from the Danish National Birth Cohort (Mikkelsen *et al.* 2006), significant associations were found between maternal fruit and vegetable consumption and birth weight. The strongest association was observed for fruit consumption: birth weight was 10.7 g [7.3-14.2] higher per fruit consumption quintile. The association was stronger among slim women (BMI <20 kg/m^2, n = 7,169), for whom the child's birth weight was 14.6 g [6.4-22.9] higher per fruit consumption quintile. The associations were similar for the consumption of green leafy vegetables, but with a lower estimate (+6.1 g per quintile, [0.35-11.8]).

The potential benefits of fruit and vegetable consumption on foetal growth could be attributed to their vitamin and mineral content, such as vitamins D and B9, but also to their fibre content and prebiotic effects (Leventakou *et al.* 2014).

As two cohort studies and one cross-sectional study showed a positive association between fruit and vegetable consumption during pregnancy and birth weight or length, and because the nature of the proposed mechanism is only suggestive, the level of evidence was graded "limited – suggestive".

- **Asthma**

A 2014 meta-analysis (Seyedrezazadeh *et al.* 2014) explored the relationship between fruit and vegetable consumption and the risk of wheezing and asthma. Twelve cohorts, four case-control studies and 26 cross-sectional studies published between January 1990 and July 2013 were identified. Five cohort studies specifically investigated the relationship between fruit or vegetable consumption during pregnancy and the risk of wheezing in children. The meta-analysis did not find any association between fruit or vegetable consumption during pregnancy and the risk of wheezing in children (RR = 0.94 [0.73-1.27], I^2 = 70% for fruits; RR = 0.91 [0.70-1.18], I^2 = 61% for vegetables).

Among the 1277 mothers in the American Project Viva cohort (Bunyavanich *et al.* 2014), maternal consumption of common food allergens was assessed during the first and second trimesters of pregnancy. No significant association was observed between the consumption of allergens from plant sources (peanut, wheat, soy) and the risk of asthma in children followed up at an average age of 7.9 years.

A meta-analysis of five prospective studies and one subsequent prospective cohort did not find any association between fruit and vegetable consumption during pregnancy and the risk of wheezing or asthma in children. The level of evidence was graded "limited – no conclusion".

- **Child's allergy**

Among the 1277 mothers in the American Project Viva cohort (Bunyavanich *et al.* 2014), maternal consumption of common food allergens (peanut, wheat, soy) was assessed during the first and second trimesters of pregnancy. No significant association was observed between the consumption of allergens from plant sources and the risk of allergies in children followed up at an average age of 7.9 years.

Among the 931 five-year-olds in the Finnish type-1 diabetes prediction and prevention nutrition study (Nwaru *et al.* 2010), increased maternal consumption of citrus fruits and vegetables was positively associated with sensitisation to inhalant allergens (OR = 1.14 [1.05-1.25] for citrus fruits; OR = 1.36 [1.09-1.70] for fruits).

Among the 2641 two-year-olds in a German prospective birth cohort study (LISA) (Sausenthaler *et al.* 2007), high consumption of celery during the last four weeks of pregnancy and of citrus fruits increased the risk of food allergen sensitisation in children (OR = 1.85 [1.18-2.89] for celery and OR = 1.73 [1.18-2.53] for citrus fruits). Sensitisation of children to airborne allergens was positively related to high maternal intakes of bell peppers (OR = 2.16 [1.20-3.90]) and citrus fruits (OR = 1.72 [1.02-2.92]).

Studies on the links between fruit and vegetable consumption and children's allergies are too heterogeneous in the fruit and vegetable categories studied and the food allergy assessment methods to be able to reach any overall conclusion. Regarding the increased risk of allergen sensitisation in children related to the consumption of certain fruits and vegetables containing food allergens, the level of evidence was graded "limited – no conclusion".

3.7.2.6. Milk and dairy products

- **Gestational diabetes**

Only one study, involving very low-income women in the suburbs of Mumbai, India, explored the impact of increased consumption of whole milk before and during pregnancy on the risk of gestational diabetes (Sahariah *et al.* 2016). **The level of evidence was therefore graded "limited – no conclusion".**

- **Maternal depression**

Only one study looked at the relationship between dairy consumption during pregnancy and depressive symptoms during pregnancy (Miyake *et al.* 2007).

Only one study investigated the relationship between dairy consumption during pregnancy and postpartum depression (Miyake *et al.* 2006).

As only one study focused on depression during pregnancy and only one on postpartum depression, **the level of evidence was therefore graded "limited – no conclusion"**.

- **Premature delivery**

Only one Swedish study (All Babies in Southeast Sweden – ABIS) (Ludvigsson et Ludvigsson 2004) examined the association between the risk of premature delivery and milk consumption during pregnancy. **The level of evidence was therefore graded "limited – no conclusion".**

- **Pre-eclampsia**

Among the 9291 pregnant women in the Child Health and Development Study at the University of California (Berkeley), monitored between 1959 and 1966 (Richardson et Baird 1995), a U-shaped distribution was observed between the risk of pre-eclampsia and milk consumption. Thus, compared to women who drank two glasses of milk per day, those who drank less than one glass of milk per day had an increased risk (RR = 1.9 [1.2-2.9]), as did those who drank three glasses per day (RR = 2.0 [1.2-3.4]) or at least four glasses per day (RR = 1.8 [1.1-3.0]).

A case-control study was conducted in 163 pre-eclamptic women between 1991 and 1996 (Duvekot *et al.* 2002). Cases and controls were matched by age and delivery date. Daily milk consumption was higher in the control group (3.0 ± 0.1 units per day) than in the pre-eclampsia group (2.4 ± 0.1 units per day, $p < 0.01$).

As only one prospective study and one case-control study had examined the relationship between milk consumption and the risk of pre-eclampsia, the level of evidence was graded "limited – no conclusion".

- **Mother's allergy**

Only one study investigated the relationship between consumption of dairy products during pregnancy and the risk of allergic rhinitis in the mother during pregnancy (Miyake *et al.* 2007). **The level of evidence was therefore graded "limited – no conclusion".**

- **Foetal growth**

Among the 3405 pregnant women in a cohort study (Xue *et al.* 2008), foetal weight gain was greater in the third trimester of pregnancy when mothers consumed more than three glasses of milk per day compared to mothers consuming less than two glasses per day. As a result, at birth, the weight was 88 g [39-135] higher and the head circumference tended to be 2.3 cm [0.0-4.6] greater, but the length was unchanged.

Among the 34,063 women in the Nurses' Mother's Cohort (Xue *et al.* 2008), each additional daily glass of milk was associated with an increase in birth weight of about 6 g.

Among the 50,117 women in the Danish National Birth Cohort (Olsen *et al.* 2007), consumption was inversely associated with the risk of lower birth length and weight. The odds ratio of a small birth size was 0.51 [0.39-0.65] and a large birth size was 1.59 [1.16-2.16] for women who drank more than six glasses of milk per day compared to those who did not drink it. Similarly, the increase in average birth weight was 108 g [74-143].

A Canadian study (Mannion, Gray-Donald et Koski 2006) showed that women who consumed less than 250 mL of milk per day (n = 72) gave birth to infants whose weight was lower than that of those born to women who consumed more (n = 207; 3410 g versus 3530 g, respectively). The infants were similar in size and head circumference. Each additional glass of milk per day was associated with a 41 g [14.0-75.1] increase in birth weight.

The Swedish ABIS study (Ludvigsson et Ludvigsson 2004) showed that low milk intake during pregnancy was not associated with a risk of low birth weight but was associated with a higher risk of intrauterine growth retardation, a dynamic foetal growth defect that results in a foetus of insufficient size for gestational age.

The potential benefits of milk consumption on foetal growth could be attributed to its insulin-like growth factor-1 (IGF-1) content and/or to the stimulation of endogenous IGF-1 production by milk (Heppe, van Dam*, et al.* 2011).

Four prospective studies showed a positive association between milk consumption during pregnancy and birth weight, and another study between milk consumption during pregnancy and the risk of intrauterine growth retardation. As a potential mechanism was identified, the level of evidence was graded "probable" regarding the relationship between milk consumption during pregnancy and birth weight.

- **Asthma and wheezing in children**

Only one study looked at the relationship between dairy consumption during pregnancy and the risk of asthma in children (Bunyavanich *et al.* 2014). **The level of evidence was therefore graded "limited – no conclusion".**

Only one study examined the link between dairy consumption during pregnancy and the risk of infant wheezing (Miyake *et al.* 2010). **The level of evidence was therefore graded "limited – no conclusion".**

- **Eczema**

In two prospective studies in 771 (Saito *et al.* 2010) and 763 (Miyake *et al.* 2010) Japanese women, consumption of dairy products, milk, cheese and calcium during pregnancy was not significantly related to the risk of eczema in infants aged 3-4 months and 16-24 months, respectively.

Only two prospective studies examined dairy consumption and eczema risk and were unable to find a link. The level of evidence was therefore graded "limited – no conclusion".

- **Child's allergy**

Only one study looked at the relationship between maternal consumption of dairy products during the first two trimesters of pregnancy and the risk of allergic rhinitis or food allergy in children (Bunyavanich *et al.* 2014). **The level of evidence was therefore graded "limited – no conclusion".**

3.7.2.7. Sugar-sweetened beverages

Few data on the links between the consumption of non-coffee beverages and sugar-sweetened beverages during pregnancy or breastfeeding and maternal or child health are available in the literature. As caffeine intake and intense sweeteners have been the subject of recent opinions from ANSES (Anses 2013b, 2015), only sugar-sweetened beverages are covered here.

- **Gestational diabetes**

Only one study investigated the association between the consumption of sugar-sweetened beverages during pregnancy and the risk of gestational diabetes (Chen *et al.* 2009). **The level of evidence was therefore graded "limited – no conclusion".**

- **Premature delivery**

A Japanese study looked at the relationship between consumption of non-alcoholic beverages and gestation time and found no association (Okubo *et al.* 2015).

Three prospective studies on the association between consumption of sugar-sweetened beverages during pregnancy and gestation time were identified. These are all European studies: the Danish National Birth Cohort, the Norwegian MOBa cohort and the Born in Bradford cohort. The Danish cohort (Halldorsson *et al.* 2010) did not find any association between the consumption of sugar-sweetened beverages and the risk of prematurity. The Norwegian cohort (Englund-Ogge *et al.* 2012) found a higher risk of prematurity associated with a sugar-sweetened beverage intake of more than four glasses per day compared to no consumption (OR = 1.41 [1.11-1.79]). The English cohort (Petherick, Goran et Wright 2014) also found this association (OR = 1.81 [1.03-3.18]).

Two out of three European prospective studies found an association between high consumption of sugar-sweetened beverages and an increased risk of prematurity, while another prospective study did not find this link. In the absence of an identified mechanism, the level of evidence was graded "limited – no conclusion".

- **Pre-eclampsia**

Only one study investigated the association between the consumption of sugar-sweetened beverages during pregnancy and the risk of pre-eclampsia (Borgen *et al.* 2012). **The level of evidence was therefore graded "limited – no conclusion".**

- **Foetal growth**

Only two studies on the association between sugar-sweetened beverage consumption and foetal growth were identified. No association was found in the Japanese OMCHS cohort (Okubo *et al.* 2015). In the American Fit for Delivery study, the share of energy provided by sugar-sweetened beverages was positively associated with birth weight (Phelan *et al.* 2011).

As only one study out of two had found a link between sugar-sweetened beverage consumption and foetal growth, the level of evidence was graded "limited – no conclusion".

- **Postnatal growth**

Three studies on the association between maternal consumption of sugar-sweetened beverages and postnatal growth were identified. In the American Project Viva cohort (Gillman *et al.* 2017), sugar-sweetened beverage consumption during pregnancy was not related to body mass index or body fat assessed by DXA at the eight-year follow-up, but was positively associated with skinfolds (beta = 0.85 [0.06-1.64] per glass/day) and child waist circumference (beta = 0.65 [0.01-1.28] per glass/day). The associations persisted after adjustment for the child's consumption. In the Dutch Generation R cohort (Jen *et al.* 2017), the consumption of sugar-sweetened beverages during pregnancy was positively associated with the body mass index of children at six years of age (beta = 0.04 [0.00-0.07] for one drink per day) or body fat (beta = 0.05 [0.01-0.08] for one drink per day) but not with the child's lean body mass. In the Canadian CHILD cohort (Azad *et al.* 2016), sugar-sweetened beverage consumption was not associated with a risk of being overweight at one year of age.

Maternal consumption of sugar-sweetened beverages during pregnancy could determine the child's future consumption, either through the parental model or through biological mechanisms activated by excessive exposure of the embryo to glucose (Gillman *et al.* 2017).

Two out of three prospective studies showed an association between the consumption of sugar-sweetened beverages during pregnancy and post-natal growth. Given the relative heterogeneity of the data and the fact that the nature of the proposed mechanism is only suggestive, the level of evidence was graded "limited – suggestive".

3.7.3.Summary of epidemiological relationships for food groups

It was not possible to use the literature data to analyse the links between women's consumption during breastfeeding and their health or that of their children.

Concerning the diet of pregnant women, the data in the literature did enable a relationship to be identified between:

- the consumption of fish during pregnancy and
  - a lower risk of prematurity, a higher birth weight and better cognitive development of the child, with a "probable" level of evidence;
  - a lower risk of eczema before five years of age, with a "limited – suggestive" level of evidence.
- the consumption of dairy products during pregnancy and
  - a higher birth weight, with a "probable" level of evidence for milk.
- the consumption of cured meat during pregnancy and
  - a higher risk of brain tumour in children, with a "limited – suggestive" level of evidence.
- the consumption of fruits and vegetables during pregnancy and
  - a lower risk of gestational diabetes and a higher birth weight or length, with a "limited – suggestive" level of evidence.
- the consumption of sugar-sweetened beverages during pregnancy and
  - a higher risk of weight gain in children, with a "limited – suggestive" level of evidence.

This analysis of the epidemiological data for pregnant or breastfeeding women did not call into question the recommendations for the general adult population (Anses 2016b). The general trends underpinned by the dietary guidelines for the adult population therefore also apply to pregnant or breastfeeding women.

When transposing the dietary guidelines to pregnant or breastfeeding women, attention should be paid to certain nutrients that may be provided in insufficient quantities by this transposition, due to increased needs during pregnancy and breastfeeding, despite the

increase in dietary nutrient intakes in proportion to energy intake (see Section 3.6). These nutrients are vitamin B9, iron and iodine during both pregnancy and breastfeeding, and vitamins A and C during breastfeeding.

3.8. Dietary guidelines for pregnant or breastfeeding women

Following on from the analysis of the epidemiological data and the results obtained from transposing the dietary guidelines from the general adult population, the recommendations for pregnant or breastfeeding women are presented below, along with additional recommendations related to increased nutrient requirements. Some recommendations for the general population are particularly important for pregnant or breastfeeding women because the requirements for certain nutrients (vitamins A, B9, C and D, iron and iodine) may not be met simply by increasing food intakes. The requirements for these nutrients can be met by modulating the general adult recommendations in favour of certain source foods (Ciqual 2017 data) within the food groups for which recommendations have been made. Specific restrictions regarding microbiological and chemical risks have also been identified. The CES therefore recommends for pregnant or breastfeeding women:

Fruits and vegetables

- As with the adult population, current average consumption of the "fruits and vegetables" group should be increased considerably, giving preference to the "fresh fruits" and "vegetables" sub-groups.

Specific recommendation related to the increased vitamin B9 requirement in pregnant or breastfeeding women:

  - Choose vegetables rich in vitamin B9 (particularly spinach, asparagus, salads, Brussels sprouts, cauliflower, broccoli, celeriac and red beetroot)

Specific recommendation related to the increased vitamin A requirement in breastfeeding women:

  - Choose fruits and vegetables rich in beta-carotene (particularly carrots, sweet potatoes, spinach, pumpkin, cabbage, salads, melon, tomatoes and apricots)

Specific recommendation related to the increased vitamin C requirement in breastfeeding women:

  - Choose fruits and vegetables rich in vitamin C (particularly blackcurrants, kiwis, strawberries, oranges, pineapple, grapefruit, bell peppers, broccoli, Brussels sprouts and cauliflower)

Specific restriction related to microbiological risks for pregnant women:

  - Ensure that fruits and vegetables are thoroughly washed and that all traces of soil have been removed

Starches

- As with the adult population, current average consumption of refined starches should be reduced. Conversely, consumption of wholegrain starches should be increased considerably, to become daily, which would result in an increase in total starch consumption.

Pulses

- As with the adult population, current average consumption of pulses should be increased considerably. They should be consumed several times a week.

Specific recommendation related to the increased vitamin B9 requirement in pregnant or breastfeeding women:

  - Preferably choose pulses rich in vitamin B9 (especially lentils, split peas and broad beans)

Specific restriction related to chemical risks for pregnant or breastfeeding women:

- Limit soy-based foods (no more than once a day) because of their high phyto-oestrogen content

Oilseeds

- Eat a small handful of unsalted nuts per day (particularly hazelnuts, walnuts, pistachios and almonds).

Meat

- As with the adult population, consumption of red meat must remain below 500 g/week.

Specific recommendation related to the increased iron requirement in pregnant or breastfeeding women:

- Choose iron-rich meats (particularly beef, rabbit, duck, pigeon and quail)

Specific restriction related to microbiological risks for pregnant women:

- Avoid all raw or undercooked meats

Delicatessen meats

- As with the adult population, current average consumption of delicatessen meats should be reduced considerably. It must remain below 25 g/day.

Specific recommendation related to the increased iron requirement in pregnant or breastfeeding women:

- Preferably choose iron-rich delicatessen meats (especially blood sausage)

Specific restrictions related to microbiological risks for pregnant women:

- Avoid eating cooked delicatessen meats that require cold storage (examples: rillettes, pâtés and jellied products)
- Avoid eating delicatessen meats made from raw pork liver (for example: figatelli and liver sausage) and raw or undercooked pork liver

Specific restriction related to the risk of exceeding the upper intake level for vitamin A for pregnant women:

- Limit the consumption of liver

Fish, molluscs or crustaceans

- As with the adult population, current average consumption of oily fish should be increased. Eat two servings of fish per week, one of which is high in eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), varying species and supply locations.

Specific recommendations related to the increased iodine and iron requirements in pregnant or breastfeeding women:

- Sea fish, especially oily fish such as salmon or herring, sea fish eggs and seafood are important vectors of iodine
- Choose iron-rich fish and seafood (particularly clams, octopus, mussels, anchovies, squid and whelks)

Specific restrictions related to chemical risks for pregnant or breastfeeding women:

- Consumption of freshwater fish that are highly bioaccumulative (in particular eel, barbel, freshwater bream, carp, catfish) should be limited to once every two months
- Consumption of wild predatory fish (particularly monkfish or angler fish, sea bass, bonito, eel, orange roughy, grenadier, halibut, pike, sea bream, skate, cutlassfish and tuna) should be limited, and that of swordfish, marlin, siki shark, shark and sea lamprey should be avoided

Specific restrictions related to microbiological risks for pregnant women:

- Avoid eating raw shellfish, raw fish (sushi, sashimi and taramasalata) and smoked fish
- Avoid eating shelled crustaceans sold cooked and requiring cold storage

Eggs

Specific recommendation related to the increased iodine requirement in pregnant women:

- Cooked egg yolk is an important source of iodine

Specific recommendation related to the increased iodine and vitamin A requirements in breastfeeding women:

- Cooked egg yolk is an important source of iodine and vitamin A

Specific restriction related to microbiological risks for pregnant women:

- Avoid consuming raw eggs and products made from raw or undercooked eggs (such as homemade chocolate mousse and mayonnaise)

Dairy products

Specific recommendation related to the increased iodine requirement in pregnant or breastfeeding women:

- Dairy products are an important source of iodine

Specific restriction related to microbiological risks for pregnant women:

- Avoid consuming raw milk and raw milk cheeses (except for hard pressed cheeses such as gruyère or comté), soft cheeses with a surface mould (such as camembert and brie) or washed rind (such as munster and pont l'évêque), as well as cheeses sold grated

Specific recommendation related to the increased vitamin A requirement in breastfeeding women:

- Cheeses are important sources of vitamin A (especially pasteurised sheep's or goat's milk cheeses and hard pressed cheeses)

Fats

- As with the adult population, current average consumption of vegetable oils and margarines poor in ALA should be reduced. Conversely, consumption of vegetable oils rich in ALA should be increased considerably, which would result in an increase in the total consumption of vegetable oils. Consumption of vegetable oils rich in ALA (such as walnut or rapeseed oils) should be daily.

Specific recommendation related to the increased vitamin A requirement in breastfeeding women:

- Butter and fresh cream are important sources of vitamin A

Specific restriction related to the increased vitamin A requirement in pregnant or breastfeeding women:

- Avoid consuming products fortified with phytosterols/stanols

Beverages

- As with the adult population, current average consumption of the "sugar-sweetened beverages such as soda" sub-group should be reduced considerably. Consumption of the "sugar-sweetened beverages" group must remain below one glass per day, including fruit juices.

Specific recommendations related to the increased water requirement in pregnant or breastfeeding women:

- Give preference to water (1.3 and 1.7 litres per day respectively for pregnant or breastfeeding women)
- Give preference to herbal teas rather than tea or coffee

Specific restrictions related to chemical risks for pregnant or breastfeeding women:

- Avoid drinking large quantities of tea (~1 litre/day) and curb coffee consumption (two or three cups per day for pregnant women)
- Avoid consuming so-called energy drinks

Note: As a reminder, the French Public Health Agency (SPF) recommends that pregnant and breastfeeding women avoid consuming alcoholic beverages.

Salt

Specific recommendation related to the increased iodine requirement in pregnant or breastfeeding women:

- Use iodised table salt and give preference to preparing dishes at home because this enables iodised salt to be used in reasonable quantities

3.9. Review of the degree to which intakes meet needs for pregnant women, based on data from the INCA 3 and Elfe studies

3.9.1. INCA 3 study over the preconception period

Data observed in 2014-2015 in the third Individual and National Study on Food Consumption (INCA 3) showed that average **fibre** intakes are 17.1 g/d for women of childbearing age, or 8 g/d below the guidelines (Anses 2017).

There is also a discrepancy between the dietary reference values (PRI or AI) and the average reported intakes for the female population of childbearing age for the following nutrients: **calcium, magnesium and vitamins B1, D and E**. For these nutrients, specific information is recommended during the "preconception" consultation, taking into account the interactions between vitamins and minerals that can affect their absorption and bioavailability.

Table 8: Average intakes observed in the INCA 3 study (2014-2015) for vitamins and minerals compared to current dietary reference values

	Dietary reference values	ANSES, 2017 **INCA 3 observed data on the diet of women 18-44 years of age (excluding food supplements):** average +/- standard deviation
	Identical to that of adult women	
Ca mg/d	18-24 years: 1000 (PRI) ≥ 25 years: 950 (PRI)	**858** *+/- 343*
P mg/d	550 (AI)	1089 *+/- 342*
Mg mg/d	360 (AI)	**297** *+/- 103*
Mn mg/d	2.5 (AI)	2.8 *+/- 1.2*
Vitamin B1 mg/d	1.2 (AI)	**1.1** *+/- 0.4*
Vitamin B3 mg/d	14 (PRI)	17 *+/- 7*
Vitamin D µg/d	15 (PRI)	**3** *+/- 2*
Vitamin E mg/d	9.9 (AI)	**9.1** *+/- 4.2*
	Specific to pregnant women	
Fe (mg/d)	16 (PRI)	**9** *+/- 3*
Cu (mg/d)	1.5 (AI)	**1.4** *+/- 0.6*
I (µg/d)	200 (AI)	**128.9** *+/- 49.9*
Se (µg/d)	70 (AI)	109.0 *+/- 42.5*
Zn (mg/d)	10.9 (PRI)	**8.1** *+/- 3.1*
Vitamin A (µg/d)*	700 (PRI)	**547.4** *+/- 704.8*
Vitamin B2 (mg/d)	1.9 (PRI)	**1.6** *+/- 0.6*

Vitamin B5 (mg/d)	5 (AI)	5.0 *+/- 1.5*
Vitamin B6 (mg/d)	1.8 (PRI)	**1.5** *+/- 0.5*
Vitamin B9 (µg dietary folate equivalent/day)	600 (AI)	**267.3** *+/- 93.7*
Vitamin B12 (µg/d)	4.5 (AI)	**4.4** *+/- 3.1*
Vitamin C (mg/d)	105 (PRI)	**77.8** *+/- 46.9*

* RE: retinol equivalent (1 µg RE = 1 µg retinol = 12 µg beta-carotene)

For iodine, the data observed in the INCA 3 study show that the average iodine intake for women of childbearing age (18-44 years) is 129 micrograms per day, suggesting inadequate iodine intake in this population.

An assessment of so-called "usual" intakes was carried out for women of childbearing age (559 women aged 18 to 44 years) based on intake data observed in the INCA 2 study. The prevalence of inadequate iodine intakes in the population of women of childbearing age was estimated with the method using the average requirement threshold (AR = 107 µg/d). The distribution of usual iodine intakes from food alone shows that 43% of women of childbearing age have inadequate iodine intakes (Table 10), including those who take food supplements.

Table 9: Average iodine intakes observed in the INCA 2 study (2006-2007) and prevalence of inadequate iodine intake

	Usual iodine intakes (µg/d) from food alone	Usual iodine intakes (µg/d) from food and food supplements
Average	113.7	115.1
Standard deviation	31.0	33.5
P5	67.2	67.2
P25	93.1	93.2
Median	111.4	112.2
P75	132.3	134.8
P95	168.5	171.3
Prevalence of inadequate iodine intake (% and 95% CI)	43.2 [37.9-48.6]	42.0 [36.7-47.4]

3.9.2. Elfe study on pregnant women

In the Elfe study, the dietary intakes of pregnant women were assessed using a self-administered dietary frequency questionnaire given to 14,257 women during their stay in the maternity ward. This questionnaire covered consumption during the last three months of pregnancy. It did not assess usual intakes but only intakes observed during the study. A weighting was applied to take into account non-inclusion and non-response to the questionnaire, in order to make the data representative of all 2011 births in metropolitan France (Kadawathagedara *et al.* 2017).

In this study, the prevalence of inadequate intakes was estimated by the AR threshold value method and the percentage of women with intakes below the AI was calculated. These situations of inadequate intake concern:

- <25% of pregnant women for vitamin B3, calcium and phosphorus;
- between 25 and 50% for vitamin B5, vitamin B12, vitamin C, vitamin E and magnesium;
- between 50 and 75% for linoleic acid, DHA, vitamin A, vitamin B1, vitamin B2 and vitamin B6;
- **>75% for ALA, EPA, fibre, vitamin B9, vitamin D and iodine.**

For iron, only 55% of women had intakes greater than or equal to the dietary reference value (adequate intake).

Lastly, 46% of women consumed less than 35% of their TEI as fat and 19% less than 30%. However, fat intakes at these levels could help meet the requirement for polyunsaturated fatty acids (Anses 2011a).

3.9.3. Summary of differences between observed intakes and nutrient requirements in pregnant or breastfeeding women

The results of the INCA 3 and Elfe studies raise the issue of inadequate intakes for a large proportion of the population of pregnant women, particularly for ALA, EPA, fibre, vitamins B9 and D, and iodine. While some inadequate intakes are not specific to pregnant women, inadequate intakes can be particularly critical at this time of life, as is the case with vitamin B9 or iodine.

For vitamin B9, the diet optimisation work carried out as part of the revision of dietary guidelines for the adult population showed that it was possible to reach the threshold of 400 micrograms per day that would prevent neural tube closure defects. The high rate of inadequate vitamin B9 intakes makes it all the more important to promote the consumption of folate-rich foods by pregnant women. In addition, EFSA has set an adequate intake of vitamin B9 for pregnant women at 600 micrograms per day. This adequate intake is based on a single study with biomarkers of folate status. However, there are no data available to confirm whether lower intakes would meet the selected criteria. The dietary reference value of 600 µg is therefore based on metabolic criteria and not on a health criterion. Since 400 µg is sufficient to prevent neural tube closure defects, it does not seem essential to follow this 600 µg dietary reference value, which is still difficult to meet via food for most women. Communication efforts should be made to ensure that women of childbearing age or pregnant women actually consume the 400 µg corresponding to the dietary guidelines.

Concerning iodine, physiological changes in pregnancy result in an increase in iodine requirements, which led EFSA to increase the dietary reference value by 50 micrograms per day in pregnant or breastfeeding women. The increased need for iodine during pregnancy and breastfeeding may not be met in areas where iodine deficiency is mild to moderate (World Health Organization 2007), as is the case in France. A review article (Caron 2015) suggested that the average iodine intake for pregnant women living in France is less than 50% of the adequate intake during pregnancy. In addition, iodine absorption may be impaired by the consumption of oestrogenic isoflavones and by certain pollutants, such as perchlorate, nitrates and thiocyanate. Recent data in the literature (Wang *et al.* 2017, McNulty *et al.* 2017) suggest that several strategies should be combined to ensure that the needs of pregnant or breastfeeding women are met, particularly during the first trimester of pregnancy. These strategies include, among other things, the consumption of iodised salt and dairy products.
Until 20-22 weeks of amenorrhoea, when it begins to produce its own thyroid hormones, the foetus depends exclusively on maternal thyroid hormones. Thereafter, it still needs maternal iodine for proper thyroid function. A severe iodine deficiency in the mother from the first few weeks of gestation has dramatic consequences on the neurological development of the foetus (World Health Organization 1996). It is therefore vital to ensure that iodine intakes of pregnant women are adequate from the start of pregnancy, which can be the case when the general recommendations are followed, along with their adaptations.

With regard to **iron,** inadequate iron intakes could have a serious specific effect on pregnant women, as haemoglobin levels below 110 g/L during the first trimester or early second trimester of pregnancy are associated with an increased risk of adverse pregnancy outcomes (such as low birth weight, prematurity and perinatal mortality). On the other hand, it should be noted that studies suggest a link between high iron intake and/or high iron stores and the risk of gestational diabetes (Zhang et Rawal 2017). In pregnancy, iron status is mainly assessed by biological monitoring of pregnant women.

3.10. Dietary guidelines related to the specific needs of pregnant or breastfeeding women

3.10.1. Source foods related to the specific needs of pregnant or breastfeeding women

Regarding nutrients for which requirements are increased during pregnancy or breastfeeding and for which a gap has been identified between observed intakes and requirements, communication should focus on source foods (as listed in the Ciqual 2017 composition table), targeting both the population concerned and health professionals. For this purpose, the dietary guidelines described above identify source foods for nutrients whose intakes may be relatively inadequate when transposing the guidelines to the pregnancy or breastfeeding situation; these nutrients are iodine, iron and vitamins A, C and B9. In addition, regarding the situation observed in pregnant women, the Elfe study showed inadequate intakes of three other nutrients: ALA, EPA and fibre. Lastly, in reference to the food consumption of women of childbearing age in the INCA 3 study, intakes of many nutrients seem inadequate with regard to requirements in the first trimester of pregnancy (see Table 8).

Concerning the intake of **fatty acids**, pregnant women are advised to consume rapeseed or walnut oils so as to also achieve a better balance between omega 6 and omega 3. It is also important to achieve a better balance between saturated and unsaturated fatty acids by promoting the consumption of vegetable fats that are low in saturated fatty acids, such as olive oil.

To address constipation problems that in some cases are aggravated during pregnancy, pregnant or breastfeeding women are advised to increase their intake of **high-fibre** foods (e.g. wholegrain cereal products, pulses, or fruits and vegetables).

Regarding the coverage of **iodine** needs, which is very important, especially during the first trimester of pregnancy, it should be noted that organic dairy products contain about 45% less iodine than standard dairy products (Walther *et al.* 2018). In addition, in view of the variability of iodine content in seaweed and the adverse effects reported, ANSES advises against the consumption of foods or food supplements containing seaweed by pregnant or breastfeeding women without medical advice (Anses 2018).

Lastly, dark chocolate with a high cocoa content is a source of iron and iodine.

3.10.2. Structuring of food intake related to the specific needs of pregnancy

The guide to nutrition during and after pregnancy aimed at health professionals (INPES 2007c) provides dietary advice in case of nausea and vomiting, such as consuming food and drinks at more regular intervals and in smaller amounts, avoiding an empty stomach, avoiding fatty or spicy foods, having a light meal in the evening and avoiding eating breakfast too late. Nevertheless, there are few epidemiological studies on nausea and vomiting during pregnancy and food consumption, and these are heterogeneous and most often cross-sectional. It is therefore difficult to draw conclusions from these data (in particular because of non-explicit associations and a lack of adjustment for confounding factors).

Simulation studies conducted in France have shown the importance of a light meal consisting of fruit and a "low-fat" dairy product such as yoghurt or *fromage blanc* (considered either as a supplement to the daily intake or as a substitute for part of it) to better meet requirements during pregnancy (Bianchi *et al.* 2016). The work also indicates that some light meals offered in the INPES pregnancy guides (INPES 2007a, b) are, on the other hand, rather ineffective at responding to the new nutritional situation ("a *pain au lait* bun and an individual milk carton", "four petit-beurre biscuits and a glass of milk" and "1/6 of a baguette with a serving of cheese + a glass of water").

For some women, eating a snack (the fourth meal) in the first trimester of pregnancy helps deal with possible "cravings" but requires the energy intake of the other meals to be adapted. In addition, fragmenting the food intake may be recommended in the third trimester of pregnancy to deal with possible pregnancy-related intestinal disorders. Nevertheless, to avoid excessive weight gain, this fragmentation of food intake throughout pregnancy should be adapted to the calorie intake required over a day, and should not promote excess intake. Postponing part of the food intake from the previous meal (such as the dessert), and structuring it into four meals a day with the inclusion of a snack, appear to be a good strategy.

Lastly, it is advisable to avoid drinking tea close to mealtimes because it can reduce the absorption of iron from plant sources (Ahmad Fuzi *et al.* 2017).

3.11. Conclusion and recommendations of the CES on "Human nutrition"

The analysis of the epidemiological links between the consumption of food groups during pregnancy or breastfeeding and the health of the child or mother does not call into question the relevance of applying the dietary guidelines developed for the general adult population to pregnant or breastfeeding women (Anses 2016b). In particular, this analysis suggests that there are specific benefits associated with the consumption of fruits and vegetables, dairy products and fish.

Nevertheless, these guidelines require certain adaptations and restrictions for the population of pregnant or breastfeeding women to take account of certain risks, particularly microbiological and chemical risks. In addition, to ensure that the dietary reference values for vitamin B9, iron and iodine are achieved, the guidelines should include specific recommendations for certain foods rich in these nutrients. During breastfeeding, foods rich in vitamins A and C are also recommended.

Since there is no monitoring of iodine status in pregnant and breastfeeding women, the CES on "Human Nutrition" wishes to draw attention to the high risks of inadequate iodine intake in this population and the difficulty of reducing these risks with the current food supply and eating habits.

In the event that pregnant women increase the frequency of their daily food intake, this should not promote over-consumption of energy, in order to avoid excessive weight gain.

4. AGENCY CONCLUSIONS AND RECOMMENDATIONS

The French Agency for Food, Environmental and Occupational Health & Safety adopts the conclusions and recommendations of the CES on "Human Nutrition".

This work supplements the Agency's work in formulating dietary guidelines for different types of populations: the general adult population, children from birth to three years of age, children from four to 17 years of age, postmenopausal women and the elderly. It may be further supplemented by work carried out for populations with dietary restrictions such as vegetarians or vegans.

This work does not incorporate any economic or environmental considerations, only nutritional risk considerations. It does not take into account the variability of nutritional compositions or levels of contaminants and pesticide residues according to crop varieties, production systems, storage and processing conditions, preparation methods, etc. Further research should be conducted on the exposure of pregnant or breastfeeding women to contaminants and pesticide residues depending on production methods and the associated risks.

The expert appraisal was based on the latest dietary reference values for pregnant and breastfeeding women (EFSA 2017), the PNNS dietary guidelines for the adult population, using the same food categorisation system, and a literature review of the epidemiological links between the consumption of food groups during pregnancy or breastfeeding and maternal or child health. This

analysis of epidemiological links suggests that there are specific benefits associated with the consumption of fruits and vegetables, dairy products and fish[2]. It leads to the dietary guidelines developed for the adult population being applied to pregnant or breastfeeding women, taking into account the specificities of this population, particularly the microbiological or chemical risks.

The data on nutritional intakes currently observed in France for women of childbearing age (INCA 3 study) and pregnant women (Elfe study) support the recommendation to consume foods that are sources of vitamin B9, iron and iodine, and vitamins A and C for women during breastfeeding only.

The Agency also recommends monitoring iodine status in pregnant and breastfeeding women (in addition to the existing measures for vitamin B9 and iron).

Lastly, the Agency recommends that women of childbearing age take care to eat a balanced diet without waiting until they become pregnant, in order to ensure that from conception their nutritional status is satisfactory and compatible with the needs of the foetus and mother.

Dr Roger Genet

KEYWORDS

Plan national nutrition santé, risque santé, nutrition, consommation alimentaire, nutriment, référence nutritionnelle, repères alimentaires, femmes enceintes, femmes allaitantes, iode

French National Nutrition and Health Plan, health risk, nutrition, food intake, nutrient, dietary reference value, food-based dietary guidelines, pregnant women, breastfeeding women, iodine

GLOSSARY

Dietary recommendation: a recommendation on consumption of a food or food group to achieve a dietary guideline level.

Dietary reference value: a reference value for a nutrient. These may include the average requirement (AR), population reference intake (PRI), adequate intake (AI), reference intake range (IR) or upper intake level (UL).

Dietary guideline: the level of consumption of a food or food group or other consumption characteristic that is beneficial to health.

[2] The Cochrane review published in 2018 (Middleton *et al.* 2018) confirmed the beneficial effects of omega-3 long-chain polyunsaturated fatty acids during pregnancy in reducing the risk of premature delivery and low birth weight. Oily fish are the best vectors for this.

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ANNEX 1

Presentation of the participants

PREAMBLE: The expert members of the Expert Committees and Working Groups or designated rapporteurs are all appointed in a personal capacity, *intuitu personae*, and do not represent their parent organisation.

EXPERT COMMITTEE

- CES on "Human Nutrition" – 2015-2018

Chair

Mr François MARIOTTI – Professor (AgroParisTech) – Specialities: metabolism of proteins, amino acids, nutritional requirements and recommendations, postprandial metabolism, cardiometabolic risk

Members

Ms Catherine ATLAN – University Lecturer-Hospital Practitioner – Doctor (Luxembourg Hospital Centre) – Specialities: endocrinology, metabolic diseases and nutrition

Ms Catherine BENNETAU-PELISSERO – Professor (Bordeaux Sciences Agro) – Specialities: phyto-oestrogens, isoflavones, endocrine disruptors, bone health

Ms Marie-Christine BOUTRON-RUAULT – Research Director (CESP Inserm) – Specialities: nutritional epidemiology and cancer, digestive system

Mr Jean-Louis BRESSON – University Professor-Hospital Practitioner (AP-HP Necker Hospital – Sick Children, Centre for Clinical Investigation 0901) – Specialities: epidemiology, immunology, infant nutrition, pregnant women and proteins

Mr Olivier BRUYERE – University Professor (University of Liège) – Specialities: epidemiology, public health, osteoporosis

Ms Blandine de LAUZON-GUILLAIN – Research Director (INRA, CRESS, Villejuif) – Specialities: epidemiology, infant nutrition, nutrition of pregnant and breastfeeding women, public health

Ms Anne GALINIER – University Lecturer – Hospital Practitioner (Paul Sabatier University – Toulouse University Hospital) – Specialities: metabolism of adipose tissue/obesity, pathophysiology

Mr Jean-François HUNEAU – Professor (AgroParisTech) – Speciality: human nutrition

Ms Emmanuelle KESSE-GUYOT – Research Director (INRA, UMR Inserm U1153/INRA U1125/CNAM/University of Paris 13) – Specialities: epidemiology, nutrition and pathologies, nutrition and public health

Ms Corinne MALPUECH-BRUGERE – University Professor (University of Clermont Auvergne) – Specialities: nutrition of pathologies, metabolism of macro- and micronutrients

Ms Catherine MICHEL – Research Manager (INRA, UMR INRA/University, Nantes) – Specialities: infant nutrition, intestinal microbiota, colic fermentation, prebiotics

Ms Beatrice MORIO-LIONDORE – Research Director (INRA Lyon) – Specialities: human nutrition, energy metabolism

Ms Jara PEREZ-JIMENEZ – Contract Researcher (ICTAN – CSIC, Madrid) – Specialities: micro-constituents, nutrition and pathologies, bioavailability

Mr Sergio POLAKOFF – Research Manager (INRA Clermont-Ferrand/Theix) – Specialities: nutrition and pathologies, nutrition and public health, energy metabolism

Mr Jean-Marie RENAUDIN – Hospital Practitioner (Emilie Durkheim Hospital Centre) – Speciality: allergology

Ms Anne-Sophie ROUSSEAU – University Lecturer (University of Nice Sophia Antipolis) – Specialities: nutrition and physical activity, bioavailability, oxidative stress

Mr Luc TAPPY – University Professor – Hospital Practitioner (University of Lausanne) – Specialities: endocrinology, metabolism of carbohydrates

Mr Stéphane WALRAND – Research Director (INRA Clermont-Ferrand/Theix) – Specialities: pathophysiology, protein metabolism and amino acids

RAPPORTEURS

Ms Blandine de LAUZON-GUILLAIN – Research Director (INRA, CRESS, Villejuif) – Specialities: epidemiology, infant nutrition, nutrition of pregnant and breastfeeding women, public health

Ms Beatrice MORIO-LIONDORE – Research Director (INRA Lyon) – Specialities: human nutrition, energy metabolism

- CES on "Assessment of the biological risks in foods" (BIORISK) – 2015-2018

Chair

Ms Isabelle VILLENA – Reims University Hospital. Parasitology, infectious diseases

Members

Mr Jean-Christophe AUGUSTIN – Alfort National Veterinary School. Modelling, quantitative risk assessment, food microbiology

Ms Anne BRISABOIS – ANSES, Laboratory for Food Safety Food microbiology, microbial ecology, analytical methods

Mr Frédéric CARLIN – INRA. Food microbiology (plant products), *Listeria monocytogenes*, sporulated bacteria

Mr Olivier CERF – Emeritus professor, Alfort National Veterinary School. Microbiological risk assessment, food microbiology

Mr Pierre COLIN – Emeritus professor. University of Western Brittany. Food hygiene and microbiology (meat and meat products – poultry)

Mr Philippe DANTIGNY – AgroSup Dijon. Mycology, decontamination procedures, microbial ecology

Ms Florence DUBOIS-BRISSONNET – AgroParisTech. Food microbiology, mechanisms of adaptation to stress, biofilms, hygiene of surfaces and processes

Mr Michel FEDERIGHI – ONIRIS, Nantes. Food hygiene and microbiology (meat and meat products), decontamination processes

Mr Benoît FOLIGNE – Faculty of Pharmacy, Lille. Intestinal microbiota, food ecosystem/microbiota interaction

Ms Florence FORGET-RICHARD – INRA. Mycotoxins, filamentous fungi, biochemistry, cereal production sectors

Mr Philippe FRAVALO – University of Montreal. Food hygiene and microbiology (meat and meat products)

Mr Pascal GARRY – Ifremer, Nantes. Food hygiene and microbiology (meat and meat products, shellfish)

Mr Michel GAUTIER – Agrocampus Ouest. Food microbiology, molecular biology, genetic engineering

Mr Laurent GUILLIER – ANSES, Laboratory for Food Safety Modelling, quantitative risk assessment, food microbiology

Ms Nathalie JOURDAN-DA SILVA – French Public Health Agency. Epidemiology of enteric diseases and zoonoses

Mr Alexandre LECLERCQ – Institut Pasteur. Food microbiology (*Listeria monocytogenes*, *Yersinia* enteric pathogens), phenotypic and molecular methods

Mr Simon LE HELLO – Institut Pasteur. *Salmonella,* epidemiology, phenotypic and molecular methods

Mr Eric OSWALD – Toulouse University Hospital. Clinical infectious diseases, microbial ecology, *E. coli*

Ms Nicole PAVIO – ANSES, Maisons-Alfort Laboratory for Animal Health Virology

Ms Sabine SCHORR-GALINDO – University of Montpellier 2. Mycology, microbial ecology

Ms Muriel THOMAS – INRA. Intestinal microbiota, probiotics

ANSES PARTICIPATION

Scientific coordination of the project was provided by the Nutritional Risk Assessment Unit of the Risk Assessment Department (DER), under the direction of Ms Irene MARGARITIS – Seconded University Professor (University of Nice Sophia Antipolis).

Scientific coordination

Ms Claire BLADIER – Scientific Project Manager – Nutritional Risk Assessment Unit, Risk Assessment Department – ANSES

For aspects related to the microbiological risks (CES BIORISK):

Ms Pauline KOOH – Scientific and Technical Project Manager – Food Risk Assessment Unit – Risk Assessment Department – ANSES

Scientific contribution

Ms Claire BLADIER – Scientific Project Manager – Nutritional Risk Assessment Unit, Risk Assessment Department – ANSES

Ms Sandrine WETZLER – Scientific and Technical Project Leader – Nutritional Risk Assessment Unit – Risk Assessment Department – ANSES

Administrative secretariat

Ms Virginie SADE – Risk Assessment Department – ANSES

HEARINGS WITH EXTERNAL PERSONS

French College of Gynaecologists and Obstetricians (CNGOF)

Mr Philippe DERUELLE – Obstetrician gynaecologist, Director of the Laboratory for Perineal Environment and Health at the University of Lille, and Secretary General of the CNGOF

Mr Florent FLUCHS – Obstetrician gynaecologist at Montpellier University Hospital and member of the CNGOF's Foetal Medicine Commission

ANNEX 2

Analysis and conclusions of the CES BIORISK on recommendations for the prevention of foodborne microbiological risks for specific populations

Discussion and conclusions of the CES

The prevention of foodborne diseases by consumers requires three types of measures (ANSES, 2015, 2014, 2013):

- prevention of cross-contamination: hand-washing, cleaning of surfaces, equipment and utensils, separation of raw and cooked food;
- application of specific measures to inactivate micro-organisms or prevent them from multiplying: refrigeration, freezing, cooking, decontamination;
- the exclusion of some foods for certain categories of the population.

1. Recommendations on prevention intended for the general population

Measures enabling consumers to prevent and control the main foodborne microbial hazards are described in the ANSES biological hazard sheets and summarised in Table 1.

Table 1: Main measures enabling consumers to prevent foodborne microbiological risks

Foods concerned	Main recommendations to consumers
All	○ Wash hands (after going to the toilet, before and during food preparation, before eating, after contact with animals, etc.) ○ People with gastroenteritis symptoms should avoid preparing meals for others. ○ Regularly clean work surfaces, equipment and utensils. ○ Refrigerator hygiene: surfaces should be cleaned whenever food has soiled them. ○ Comply with the cold chain: maintain a maximum temperature of 4°C in the coldest part of the refrigerator and check the seal on its doors. ○ Comply with the UBD for packaged products and rapidly consume (within three days of purchase) retail foods sold without a stated UBD. ○ Quickly refrigerate cooked dishes (resting time at room temperature <2h). ○ Separate raw and cooked foods: - use a separate cutting board for raw meat and fish, - dishes and utensils used in the seasoning of raw meat or fish should be cleaned before being reused for cooked foods.
Meat and meat products	Cook poultry and red meat thoroughly (>70°C internal temperature)
Milk and dairy products	Infant formula: - Comply with the rules on preparation and storage of feeding bottles: ○ reduce the time between preparation and consumption to no more than one hour if the product is at room temperature, and 30 minutes if it has been heated, ○ store reconstituted meals/bottles at 4°C and for 48 hours at most. - Preferably use sterile formula in liquid form for infants most susceptible to infection.
Eggs and egg products	Home-made uncooked egg-based preparations (mayonnaise, creams, chocolate mousse, pastries, etc.) should be prepared as close as possible to the time of consumption, kept cool and consumed within 24 hours.
Seafood and freshwater products	Fish - Cook fish thoroughly (65°C) - For lovers of raw fish (sushi, fillets, marinades, carpaccio, etc.): freeze for 7 days in a domestic freezer, gut and clean caught fish rapidly. Shellfish - Avoid consuming shellfish that do not come from authorised and inspected areas of production, or cook them for a prolonged period. - Consume live bivalve shellfish and raw seafood within two hours of being fished/picked or taken out of the refrigerator.
Plants	- Wash fresh produce (fruits, vegetables and herbs) thoroughly, cook foods if washing conditions cannot be applied due to a lack of drinking water. - In countries with low levels of hygiene: avoid consumption of unpasteurised fresh fruit juices.

2. Additional recommendations for susceptible populations

Certain categories of the population are more likely than average to develop symptoms, severe forms or complications of a foodborne infectious disease after exposure to a hazard. These include infants, young children, the elderly, pregnant women, immunocompromised individuals and those suffering from chronic diseases.
These susceptible populations are characterised by an immune system deficiency that may be physiological (in the case of infants, young children, the elderly, pregnant women) or related to a chronic disease or immunosuppressive treatment.
The main infections associated with the populations considered in this request are presented in Table 2.

Table 2: Main diseases or complications that may occur in pregnant women

Susceptible population group	Diseases or complications related to foodborne pathogens
Pregnant women	Listeriosis: miscarriage, death in utero, prematurity, neonatal infection. Congenital toxoplasmosis: miscarriage, death in utero, brain or eye damage in the foetus. Fulminant hepatitis related to hepatitis E virus. Trichinellosis: miscarriage, prematurity.

The exclusion of certain foods by pregnant women reduces the risk of infection. The main foods to be avoided are shown in Table 3.

Table 3: List of foods to be avoided by pregnant women

Population category	Foods to be avoided
Pregnant women	All raw or undercooked meats. Cooked delicatessen meat products requiring cold storage (e.g. rillettes, pâtés, jellied products). Delicatessen meat products containing raw pork liver (e.g. figatelli, liver sausage), raw or undercooked pork liver. Raw milk. Cheeses made from raw milk (with the exception of hard pressed cheeses such as gruyère or comté). Soft cheeses with a surface mould (such as camembert or brie) or washed rind (such as munster or pont l'évêque), cheeses sold grated. Raw eggs and products containing raw or undercooked eggs. Raw shellfish, raw fish (sushi, sashimi, taramasalata), smoked fish. Shelled crustaceans sold cooked and requiring cold storage.

List of expert appraisals consulted

- Foodborne biological hazard data sheets https://www.anses.fr/en/content/microbiological-hazards-files
- ANSES Opinion of 18 December 2015 on a draft decree pursuant to Article L. 214-1 of the French Consumer Code and concerning the labelling of raw milk intended to be provided for direct consumption by the final consumer. https://www.anses.fr/fr/system/files/Biorisk2015SA0114.pdf
- ANSES Opinion and Report of 14 October 2015 relating to consumer information on prevention of foodborne microbiological risks – Volume 2:Assessment of the effectiveness of communication strategies. https://www.anses.fr/fr/system/files/Biorisk2012sa0118Ra-02.pdf
- ANSES Opinion and Report of 9 May 2014 relating to consumer information on prevention of foodborne microbiological hazards – Volume 1: Prioritisation of the hazard-food combinations and review of information measures https://www.anses.fr/fr/system/files/BIORISK2012sa0118Ra-01.pdf
- ANSES Opinion of 7 February 2013 on the request to re-assess seafood products posing a risk for pregnant women in the PNNS guide "Guide to nutrition during and after pregnancy" https://www.anses.fr/fr/system/files/BIORISK2012sa0102.pdf
- ANSES Opinion of 8 October 2013 on prevention of foodborne microbiological risks by consumers at home: main measures adopted https://www.anses.fr/fr/system/files/BIORISK2012sa0005.pdf
- Data sheet on foodborne biological hazards: "Domestic hygiene" – October 2013. https://www.anses.fr/en/system/files/MIC2012sa0005Fi.pdf
- AFSSA. December 2005. Report Toxoplasmosis: state of knowledge and dietary risk assessment: report of the AFSSA "*Toxoplasma gondii*" Working Group. https://www.anses.fr/fr/system/files/MIC-Ra-Toxoplasmose.pdf
- AFSSA. July 2005. Report on the hygiene recommendations for the preparation and storage of infant feeding bottles. https://www.anses.fr/fr/system/files/MIC-Ra-BIB.pdf

- **Recommendations by hazard considered (source: biological hazard data sheets)**

Name	Susceptible population group	Main foods concerned	Recommendations for consumers	Data sheet version date
Bacteria, toxins or metabolites				
Listeria monocytogenes	People with haematological cancers, people infected with HIV, organ transplant patients, people with kidney or liver failure, pregnant women, people with inflammatory diseases (Crohn's disease, rheumatoid arthritis, etc.) or non-haematological cancers, people over 65 years of age without other underlying conditions, diabetics (type 1 or 2) and people with heart disease.	All major food categories that allow the growth of *Listeria monocytogenes*	– Basic hygiene rules – Refrigerator hygiene: whenever food has soiled surfaces, they should be cleaned immediately. Do not place unwrapped food directly on the shelves – Compliance with the cold chain: the refrigerator must be set at no more than +4°C – Store leftovers for no more than 3 days, and for foods to be consumed hot, heat to an internal temperature of more than +70°C – Compliance with the use-by date (UBD) for packaged products and rapid consumption of foods cut to order – **Pregnant women and other sensitive populations** are advised to avoid foods such as certain cooked delicatessen meat products, soft cheeses with a surface mould (such as camembert or brie) or washed rind (such as munster or pont l'évêque), especially if they are made from raw milk, cheeses sold grated, raw or undercooked meat, raw shellfish, raw fish (sushi, sashimi, taramasalata), smoked fish and shelled crustaceans sold cooked	Revision 2018
***Salmonella* spp.**	Infants, the elderly, subjects suffering from malnutrition, achlorhydria, hypochlorhydria or a neoplastic disease, or following an antacid treatment, broad-spectrum antibiotherapy or immunosuppressor treatment.	Raw eggs and products made from raw eggs, meat (beef, pork, poultry), dairy products (raw or slightly heat-treated milk)	– Basic hygiene rules – Thorough cooking of meat – Specific measures concerning eggs and preparations containing raw eggs: ○ Eggs should be stored at a stable temperature to avoid condensation on their surface. Under no circumstances should eggs be washed before storage. – Uncooked egg-based preparations (mayonnaise, creams, chocolate mousse, pastries, etc.) should be consumed immediately after preparation or kept cool and consumed within 24 hours. **The elderly, immunocompromised people, young children and pregnant women should not eat raw or undercooked eggs**	Revision 2018

Name	Susceptible population group	Main foods concerned	Recommendations for consumers	Data sheet version date
Viruses				
Hepatitis E virus	People with underlying liver conditions Immunocompromised individuals Pregnant women	Raw or undercooked pork liver Raw pork-liver delicatessen meat products (figatelli, liver sausage)	– Basic hygiene rules: washing hands, cleaning utensils after handling raw pork liver – **Thorough cooking of foods, especially for sensitive populations**	Revision 2018
Parasites				
Toxoplasma gondii	Pregnant women seronegative for toxoplasmosis Immunocompromised people (especially HIV-infected patients, bone marrow transplant recipients)	Raw or undercooked meat, vegetables, water	The people concerned are sensitive populations (pregnant women and immunocompromised toxoplasmosis-seronegative individuals) to whom the following recommendations apply: – Washing hands after gardening (or wearing gloves) or handling food potentially contaminated with oocysts, washing kitchen utensils after cutting meat; – Thorough washing of raw vegetables to eliminate oocysts; – Thorough cooking of meat (67°C internal temperature) and fresh produce; – Freezing of meat to a temperature of -12°C for at least 3 days; – If there are cats in the home: avoid changing the litter box yourself, otherwise always wear gloves and wash hands after handling the cat or its litter box (clean the tray with hot water at a temperature of ≥ 70°C);	Revision 2018
***Trichinella* spp.**	The elderly Pregnant women	Raw or undercooked pork, wild boar or game meat (bear, warthog, etc.)	– Do not eat pork or wild boar meat that has not been officially inspected. If in doubt, cook the meat thoroughly to ensure it is well-done – For hunters and travellers abroad, do not consume raw or undercooked meat that has not been inspected	Revision 2018