ANSES Opinion
Request No 2017-SA-0145

The Director General

Maisons-Alfort, 12 June 2019

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

on the updating of the PNNS dietary guidelines for children from birth to three years of age

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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 12 June 2019 shall prevail.

On 28 March 2017, ANSES received a formal request from the Directorate General for Health (DGS) regarding the impact of early childhood exposure to environmental and nutritional 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 children from birth to three years of age. A separate opinion (2017-SA-0141) supplements this expert appraisal by considering prenatal exposure through the diet of pregnant and breastfeeding women.

1. BACKGROUND AND PURPOSE OF THE REQUEST

The scientific basis for establishing the dietary guidelines of the French National Nutrition and Health Programme (PNNS) was updated by ANSES for adult men and women in 2016, on the basis of new dietary reference values and existing data on food consumption and composition (ANSES 2016b).

Since these guidelines focus on the general adult population, i.e. male and female adults excluding special populations, the Director General for Health submitted a formal request to ANSES on 12 July

2016 in order that guidelines also be formulated for the specific populations of pregnant and breastfeeding women, children and adolescents, the elderly and postmenopausal women. This opinion focuses on children from birth to three years of age.

1.1. Background

1.1.1. Specificities of the population

The population of children from birth to three years of age has several specific characteristics. Babies are born physically and psychologically immature and this early childhood period is one of intense development of neurological, gastrointestinal and cognitive functions, and oral skills. During this period, the body is particularly sensitive to the effect of its environment in all its forms, in particular its nutritional environment. This is the origin of the concept of "1000-day window" (from conception to two years of age), according to which the conditions in which an individual begins his life – from the intrauterine period, or even during the preconception period – influence his long-term health.

It is also during this period from birth to three years of age that major changes in diet occur: the transition from umbilical to oral feeding with a single liquid food (milk), followed by a second transition occurring during the introduction of varied foods, particularly solids (first phase of complementary feeding), and then a final transition with the move to foods from the family table (second phase of complementary feeding).

1.1.2. Current recommendations in France

The previous PNNS recommendations concerning children from birth to three years of age were published in 2004, on the basis of scientific principles validated by the CES on "Human Nutrition" in January 2004.

The guidelines for children from birth to three years of age are presented in a practical guide on the diet of children from birth to three years of age, focusing on:

- breastfeeding: its benefits, practical considerations related to its implementation, cessation of breastfeeding and possible problems that may be encountered;
- infant formula and follow-on formula: their differences, the way feeding bottles are prepared;
- complementary feeding: when it should start and how to proceed, illustrated by examples of menus at different ages and a list of foods to be avoided;
- prevention of food allergies.

Finally, a table summarises the guidelines (in terms of age) on the introduction of food groups for children from birth to three years of age.

Regarding the quantitative aspect, the guide states that the child is generally good at regulating his own food intake, whether at the level of the individual meal or over the course of a day, during both the period of the milk-based diet and the complementary feeding period. This guide encourages parents to respect the child's appetite. Quantitative guidelines are given only for the meat-fish-eggs group and for milk.

1.1.3. Current recommendations in Europe

Many other European countries have also published diet guides, generally covering the same subjects as the French guide. Guides are sometimes divided by age group, with one guide for infants under one year of age and another for toddlers, as is the case with Sweden and Austria. Finland has opted for a single guide for families with children.

However, some differences can be highlighted:

- Some guides (such as those in Austria and Northern Ireland) suggest the number of servings of different food groups after beginning complementary feeding. Others (such as those of

Sweden and Finland) state that it is up to parents to decide what the child eats and when, while the child decides how much he wants to consume.

- Several guides suggest giving the child foods from the family table at the start of complementary feeding (Northern Ireland guide) or as early as six months (Finnish guide), taking care not to add salt when preparing meals, mashing foods and avoiding certain foods not suitable for children under three years of age.
- The guides in Northern Ireland, Austria and England recommend that a cup be used instead of a feeding bottle (or other container used by the child for suckling), for liquids other than milk. The English guide advises against using a feeding bottle after one year (for milk or any other drink), so that the child learns to drink without sucking and limits the contact time with the drink.
- Advice on complementary feeding practices (repeated exposure, diversity of textures and presentation methods, meals taken with the child, etc.) is formulated fairly regularly, and developed to varying degrees according to the guides.

1.2. Purpose of the request

This opinion focuses on the population of children from birth to three years of age[1]. Its purpose is to provide the scientific principles for the dietary guidelines established under the PNNS, based on the most recent scientific data available.

In principle, the recommendations in this opinion apply only to healthy children born at full-term (after at least 37 weeks of amenorrhoea). Children born prematurely or with diseases need to follow a diet adapted to their condition as part of their individual medical care.

Throughout the document, ages are expressed in completed months (or years), i.e. the entire number of months (or years) lived by the child.

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)".

The expert appraisal drew on:

- an analysis of the work by national and international scientific bodies (French Paediatric Society (SFP), World Health Organisation (WHO), European Food Safety Authority (EFSA), European Society for Paediatric Gastroenterology, Hepatology and Nutrition (ESPGHAN), UK Scientific Advisory Committee on Nutrition (SACN));
- a literature search on the epidemiological links between the different food categories and children's health;
- an analysis of the work on current dietary practices in France;
- estimates of intakes and the risk of inappropriate intakes of certain nutrients based on consumption data from the Nutri-Bébé study, conducted in 2013 by the French Organisation for Children's Food (SFAE) in partnership with the CREDOC and TNS SOFRES survey institutes;
- a hearing with the French Group on Hepato-Gastroenterology and Paediatric Nutrition (GFHGNP) and the SFP's Nutrition Committee, which identified obsolete aspects and missing information in the French "Nutrition guide from birth to three years of age";

[1] The other populations (children aged four to 17 years, pregnant and breastfeeding women, and the elderly) are each addressed by separate opinions (2017-SA-0142, 2017-SA-0141 and 2017-SA-0143 respectively)

- a hearing with two researchers from the French Centre for Taste and Feeding Behaviour (CSGA) on early dietary practices that promote dietary diversity later in life.

This information was presented to and discussed by the Expert Committee (CES) on "Human Nutrition", which met regularly between 5 October 2017 and 5 July 2018, and led to recommendations that were adopted by the CES on 6 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 children from birth to three years of age. This collective expert appraisal was carried out during meetings on 30 January and 10 April 2018. It drew on:

- previous opinions and reports of the Agency;
- knowledge of the hazards, summarised in the foodborne biological hazard data sheets.

The risks associated with chemicals potentially found in food (such as contaminants, pesticide residues, phyto-oestrogens) for children under three years of age were addressed by a specific expert appraisal in the infant total diet study (iTDS) (ANSES, 2016c). This study's conclusions will be restated in this opinion.

ANSES analyses links of interest 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 interests are made public via the ANSES website (www.anses.fr).

3. ANALYSIS AND CONCLUSIONS OF THE CES

3.1. Scientific principles for updating the dietary guidelines

3.1.1. Study of the relationships between the consumption of food groups and the risk of diseases

A literature search was conducted in November 2017 using the PubMed database over the previous ten years, in order to study the relationships between food group consumption and risk of diseases in children from birth to three years of age. To avoid restricting the search to certain specific diseases, no diseases or health parameters were included in the search, which consisted in combining population terms *(infant, baby*) and food group terms *(legumes, vegetable, fruit, nut, meat, fat, fish, cereal, dairy),* and only included intervention studies and cohort studies. Due to the ongoing work on breastfeeding (Request 2017-SA-0069[2]), studies on this subject and on infant formula or follow-on formula were excluded.

A few studies on the allergy risk associated with the consumption of nuts, meat and eggs were identified but were not included because this topic is covered elsewhere (ANSES 2018). Three studies on dietary patterns and risk of overweight (Baird *et al.* 2008, Bell *et al.* 2013, Robinson *et al.* 2009) and one on bone mass (van den Hooven *et al.* 2015) were identified but not analysed, because they did not focus on food groups but on different dietary patterns, considered different ages, and did not enable any comparison. Three studies on the consumption of sugar-sweetened beverages, soda or fruit juices in early childhood were identified (Pan *et al.* 2014, Park *et al.* 2014, Weijs *et al.* 2011), but the parameters studied (risk of overweight or obesity in the longer term, consumption of sugar-sweetened beverages at a later age) and the use of a range of different protocols prevented an analysis from being conducted.

[2] Request on the "consideration, among the nutritional and environmental factors through food during the first 1000 days, of the breastfeeding phase, based on the latest work of the CONTA-LAIT study"

At the end of this literature analysis, the CES on "Human Nutrition" considered these data insufficient as a basis for dietary guidelines for children from birth to three years of age.

3.1.2.Milk-based diet

- Breastfeeding

As part of the ongoing work to address Request 2017-SA-0069[3], ANSES is conducting a review of data on the benefits of breastfeeding on infant health, taking into account the following parameters: anthropometric data and risk of metabolic syndrome, cognitive and motor development, immune response and associated diseases. These aspects will not therefore be developed in this opinion. Only the effect of breastfeeding on the acceptance of new foods during complementary feeding will be discussed.

Compared to formula feeding, breastfeeding can influence food acceptability at older ages in several ways: it can modify the development of taste acceptance, the oral skills needed for feeding and energy-intake control skills (for review, (Nicklaus 2016)). The effect of breastfeeding may be due to two factors that cannot be distinguished in practice: firstly, the intrinsic properties of the breast milk (such as nutrient or other substance composition); secondly, the behaviours and environment associated with breastfeeding that differ from those associated with bottle-feeding (such as on-demand breastfeeding or reduced parental control of intakes, mother-infant interactions). The psychological and emotional aspects will not be covered here.

To begin with, the infant's exposure to flavours is different depending on whether he receives breast milk or formula (see glossary). Indeed, the flavours of breast milk can change from one feed to another depending on the mother's diet, whereas it is necessary to change formula in order to change its flavour. This argument is often used to explain why breastfeeding is associated with better acceptance of new foods during the first few days (Maier *et al.* 2008, Mennella, Jagnow, and Beauchamp 2001, Sullivan and Birch 1994) or first month of complementary feeding (Hausner *et al.* 2010). However, this association was not observed in a study measuring the overall acceptance of new foods over a two-month period (Lange *et al.* 2013). In addition, the duration of breastfeeding is associated with healthier eating habits at two years of age (Abraham *et al.* 2012), greater food variety at two years (Scott, Chih, and Oddy 2012), higher fruit consumption over the 6-8 year period (Skinner *et al.* 2002) and a healthier diet over the 2-8 year period (Grieger, Scott, and Cobiac 2011). In a study of four European cohorts, longer breastfeeding time was systematically associated with higher fruit and vegetable consumption in the period between two and four years of age (de Lauzon-Guillain *et al.* 2013). In this study, the association persisted after adjustment for the mothers' fruit and vegetable consumption, suggesting that this association may be specific to breastfeeding.

In addition, the positive association between breastfeeding and acceptance of new foods during complementary feeding may also be explained by the infant's improved ability to feed himself when he has been breastfed. One study reported that the duration of breastfeeding was associated with better chewing ability measured over the period from three to five years of age (Pires, Giugliani, and Caramez da Silva 2012). A review of the effects of the type of milk-based diet concluded that breastfeeding an infant could promote oral motor development, but additional data are needed to confirm this (Neiva *et al.* 2003).

Lastly, breastfeeding has a different effect than bottle-feeding on the infant's ability to control dietary intake. Unlike breastfeeding, bottle-feeding allows parents to control dietary intake. It has therefore been hypothesised that this mode of feeding could alter the infant's ability to self-regulate food intake in the short term (Disantis *et al.* 2011, Li, Fein, and Grummer-Strawn 2010, Li *et al.* 2014, Reyes *et al.* 2014) and that this effect could persist at six years of age (Li *et al.* 2014).

[3] Request on the "consideration, among the nutritional and environmental factors through food during the first 1000 days, of the breastfeeding phase based on the latest work of the CONTA-LAIT study"

In order to preserve the infant's self-regulatory abilities, it is important for parents of bottle-fed infants to detect their infant's hunger and satiety cues and adapt their behaviour accordingly. Signs of hunger include crying, excited arm and leg movements and mouth opening when the bottle approaches. Satiety cues include falling asleep on the bottle, slowing down feeding, stopping sucking, and spitting out the teat (Butte *et al.* 2004). Since crying is not always a sign of hunger, other possible causes should be investigated when the infant cries. Monitoring the increase in height and weight is essential to ensure that the quantities ingested by the infant correspond to his needs (adjusting them if necessary). For breastfed infants, the SFP recommends breastfeeding the infant each time he wakes up during the first few weeks of life, and then on demand. As with formula-fed infants, monitoring the increase in height and weight is essential to ensure that breastfeeding meets the infant's needs and to control the rate of food intake.

The nutritional composition of breast milk may be modified by inadequate nutritional intakes due to altered bioavailability or diets providing insufficient quantities of nutrients. This is the case, for example, with mothers who have undergone bariatric surgery or who are on a vegan diet. These situations call for caution and may require medical supervision.

- Formula

This includes infant formula, follow-on formula and "growing-up milk".

Infant formula is defined by Regulation (EU) No 609/2013[4] as food intended for use by infants during the first months of life and satisfying by itself the nutritional needs of such infants until the introduction of appropriate complementary feeding. In everyday language, the term "first infant milk" is sometimes used. Infant formula is intended to replace breast milk before the infant begins receiving full meals without milk.

Follow-on formula is defined by the same Regulation as a food intended for use by infants when appropriate complementary feeding is introduced and which constitutes the principal liquid element in a progressively diversified diet of such infants. This type of formula is used when the infant begins to have at least one full meal a day without milk. In everyday language, the term "second-stage milk" is occasionally used.

Milk-based foods for young children, often referred to as "growing-up milks", are intended for children aged 12 months or older. They are governed by the French Ministerial Order of 30 March 1978[5]. Many of them meet the composition criteria for follow-on formula.

From the point of view of nutritional composition, Commission Delegated Regulations (EU) 2016/127[6] and 2016/128[7] lay down minimum and maximum levels for a number of mandatory nutrients such as protein, fat and certain vitamins and minerals in infant formula and follow-on formula, while allowing for variability within a range. Other nutrients, such as eicosapentaenoic acid (EPA), taurine, fructo-oligosaccharides (FOS) and galacto-oligosaccharides (GOS) are not mandatory but are subject to maximum levels. Lastly, the Regulation provides for the possibility of adding ingredients not mentioned in its Annexes provided that their suitability for the needs of infants

[4] Regulation (EU) No 609/2013 of the European Parliament and of the Council of 12 June 2013 on food intended for infants and young children, food for special medical purposes and total diet replacement for weight control and repealing Council Directive 92/52/EEC, Commission Directives 96/8/EC, 1999/21/EC, 2006/125/EC and 2006/141/EC, Directive 2009/39/EC of the European Parliament and of the Council and Commission Regulations (EC) No 41/2009 and (EC) No 953/2009

[5] Ministerial Order of 30 March 1978 laying down the provisions relating to certain milk products intended for a particular diet http://www.legifrance.gouv.fr/affichTexte.do?cidTexte=JORFTEXT000000000045451287

[6] Commission Delegated Regulation (EU) 2016/127 of 25 September 2015 supplementing Regulation (EU) No 609/2013 of the European Parliament and of the Council as regards the specific compositional and information requirements for infant formula and follow-on formula and as regards requirements on information relating to infant and young child feeding

[7] Commission Delegated Regulation (EU) 2016/128 of 25 September 2015 supplementing Regulation (EU) No 609/2013 of the European Parliament and of the Council as regards the specific compositional and information requirements for food for special medical purposes

has been demonstrated and can be verified by the competent national authorities. The regulatory framework therefore allows for some variability in nutritional composition. Formula can therefore be classified according to its composition into categories not defined by regulations:

- "anti-regurgitation" formula: infant formula or follow-on formula with a consistency thickened by the addition of starch or locust bean;
- preparations fortified with substances (e.g. GOS and FOS) listed as prebiotics;
- preparations fortified with bacteria regarded as probiotics, defined by the FAO/WHO in 2001 as living micro-organisms, which, when administered in adequate amounts [...] confer a health benefit on the host[8];
- "hypoallergenic" formula: preparations formulated from partially hydrolysed cow's milk proteins. These have been designed to prevent allergy risk in infants who may have allergic conditions (i.e. when one of the parents or a sibling is allergic). However, their effectiveness is controversial (ANSES 2018). They are in no way suitable for infants with a proven allergy to cow's milk protein;
- formula based on extensively hydrolysed cow's milk protein: designed for infants with an allergy to cow's milk protein, these preparations are characterised by a protein fraction consisting of enzymatic hydrolysates of casein or whey protein;
- hydrolysed rice protein formula: also designed for infants with an allergy to cow's milk protein, these preparations are characterised by a protein fraction consisting of rice protein hydrolysates;
- soy protein formula: like rice protein formula, it is designed for infants with an allergy to cow's milk protein. However, 10 to 14% of infants allergic to cow's milk protein are also allergic to soy protein (Koletzko *et al.* 2012). In addition, their phytate content may decrease the absorption of minerals and trace elements, and their high levels of isoflavones (the major compound of which is genistein), with oestrogenic action, may lead to an increase in the plasma concentration of isoflavones in children. As a result, ESPGHAN (2006) and the American Association of Pediatrics (Bhatia, Greer, and American Academy of Pediatrics Committee on 2008) consider that for healthy infants, cow's milk protein formula should be preferred to soy protein formula. The latter should not generally be offered during the first six months of life. For infants over six months of age who are allergic to cow's milk protein, these types of formula should not be used as an initial solution;
- formula based on goat's milk protein.

While rice- and soy-based infant formula and follow-on formula are formulated to meet the needs of infants, this is not the case with other foods such as plant-based drinks, sometimes misrepresented as plant-based "milks" (e.g. made from soy, rice, almonds, etc.). Substituting infant formula and follow-on formula by plant-based drinks in infants under one year of age may lead to slight or serious nutritional deficiencies with manifestations of disease that are more severe when the inadequate intake occurs early and with exclusive and prolonged consumption of these substitutes (ANSES 2013a).

The nutritional composition of cow's milk and the milk of other mammals (such as goats, ewes or mares) differs from that of breast milk and does not meet all the minimum and maximum values defined by Commission Delegated Regulation (EU) 2016/127. For example, the protein content of cow's, sheep's, goat's and mare's milk is two or three times higher than the maximum regulatory value; the iron content of cow's, goat's and mare's milk is one third of the minimum regulatory value; and the alpha-linolenic acid content of cow's milk is half of the minimum regulatory value[9].

[8] FAO/WHO (2001). Health and nutritional properties of probiotics in food including powder milk with live lactic acid bacteria. Argentina, October 2001. http://www.fao.org/3/a-a0512e.pdf

[9] According to the CIQUAL database (https://ciqual.anses.fr) consulted in June 2018

In general, before complementary feeding begins, breast milk can only be replaced by infant formula. After complementary feeding has started, the risk of excess or inadequate intake will be even greater if the nutritional composition of the food consumed as a substitute for breast milk is far removed from that of breast milk and accounts for a major part of the child's diet.

Hygiene recommendations (described in Annex 2) are provided on the preparation and storage of feeding bottles.

3.1.3.Complementary feeding

Complementary feeding is understood here as the introduction of foods other than breast milk or formula, particularly solid foods. This period can be divided into two stages:

- the discovery of a diversified diet and eating with a spoon or by hand;
- the transition to foods from the family table, where the child consumes the same food as the rest of the family, adapted if necessary, for example by adjusting the size of the pieces or by removing certain foods (see section below on food content).

The transition from one stage to the next is gradual and must meet the child's needs.

- Age of complementary feeding

Several international (e.g. WHO, EFSA, ESPGHAN) and national (e.g. the UK's Scientific Advisory Committee on Nutrition – SACN, or the French Paediatric Society – SFP) agencies and scientific organisations have summarised existing studies and made recommendations on the optimal age for complementary feeding. They have been confronted with the difficulty of dissociating the effect of the age of complementary feeding from that of the duration of exclusive breastfeeding, using studies that do not all distinguish between the introduction of formula and complementary feeding. Different parameters were considered to determine the age of complementary feeding:

- increase in height and weight;
- development (neuromuscular coordination, food preferences, digestion and absorption, kidney function);
- the nutritional match between the infant's needs and the nutrients provided by breast milk at different ages;
- the risk of diseases such as infections, autoimmune diseases (coeliac disease and type-1 diabetes), respiratory diseases, obesity, cardiovascular diseases, type-2 diabetes and food allergies.

Gastrointestinal and kidney functions are mature enough to allow full-term infants to manage diversified foods at the age of about four months (or 17 weeks). Gastrointestinal maturation depends largely on the foods ingested. The motor skills needed for an infant to safely accept and swallow a food in purée form are acquired during the period from four to six months of age (Fewtrell *et al.* 2017, EFSA 2009). Between six and 10 months, oral feeding skills develop when the infant is stimulated by new textures (Gisel 1991). Indeed, movement sequences such as the lateral movement of the tongue only take place if the infant receives textures that require this ability (Mason, Harris, and Blissett 2005, Reilly *et al.* 1995). Some studies suggest that delaying the introduction of lumpy foods beyond 10 months is associated with problems accepting more complex textures later on (Northstone *et al.* 2001, Coulthard, Harris, and Emmett 2009).

The nutritional match between the infant's needs and the nutrients provided by breast milk has been studied by the WHO and EFSA for the few nutrients for which the requirement was not defined solely on the basis of the amounts provided by breast milk, i.e. for iron, zinc, vitamins A, D and K, and protein. In 2009, EFSA concluded that exclusive breastfeeding by a well-fed mother meets the needs of full-term infants up to the age of six months for protein, vitamin A, iron and zinc. However, for a small proportion of infants, exclusive breastfeeding no longer meets their iron and zinc needs after

4-6 months of age (EFSA 2009, Fewtrell *et al.* 2017). This is in line with the finding of the WHO, which, in its report on infant feeding intended for European countries, also states that some infants may need foods to supplement breast milk before the age of six months but that these foods should not be introduced before four months (WHO 2003). In addition, the concentrations of vitamins D and K in breast milk are insufficient to meet the needs of infants, although supplementation practices in the European Union make up for this deficiency (EFSA 2009).

With regard to growth and the risk of obesity, few controlled trials have been conducted. ESPGHAN (Fewtrell *et al.* 2017) reported three randomised trials comparing the effect of complementary feeding at four months and at six months, including two in exclusively breastfed infants (Cohen *et al.* 1995, Wells *et al.* 2012) and one in formula-fed infants (Mehta *et al.* 1998), which showed no difference in short-term growth (6-12 months). Studies on the effect of complementary feeding age on growth beyond 12 months are mostly observational studies. They are difficult to interpret because of a possible reverse causality: rapid infant growth may lead to earlier complementary feeding. Systematic reviews of these observational studies do not report any obvious association between complementary feeding age and anthropometric data or the risk of obesity (Daniels *et al.* 2015, Moorcroft, Marshall, and McCormick 2011, Pearce, Taylor, and Langley-Evans 2013). However, they do report a few studies considered to be of good quality suggesting a higher body mass index (BMI) in childhood and a subsequent risk of overweight or obesity, when complementary feeding occurs before the age of four or three months (Brophy *et al.* 2009, Hawkins *et al.* 2009, Zhou *et al.* 2011). According to ESPGHAN's conclusion, it has not been shown that complementary feeding between four and six months influences growth or adiposity during early childhood (0 to 3 years), whereas complementary feeding before the age of four months may be associated with an increase in adiposity later in life (Fewtrell *et al.* 2017).

In its draft report on feeding in the first year of life[10], the SACN reports that very few studies have investigated whether the age of complementary feeding influences the risk of cardiovascular disease or type-2 diabetes, or has an effect on their risk markers such as hypertension, cholesterol concentrations or insulin resistance, and that it is not possible to draw any conclusions from them.

The effect of complementary feeding age on infectious risk has been studied mainly indirectly, through studies on breastfeeding duration. These suggest that prolonged exclusive breastfeeding may protect infants from the risk of infection and the risk of hospitalisation for infection, including in high-income countries (EFSA 2009, Fewtrell *et al.* 2017). Studies assessing the effect of complementary feeding age on the infectious risk in breastfed infants and formula-fed infants are rare. They suggest that it is the age of introduction of formula and not the age of complementary feeding that influences the risk of hospital admission for infectious reasons (Morgan, Lucas, and Fewtrell 2004, Quigley, Kelly, and Sacker 2009). However, in two studies, early complementary feeding (occurring before three months) was associated with an increase in respiratory diseases (Forsyth *et al.* 1993) and infectious morbidity (Wright, Parkinson, and Drewett 2004), with or without adjustment for the type of feeding. In this last study, complementary feeding age had no influence when it started between four and 8 months of age (Wright, Parkinson, and Drewett 2004). EFSA thus concludes that complementary feeding age does not seem to have any effect on the risk of infection when complementary feeding takes place after four months.

With regard to coeliac disease, observational studies led ESPGHAN in 2008 to recommend avoiding the introduction of gluten before four months or after seven months and introducing it preferably while the infant is still breastfeeding (Agostoni *et al.* 2008). Subsequently, two randomised controlled trials investigating the effect of gluten introduction age on the risk of developing coeliac disease in childhood in genetically susceptible children showed that the gluten introduction age did not affect the cumulative incidence or prevalence of coeliac disease (Lionetti *et al.* 2014, Vriezinga *et al.* 2014). Thus, in 2016, ESPGHAN concluded that gluten can be introduced between the age of four and 12

[10] Scientific Advisory Committee on Nutrition, Draft report "Feeding in the first year of life". Scientific consultation: 19 July to September 2017

months and that consumption of large quantities of gluten should be avoided in the first few weeks after its introduction (Szajewska *et al.* 2016).

With regard to type-1 diabetes (T1D), ESPGHAN referred to a 2017 systematic review that identified nine studies on infant feeding practices and the risk of developing T1D. From this summary, it appears that in children at risk of developing T1D, introducing gluten before the age of three months is associated with a higher risk of developing T1D compared to introduction after three months. After three months, the age of gluten introduction has no effect on the risk of T1D (Piescik-Lech *et al.* 2017).

Recommendations on the prevention of food allergies have evolved considerably in recent years. ANSES agrees with ESPGHAN and the SFP and concludes that complementary feeding should begin neither before the age of four months nor after the age of six months, whether or not the infant is at risk of food allergies (ANSES 2018). Once complementary feeding has begun, the introduction of major food allergens such as cow's milk, hen's eggs and peanuts should not be delayed.

In order to reduce the possible risk of obesity, infections, coeliac disease and food allergies, therefore, it is preferable for full-term infants to start complementary feeding after the age of four (completed) months. On the other hand, after six (completed) months, breast milk and formula alone can no longer meet the infant's nutritional needs or provide the necessary stimulation for development. It is therefore preferable to start complementary feeding between four and six months.

- Food content

Complementary feeding is a transitional step leading the infant from exclusive consumption of breast milk or formula to a family diet. At the start of complementary feeding, breast milk or infant formula and then follow-on formula remain the basis of the infant's diet; the amounts then gradually decrease at the age of between one and three years in favour of solid foods.

Foods offered as part of complementary feeding can be homemade or purchased commercially. ESPGHAN believes that homemade food can offer the opportunity for a greater variety of textures and flavours while reflecting the family's socio-cultural habits (Fewtrell *et al.* 2017). It also enables the ingredients used to be controlled. In this case, it is necessary to apply the general hygiene measures described in Annex 2, in order to reduce the microbiological risk.

Foods marketed for infants and toddlers are subject to many regulations. Directive 2006/125/EC[11] imposes minimum and maximum levels for many nutrients (e.g. for protein, lipids and for many vitamins and minerals). It also lays down a common maximum limit for most pesticides and pesticide residues, of 10 µg/kg. This limit is far lower than the levels authorised by the regulations for normal foods (Ghisolfi *et al.* 2013). For a small number of pesticides or pesticide metabolites, a maximum level lower than the 10 µg/kg one is laid down by the Directive. Lastly, the use of a few other pesticides is also prohibited in the production of agricultural foods for cereal-based foods and foods for infants and young children. Other regulations limit the levels of contaminants such as dioxins and dioxin-like PCBs (Regulation (EC) No 1881/2006[12]). A limited list of authorised additives is provided for in the Ministerial Order of 2 October 1997[13]. The regulations also impose strict microbiological criteria, in particular for *Listeria monocytogenes* (Regulation (EC) No 2073/2005).

The nutritional needs of children under three years of age are characterised by a higher proportion of fat in total energy intake (TEI) than that of adults (Table 1) (ANSES 2016a).

[11] Directive 2006/125/EC of 5 December 2006 on processed cereal-based foods and baby foods for infants and young children
[12] Commission Regulation (EC) No 1881/2006 of 19 December 2006 setting maximum levels for certain contaminants in foodstuffs
[13] Ministerial Order of 2 October 1997 on additives that may be used in the manufacture of foodstuffs intended for human consumption

Table 1. Macronutrient reference intake ranges for children 0 to 3 years of age and adults

	0-5 months	6-11 months	12-35 months	Adults
Fat reference intake range (% of TEI)	50-55%	Gradually decreases to 45-50%	45-50%	35-40%
Protein reference intake range (% of TEI)	7-15%		6-15%	10-20%
Carbohydrate reference intake range (% of TEI)	40-50%			40-55%

TEI: total energy intake

The fat requirements are largely covered by breast milk or formula at the start of complementary feeding. The SFP recommends offering at least 500 mL of breast milk or formula per day until at least one year of age. As the consumption of breast milk or formula decreases, fat should be provided through solid foods, such as commercially available jars of babyfood or homemade preparations. Fat should be added to homemade preparations and commercially available jars of babyfood when they do not contain any added fat. It is important to vary the fats used, favouring oils rich in alpha-linolenic acid (such as rapeseed and walnut oil). As the protein requirements of children under three years of age as a proportion of TEI are lower than those of adults and partly covered by breast milk or formula, intakes of meat-fish-eggs should be moderate. The SFP proposes meat-fish-egg intakes of 10 g/d from six to 12 months, 20 g/d from one to two years, and 30 g/d from two to three years. The SFP also recommends not exceeding the equivalent of 800 mL/d of milk after one year of age, in order to avoid excessive protein intake.

A number of foods are not suitable for children under three years of age because of their small size (choking hazard), contaminant content, nutritional composition or microbiological risks:

- small cylindrical or spherical foods that are resistant to crushing, such as peanuts, other nuts and grapes, should not be eaten whole because of the risk of choking;
- coffee, tea, caffeinated sodas and so-called energy drinks should be avoided because of their caffeine content (ANSES 2013c);
- artificial sweeteners, as food additives, are prohibited in foods for children under three years of age (Regulation (EC) No 1333/2008[14]). Foods containing them, such as artificially-sweetened beverages, should therefore be avoided;
- chocolate products should be limited due to their nickel content (ANSES 2016c);
- soy products should be limited due to their genistein content (ANSES 2016c).

In general, to promote a healthy diet in adulthood, children should develop healthy eating habits, including limited consumption of sweet products (such as confectionery, cream desserts, ice cream, sugar-sweetened beverages, etc.), fried foods, salt and salty products (such as snack biscuits) and delicatessen meats.

In order to allow optimal coverage of needs for eicosapentaenoic (EPA) and docosahexaenoic (DHA) acids while limiting the risk of overexposure to chemical contaminants, ANSES recommends consuming fish twice a week, including one serving with a high EPA-DHA content (salmon, sardines, mackerel, herring), and varying the species and sources of supply (wild, farmed, fishing sites, etc.) (ANSES 2013b). ANSES also reiterates that:

- freshwater fish that are highly bioaccumulative (eel, barbel, freshwater bream, carp, catfish) should be eaten less than once every two months (ANSES 2013b);
- consumption of wild predatory fish (such as monkfish, sea bass, eel, halibut, pike, sea bream, skate, tuna, etc.) should be limited (ANSES 2013b);

[14] Regulation (EC) No 1333/2008 of the European Parliament and of the Council of 16 December 2008 on food additives

- swordfish, marlin, siki shark, shark and sea lamprey should be avoided due to the risk of methylmercury (ANSES 2013b).

To reduce the microbiological risk, general hygiene measures should be applied and the consumption of certain foods by children from birth to three years of age should be avoided (see Annex 2):

- honey for infants under one year of age;
- all raw or undercooked meat: minced meat and minced meat products should be cooked thoroughly;
- raw milk and cheeses made from raw milk, with the exception of hard pressed cheeses such as gruyère or comté;
- raw eggs and products made from raw or undercooked eggs (such as homemade chocolate mousse and mayonnaise);
- raw shellfish and raw fish.

- Regulation of food intake

Newborns have a strong ability to regulate their energy intake according to their needs. With age, this ability decreases, although the precise reason why remains unclear. Unlike breastfeeding, which can promote this ability (see 3.1.2), some parenting practices, such as forcing the child to finish his bottle – or later his plate – can disrupt the child's self-regulation ability by requiring him to follow an external parental signal rather than his own internal cues (for review, (Schwartz, Scholtens*, et al.* 2011)).

The beginning and end of a meal depend not only on the child's self-regulation ability, but also on the interrelationship between the child and the feeding parent: the parent must therefore detect the child's signals, interpret them correctly and provide an appropriate response. A study conducted in the United States among low-income single mothers showed an inverse correlation between the mothers' sensitivity to their child's satiety cues and their child's weight gain between six and 12 months (Worobey, Lopez, and Hoffman 2009). Other studies report mothers' unfamiliarity with satiety cues or a failure to take these cues into account, even when they are more explicit in children aged 2-5 years (Orrell-Valente *et al.* 2007, Sherry *et al.* 2004).

Signs of hunger from young children include pointing to, asking for or taking food. Satiety cues include being distracted, turning the head away, slowing down the rate of ingestion, refusing the spoon, pushing it away or closing the mouth when the spoon approaches (Butte *et al.* 2004).

Although parents are recommended to be alert to their child's hunger and satiety cues, regular monitoring of the increase in height and weight is necessary to ensure that their child's energy intake is adjusted to his needs. Monitoring by a health professional also helps support parents in the development of food intake rhythms: the child will gradually be led to a rhythm structured into four food intakes, which will be followed at nursery school.

- Complementary feeding practices that promote high dietary diversity and healthy habits later in life

During the first phase of complementary feeding, there is high acceptance of new foods. A study based on a specific questionnaire reported "good" or "very good acceptance" for 88% of foods between the ages of five and seven months (Schwartz, Chabanet*, et al.* 2011), and for 91% of foods from complementary feeding to 15 months (Lange *et al.* 2013). However, acceptance varied according to the food in question, with fruit and vegetables being on average the least well accepted (Lange *et al.* 2013). This period of good acceptance persists until the period of food neophobia that begins at around 18 months and manifests itself mainly between two and six years (or even nine years) in most children. Food neophobia is characterised by a lower acceptance of some new foods

and the refusal of others. Previously accepted foods can also be rejected: the child becomes selective and difficult. The refusal of new foods occurs not during consumption but before, mainly on the basis of visual characteristics. However, it has been shown that children with the highest differential reactivity to different food odours are the most neophobic (Monnery-Patris *et al.* 2015). This behaviour does not constitute a developmental disorder but corresponds to a normal phase of development, with a suspected genetic influence (Harris 2017).

The period between five and 18 months thus seems to be a favourable window for the child to discover as many foods as possible, especially vegetables, which are the least well accepted foods when the child is older. Complementary feeding practices (such as breastfeeding, as seen in 3.1.2) can promote this acceptance. This is all the more important because eating behaviours established during the first thousand days can predict eating behaviour into early adulthood (Nicklaus *et al.* 2004, 2005, Nicklaus and Remy 2013, Schwartz, Scholtens*, et al.* 2011).

Role of repeated exposure

For a food to be easily and fully accepted, it must be presented several times to the child (Sullivan and Birch 1994) and at the start of complementary feeding (Cooke *et al.* 2004). A study conducted with seven-month-old children showed that at least eight exposures were necessary for an initially rejected food to be accepted (Maier, Chabanet, Schaal, Issanchou*, et al.* 2007). This effect was still visible nine months after repeated exposure. The effect of repeated exposure on a food's acceptance can persist up to the age of six years (Maier-Noth *et al.* 2016). In children aged four to seven months, the effect of repeated exposure extends to other related foods (such as another vegetable) but not to foods from other groups or with different textures (such as meat) (Birch *et al.* 1998).

While repeating the presentation of a new food is effective in promoting its acceptance in the first few months of complementary feeding, it seems to be less effective as the child grows older (Caton *et al.* 2014).

Role of exposure to a variety of foods

One study reported that at the start of complementary feeding, exposure to a variety of vegetables, compared to a single vegetable, promotes the acceptance of new vegetables or meats (Gerrish and Mennella 2001). The effect of exposure to a variety of vegetables at the start of complementary feeding on the acceptance of new foods (vegetable, meat or fish) persists until two months after the exposure period (Maier *et al.* 2008). This study also showed that over a given period of time, it is not so much the number of foods offered that promotes the acceptance of new foods, but rather the fact that they are changed every day. At six years of age, children exposed to a great diversity appreciated and consumed more of the new vegetables. They also accepted familiar vegetables more easily and had a greater desire to taste the new vegetables offered to them (Maier-Noth *et al.* 2016). Another study reported that exposure to a variety of fruits promotes the acceptance of new fruits but not new vegetables (Mennella *et al.* 2008).

This positive effect of exposure to a variety of fruits and vegetables (described mainly for vegetables) on the acceptance of new fruits and vegetables was also found in an observational study (Lange *et al.* 2013).

Role of the introduction of complex textures

Due to the limited oral skills of young children, texture is one of the food properties that requires the most adaptation on the part of the child in order to manage and swallow the food. As mentioned above, oral feeding skills develop between six and 10 months of age, when the child is stimulated by new textures (Gisel 1991).

About a quarter of children experience difficulties with pieces in foods. However, these difficulties should not drive parents to delay the introduction of more solid textures (Nicklaus 2017).

Several signs may indicate to parents that the child is ready to eat foods with a coarser texture than purée (S. Nicklaus, based on the guide developed for the pilot intervention study "Oral physiology and acceptability of food texture in young children, PATATE"[15]):

- he is able to keep his head and back straight in his chair;
- he swallows thick smooth purées without any problem;
- he makes chewing movements when he puts something in his mouth;
- he is able to hold a piece of food in his hand and put it in his mouth (he tries to feed himself);
- he is interested in the meal (for example, he tries to take food from his neighbour's plate).

The timing should therefore be left to the parents' discretion, but ESPGHAN recommends that this step should take place by the age of eight to 10 months at the latest (Fewtrell *et al.* 2017). According to other authors, the data suggest that introducing textures as soon as possible after six months and certainly before 12 months is essential to the development of the child's oral skills and the acceptance of foods with more complex textures (Harris and Mason 2017).

A new texture can be introduced at each meal. Different textures can be offered to the child successively according to the development of his abilities:

- smooth purée, to discover the taste of foods;
- thick granular purées;
- pieces that are crushed against the palate (such as very ripe fruit or well-cooked vegetables);
- pieces that are crushed between the fingers (such as small pieces of pasta, half-rounds of banana, soft cheeses);
- pieces that are broken with the teeth (such as small cubes of ham, small pieces of meat, raw vegetables cut into small sticks, baby biscuits).

It is important to vary the textures of the different food groups (smooth, granular, juicy, spongy, crumbly, dry, fibrous, crispy, crunchy, creamy, pulpy, etc.) by adapting the size and hardness of the pieces to the child's abilities, in order to develop his oral skills and acceptance of foods from the family table (Harris and Mason 2017, Harris and Coulthard 2016, Nicklaus, Demonteil, and Tournier 2015). Using hands to manipulate food with a particular texture may also promote acceptance of this texture, as shown in a study conducted with children aged three to 10 years handling jelly (Nederkoorn *et al.* 2018).

Role of the quality of the meal context and the way parents feed their child

The quality of social interactions and particularly parent-child interactions is likely to play a role in the acceptance of new foods. Two aspects of these interactions are considered: educational style and parenting practices.

- Educational style

Educational style is defined as the way in which parents interact with the child in terms of attitude and behaviour in all areas of education (Ventura and Birch 2008). Two main dimensions have been defined by sociologists: the degree of parental demandingness, i.e. the behavioural control exercised over the child, and the degree of parental responsiveness, i.e. their ability to adapt the rules according to the child's behaviour (Hughes *et al.* 2005). Several review papers have concluded that the style of food education, combining both a high level of parental demandingness and strong parental awareness of their child's needs, leads to the development of healthier eating habits (Hughes *et al.* 2005, Ventura and Birch 2008, Blissett 2011, Vollmer and Mobley 2013). However, most studies on the subject are observational studies and a reverse causal relationship is also possible: in this case, the style of parental education may be a response to the child's behaviour, for example, it is possible that parents adopt an authoritarian style when dealing with a child whose behaviour is very difficult (especially regarding food).

[15] Financed by Qualiment, sponsored by C. Tournier, French Centre for Taste and Feeding Behaviour (CSGA)

- Parenting practices

Parenting practices include the practices used to control what the child eats, and when and how he consumes it. They depend more on context than parenting style: the same parent may have different parenting practices for children in the same family, depending in particular on the child's age, sex or body weight (Ventura and Birch 2008). Parenting practices include several types of behaviours:

- because they are responsible for supplying the food, parents can choose to make some foods more available than others;
- parents can be role models by showing their children their own dietary practices;
- they can influence their child's eating behaviour by providing parental control, i.e. prohibiting the consumption of certain foods or obliging them to eat others (Schwartz, Scholtens*, et al.* 2011);
- they can also use food as an instrument, for example by using a food appreciated by the child as a reward or to comfort him.

A consensus emerges in the literature that too much parental control, such as restriction and obligation, may have negative consequences (for review (Schwartz, Scholtens*, et al.* 2011)). Restriction (e.g. prohibiting the child from eating a food) seems to promote a preference for foods to which access is restricted, increase the attention paid to these foods and increase their consumption when the child is not hungry. Pressure, i.e. forcing a child to eat using a sharp tone or coercive practices, also seems to be counterproductive. These practices reduce the child's ability to self-regulate food intake and are associated with more "difficult" behaviours. However, the possibility that a reverse causal relationship could explain the latter association cannot be ruled out. On the other hand, making healthy foods available and having a healthy eating behaviour that can serve as a model and lead to repeated exposure is likely to promote the acceptance of new foods.

Complementary feeding practices such as the repeated presentation of foods that vary in taste and texture at the start of complementary feeding, in a supportive food context, can limit the consequences of food neophobia in terms of reduced dietary diversity. To manage food neophobia and selectivity, two strategies can be adopted (Nicklaus and Monnery-Patris 2018):

- a food-based strategy: this involves increasing the familiarity of the food, without necessarily getting the child to taste it, by increasing its visual exposure (for example, taking the child to the market), reading books about the food, playing sensory games with the food (based on touch and smell), cooking, gardening, etc.
- a strategy based on the context of meals: this is about keeping a calm (without distractions such as toys or screens) and friendly atmosphere, in which parents do not force the child to eat, but set an example by consuming the food themselves or asking others to set an example.

Indeed, eating is a social situation for young children who, as they are unable to feed themselves or make appropriate food choices, eat with at least one other person responsible for feeding them. The interactions between diners contribute to the development of children's eating habits. Young children learn what foods are appetising by observing other people eating (Liberman *et al.* 2016). Eating in a social context also affects the amount consumed, the acceptance of new foods, the perception of the taste of foods, and food choices (Lumeng and Hillman). The influence of parents, other adults and peers on eating behaviour has been recognised. Talking about what is consumed can also influence the child's eating behaviour (Wiggins 2002).

3.1.4.Supplementation

Vitamin K and D supplements are prescribed by doctors for newborns and children, according to procedures recommended by the ANSM or SFP:

- in 2014, the ANSM reported major changes in the recommended dosage of vitamin K1 for the prevention of haemorrhagic disease in newborns, in connection with the harmonisation of the use of these drugs in Europe[16].
- The SFP recommends vitamin D supplementation for all infants (Vidailhet *et al.* 2012).

3.2. Current nutrient intakes and dietary practices

3.2.1. Nutrient intakes

Studies by ANSES (INCA 3, iTDS) and from the literature (Bocquet and Vidailhet 2015) have identified nutrients for which children under three years of age are at risk of inappropriate intakes, either through deficiencies or excess intakes. This evidence, combined with the characterisation of the hazards associated with such deficiencies or excess intakes in children, led the CES to focus, besides macronutrients, on calcium, iron and sodium.

A few studies have estimated the nutrient intakes of children from birth to three years of age in France.
The third Individual and National Study on Food Consumption (INCA 3) was conducted in metropolitan France between February 2014 and September 2015 among 43 children from birth to 11 months and 156 children aged from 12 to 35 months (ANSES 2017). Nutrient intakes were only calculated for children who were no longer breastfed at the time of food data collection.
The Eden study of pre- and postnatal determinants of child health followed a mother-child cohort (Yuan *et al.* 2016). Recruitment took place between 2003 and 2006. The food intake of 1275 children was collected at 8 and 12 months of age. Nutrient intakes were only calculated for children who were no longer breastfed at the time of food data collection.
The French Longitudinal Study Since Childhood (Elfe) is a national cohort study, which included around 18,000 children born in 2011 in metropolitan France (Vandentorren *et al.* 2009). It served to monitor changes in feeding practices during the first year of life but was unable to assess nutrient intakes.
Specific calculations were performed for this expert appraisal: using the data from the Eden study to assess calcium, iron and sodium intakes, and using the data from the Elfe study to assess data on cow's milk consumption and the age of complementary feeding or introduction of coarse textures.
Data from the Nutri-Bébé study on dietary behaviours and nutritional intakes among children from birth to three years of age, conducted in 2013 by the French Organisation for Children's Food (SFAE) in partnership with the CREDOC and TNS SOFRES survey institutes, were used to estimate calcium, iron and sodium intakes and inappropriate intakes. This nationally representative study covered a sample of 1188 children aged between 15 days and 35 months (Tavoularis 2015). The results presented below cover a sample of 1035 non-breastfed children aged between 15 days and 35 months. The consumption data were cross-referenced with the Ciqual composition table and a nutritional composition table for specific baby foods created for the study. The risk of inadequate intake for low nutrient intake values was estimated by ANSES using the average requirement (AR) "cut-off point" method, defined as the proportion of individuals whose nutritional intakes are lower than their individual needs. This proportion is approximated by the proportion of individuals whose usual intakes are below the AR. The nutritional risk for high intake values was measured by comparing usual intakes with the upper intake level (UL). This was to estimate the proportion of individuals with intakes above the UL. The data used here for the calculations of the prevalence of inappropriate intake were those observed from three days of consumption. They do not therefore accurately reflect usual intakes, which are long-term nutritional intakes. The distribution of observed intakes was less narrowly spread than that of usual intakes. As a result, the prevalence of

[16] http://ansm.sante.fr/S-informer/Informations-de-securite-Lettres-aux-professionnels-de-sante/Vitamine-K1-Roche-2-mg-0-2-ml-Nourissons-solution-buvable-et-injectable-Modifications-du-schema-posologique-Lettre-aux-professionnels-de-sante

inappropriate intakes and exceeded ULs calculated on the basis of observed data may be overestimated.

Macronutrients

For macronutrients, in the INCA 3 study the average fat contribution to total energy intake was 38% and 32% for children under one year of age and one to three years of age respectively (Table 2). These contributions are well below the reference intake range for these age groups, which is 50-55% of the TEI for infants aged 0-6 months and then gradually decreases to 45-50% for children aged 1-3 years (ANSES 2016a). This low fat contribution is compensated by carbohydrates and proteins for children aged one to three years.

Table 2. Average fat, carbohydrate and protein intakes (expressed as a % of total energy intake, TEI) of children from birth to three years in the INCA 3 study and dietary reference values

		0-6 months	6-11 months	1 to 3 years
Fats (% TEI)	Average intake	37.7%		32.0%
	Reference intake range	50-55%	Gradually decreases to 45-50%	45-50%
Proteins (% TEI)	Average intake	9.7%		15%
	Reference intake range	7-15%		6-15%
Carbohydrates (% TEI)	Average intake	50.9%		50.5%
	Reference intake range	40-50%		

Similarly, in the Eden study, the average fat contribution was well below the reference intake range (Table 3): 95% of 8-month-old children and 98% of 12-month-old children had intakes below 40% of the TEI, while the lower limit of the reference intake range at these ages was 45% (Yuan *et al.* 2016). The average contribution of carbohydrates to energy intake was 56%, meaning that it is above the reference intake range for this age group (ANSES 2016a). In the Eden study, 30% and 39% of children consumed added sugar (white or brown sugar, honey and jam) at eight and 12 months respectively.

Table 3. Fat and carbohydrate intakes of children in the Eden study (Yuan *et al.* 2016)

		8 months	12 months
Fats (% TEI)	Average intake ± standard deviation	31.4 ± 4.3	29.7 ± 4.8
	% of children with intakes <35%	70.8	87.8
	% of children with intakes between 35 and 39%	24.2	10.3
	% of children with intakes ⩾ 40%	5.0	2.0
Carbohydrates (% TEI)	Average intake ± standard deviation	56.2 ± 4.8	56.0 ± 5.7
	% of children with intakes <45%	2.1	4.3
	% of children with intakes ≥ 45%	97.9	95.7

Calcium

For calcium, the average intake of infants aged 0-5 months and 6-11 months in the Nutri-Bébé study was higher than the adequate intake (AI) defined by EFSA (EFSA 2013, 2015a) (Table 4). Intakes met calcium needs at a generally satisfactory level. In children aged 12 to 35 months, the prevalence of inadequate intake was low (Table 4). The UL defined by the Institute of Medicine (IoM 2011) was not found to have been exceeded to any significant degree in this study. In the Eden study, the average intakes (± standard deviation) at four, eight and 12 months were 519 ± 161, 584 ± 161 and 700 ± 172 mg/d, respectively. In the INCA 3 study, the average intake (± standard deviation) was 541 ± 146 mg/d for children aged 0-11 months and 801 ± 152 mg/d for children aged 1-3 years (ANSES 2017), which is generally consistent with the data from the Nutri-Bébé study.

Table 4. Average calcium intakes of children in the Nutri-Bébé study and percentages of inappropriate intake

	Average intake ± standard deviation (mg/d)	% with inadequate intake	% by which upper intake level was exceeded	Dietary reference values (mg/d)
0-5 months	479 ± 129	NC	0.5%, NS	AI = 200 UL = 1000
6-11 months	679 ± 155	NC	0%	AI = 280 UL = 1500
12-35 months	759 ± 191	2.6%	0%	AR = 390 UL = 2500

AI, adequate intake; AR, average requirement; UL, upper intake level; NC, not calculated due to absence of AR, NS, not significantly different from zero

In the Nutri-Bébé study, in children aged 12 to 35 months, when comparing calcium-contributing foods among low-calcium consuming children (i.e., those in the first quartile of consumption) and high-consuming children (those in the fourth quartile of consumption), it was found that all the food groups, and particularly cow's milk, dairy products, cheese and "growing-up milks", provided higher amounts of calcium to high consumers (Table 10 in Annex 3).

Iron

For iron, the average intake of children aged 0-5 months in the Nutri-Bébé study was higher than the adequate intake (AI) defined by EFSA (EFSA 2013) (Table 5). Intakes met iron needs at a generally satisfactory level in this age group. Neither ANSES nor EFSA have so far defined an upper intake level, so it is impossible to examine any potential excess intakes. For children aged 6-11 months and 12-35 months, average intakes were higher than the AR defined by EFSA (EFSA 2015b). The percentage with inadequate intake was just over 50% for children aged six to 11 months and 30% for children aged 12 to 35 months. The main contributors of iron are follow-on formula and "growing-up milks" (Table 11 and Table 12, Annex 3). Other foods could be interesting levers for diversifying intakes, such as vegetables and pulses. In the Eden study, the average intakes at four, eight and 12 months were 7.6 ± 2.5, 8.7 ± 2.9 and 8.2 ± 3.0 mg/d, respectively. In the INCA 3 study, the average intake (± standard deviation) was 6.6 ± 2.1 mg/d for children aged 0-11 months and 8.5 ± 4.3 mg/d for children aged 1-3 years (ANSES 2017), which is generally consistent with the data from the Nutri-Bébé study.

Table 5. Average iron intake of children in the Nutri-Bébé study and percentages of inappropriate intake

	Average intake ± standard deviation (mg/d)	% with inadequate intake	Dietary reference values (mg/d)
0-5 months	6.3 ± 1.9	NC	AI = 0.3
6-11 months	8.2 ± 2.7	51.1%	AR = 8
12-35 months	7.0 ± 3.2	30.9%	AR = 5

AI, adequate intake; AR, average requirement; NC, not calculated due to absence of AR

However, these results should be put into perspective using data on the iron status of children. A cross-sectional study conducted in France between 2008 and 2009 among 657 children aged six months to six years estimated that 3% of children aged 0.8 (i.e. about 10 months) to 2 years and 5% of children aged two to three years have an iron deficiency defined by serum ferritin below 10 µg/L (Sacri *et al.* 2018). In this study, the risk of iron deficiency was low and was associated with various socio-economic factors, namely the mother being an immigrant, the family being underprivileged and the mother having a low level of education.

Sodium

For sodium, the average intake in the Nutri-Bébé study was 193 mg/d in children 0-5 months of age, 512 mg/d in children 6-11 months of age and 1082 mg/d in children 12-35 months of age (Table 6). Neither ANSES nor EFSA have so far defined a dietary reference value for sodium. In the absence of a consensus-based dietary reference value, a maximum value of 2994 mg (7.6 g salt) corresponding to the median of the intakes observed in the INCA 2 study (excluding table salt) was chosen for adult men of 70 kg as part of the revision of food-based dietary guidelines for adult men. If this is adjusted to the weight of a child aged six to 11 months, i.e. around 9 kg, the value of 385 mg/d is obtained and for a child aged one to three years, i.e. around 12 kg, the value is 510 mg/d. Thus, sodium intakes seem to be too high for a majority of children aged six to 11 months and for almost all children aged 12 to 35 months.

In the Eden study, the average intakes (± standard deviation) at four, eight and 12 months were 210 ± 82, 530 ± 276 and 751 ± 333 mg/d, respectively. In the INCA 3 study, the average intakes (± standard deviation) were 416 ± 279 mg/d for children aged 0-11 months and 1283 ± 374 mg/d for children aged 1-3 years (ANSES 2017), which is generally consistent with the data from the Nutri-Bébé study.

Table 6. Distribution of sodium intakes (in mg/d) among children from birth to three years in the Nutri-Bébé study

	Average intake ± standard deviation (mg/d)	10th percentile intake (mg/d)	25th percentile intake (mg/d)	Median intake (mg/d)	75th percentile intake (mg/d)	90th percentile intake (mg/d)
0-5 months	193 ± 71	136	156	181	205	254
6-11 months	512 ± 333	244	307	434	602	820
12-35 months	1082 ± 420	602	776	1023	1372	1643

When comparing sodium-contributing foods in children aged 12 to 35 months who are low sodium consumers (i.e. in the first consumption quartile) and in high-consuming children (in the fourth consumption quartile), it can be seen that the amounts of sodium provided by "growing-up milks" and industrial jars of babyfood were higher among low consumers (Table 13 in Annex 3). On the other hand, the amounts of sodium provided by mixed dishes, sauces, meat, biscuits and cheeses are much higher among high consumers, who therefore seem more advanced in their complementary feeding. It can also be noted that table salt consumption is ten times higher among high consumers.

Sugar

For sugar, current data for children do not distinguish lactose and galactose intakes from other sugars containing fructose (sucrose, glucose-fructose syrups, honey or other syrups and natural concentrates containing fructose, pure fructose). However, deleterious effects have been observed with high intakes of sugars containing fructose in adults, which led ANSES to set an upper consumption limit for total sugars excluding lactose and galactose. In view of the quantities of lactose provided by the diet of children under three years of age, it is impossible to reach a conclusion about any possible health risk associated with sugar intakes excluding lactose and galactose in these children.

In the Nutri-Bébé study, consumption of commercial fruit juice was observed from the age of 12-17 months, with 51% of children consuming it, and of sodas from the age of 18-23 months, with 27% of consumers (Le Heuzey and Turberg-Romain 2015). Consumption of confectionery (sweets, bars, chocolate bars, etc.) was observed from the age of 8-11 months in 7% of children, and concerned 78% of children aged 24-29 months. In the Elfe study (Gassama and Charles 2018), 54% of two-year-olds consumed cakes, biscuits and dairy desserts at least once a day. Only 46% had never consumed sugar-sweetened beverages such as soda or syrups. This consumption of sweet products seems difficult to reconcile with the implementation of healthy eating habits.

3.2.2.Complementary feeding practices

The Nutri-Bébé study reported that cow's milk was consumed as the main source of milk by about 2% of children aged four to five months and 3% of children aged six to seven months (Bocquet and Vidailhet 2015). In the Elfe study, 6% of six-month-old children consumed cow's milk, but less than 1% consumed it exclusively. At the age of one year, 21% of children consumed cow's milk, and 15% of them consumed it as their only source of milk. Apart from the nutritional risk, this consumption of cow's milk instead of formula led to the observation of significantly higher exposure levels, in

particular for contaminants vectored by dairy products (ANSES 2016c). For example, in children consuming exclusively cow's milk, total exposure to PCDD/Fs (polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans) was two to three times higher and PCB exposure two to six times higher than that of children consuming formula (ANSES 2016c).

In the Nutri-Bébé study, 6% of children under three months of age had consumed foods other than breast milk or infant formula, 31% had started diversifying at four months of age and 90% were diversified at six months of age (Bocquet and Vidailhet 2015). In the Elfe study, the majority of children (62%) started complementary feeding between four and six months, 26% started before four months and 12% after six months (Bournez *et al.* 2018). The average age of introduction of coarse textures (mashed or small pieces of fruit and vegetables (unblended), small pieces of meat) was nine months. In the Nutri-Bébé study, the introduction of coarse textures was reported from 6-7 months; however, the presence of pieces was only predominant from 12 months and a smooth diet remained prevalent up to the age of one year (Bocquet and Vidailhet 2015).

A study of 139 mothers in France reported that 30% of them did not offer a food again when it was refused only once, and 40% no longer offered it after two refusals. Less than 10% of mothers continued to offer the food after five refusals (Maier, Chabanet, Schaal, Leathwood*, et al.* 2007). In the Nutri-Bébé study, when children refused certain foods, 48% of mothers encouraged their child to try them and 5% forced their child to eat while 47% did not insist. In this case, 17% of the mothers offered something else and 30% offered the food again another time (Le Heuzey and Turberg-Romain 2015). Children's exposure to new foods during complementary feeding is therefore not sufficiently repeated.

With regard to the eating context, the Elfe study reported that the television was generally on during meals for 47% of two-year-olds (Gassama and Charles 2018). This source of distraction could divert the child's attention from his plate and his satiety cues and feelings, and may also limit the child's ability to observe other diners and their eating behaviour.

3.2.3.Conclusion on current nutrient intakes and dietary practices

Nutritional intakes of children under three years of age are characterised by a contribution of fat to total energy intake below the reference intake range, compensated by carbohydrates and protein. Calcium intakes appear to be generally adequate. There are high percentages of inappropriate iron intake in children aged six to 11 months and to a lesser extent in those aged one to three years. However, the prevalence of iron deficiency is low. Since a negative association between iron deficiency and families' socio-economic status has been suggested, more information on the iron status of children from underprivileged families is required. Sodium intakes appear too high for a majority of children aged six to 11 months and even higher for children aged one to three years: the more advanced the complementary feeding, the higher the sodium intakes. Consumption of high-sugar foods such as confectionery, sugar-sweetened beverages or cakes appears early in complementary feeding and seems difficult to reconcile with the implementation of healthy eating habits.

For the majority of children, complementary feeding occurs during the recommended 4-6 month period. In 2011, 26% of children nevertheless had diversified diets before the age of four months, and 12% after six months. The average age of introduction of coarse textures is satisfactory but smooth food remains prevalent for many children up to one year of age. Moreover, children's exposure to new foods during complementary feeding is not sufficiently repeated.

3.3. Conclusion and recommendations of the CES on "Human Nutrition"

In principle, the recommendations in this opinion apply only to children born at full-term and who do not require special nutritional care. Children born prematurely or with diseases need to follow a diet adapted to their condition as part of their individual medical care.

Milk-based diet

The CES reiterates that infant formula and follow-on formula must not be substituted by plant-based drinks for children under one year of age.

Before complementary feeding, breast milk can only be replaced by infant formula. After complementary feeding, the risk of excess or inadequate intake will be even higher if the nutritional composition of the beverage consumed as a substitute for breast milk is far removed from that of breast milk and accounts for a major part of the child's diet.

Among the types of formula based on vegetable protein, soy-based formula should not be offered during the first six months of a child's life, mainly because of its isoflavone content. In addition, 10 to 14% of infants allergic to cow's milk protein are also allergic to soy protein. The CES therefore recommends that these preparations should not be used as an initial solution for children allergic to cow's milk protein.

Complementary feeding

In order to reduce the possible risk of obesity, infections, coeliac disease and food allergies, it is preferable for full-term infants to start complementary feeding after the age of four months. On the other hand, after six months, breast milk and infant formula alone can no longer meet the infant’s nutritional needs or provide the necessary stimulation for development. The CES on "Human Nutrition" therefore recommends beginning complementary feeding at the age of between four and six months. Once complementary feeding has begun, it recommends that major food allergens such as dairy products, eggs and peanuts be introduced without delay, whether or not the child is at risk of allergy (due to family history).

At the start of complementary feeding, breast milk or infant formula and then follow-on formula should remain the basis of the child's diet: a minimum of 500 mL/day must be provided until at least one year of age. Their quantity must then gradually decrease between the ages of one and three years in favour of solid foods.

In order to cover the child's iron needs after complementary feeding has begun, the CES believes it is important to offer foods that contribute to iron intake such as vegetables and meat or iron-fortified foods such as "growing-up milk" or infant cereals. However, in order to avoid excessive protein intake, the amount of milk or equivalent should not exceed 800 mL/d after one year and the amounts of meat, fish and eggs should be 10 g/d from six to 12 months, 20 g/d from one to two years and 30 g/d from two to three years. On the other hand, average fat intakes of children under three years of age are inadequate. The CES recommends adding fat (while varying it) to homemade preparations and jars of babyfood without any added fat.

In order to meet EPA and DHA requirements, fish should be offered regularly, with the aim of achieving two consumption occasions per week at the end of complementary feeding, offering fish with a high EPA and DHA content and varying fish species and supply sources. However, some species should be avoided or limited, in order to reduce the risk associated with chemical contaminants.

In order to promote healthy eating habits in adulthood, the CES recommends that from the time of complementary feeding, consumption of sweet products (such as pastries, biscuits, chocolates and sugar-sweetened beverages), fried foods, salted products (such as snack biscuits) and delicatessen

meats should be limited. Similarly, it recommends not adding salt when preparing meals and consuming food.

The CES recommends not offering coffee, tea, caffeinated sodas and so-called energy drinks to children under three years of age because of their caffeine content.

It also advises against proposing soy-based products to children under three years of age.

To reduce the microbiological risk, general hygiene measures should be applied and the consumption of certain foods by children from birth to three years should be avoided[17]:

- honey for infants under one year of age;
- all raw or undercooked meat: minced meat and minced meat products should be cooked thoroughly;
- raw milk and cheeses made from raw milk, with the exception of hard pressed cheeses such as gruyère or comté;
- raw eggs and products made from raw or undercooked eggs (such as chocolate mousse and homemade mayonnaise);
- raw shellfish and raw fish.

The CES believes that it is important to promote the discovery and acceptance of healthy foods during the period between the start of complementary feeding and 18 months. Some complementary feeding practices can promote the acceptance of generally less well accepted foods, such as vegetables:

- presenting numerous times (8-10 times) a food initially refused by the child, at the start of complementary feeding;
- introducing a great diversity of foods at the start of complementary feeding, by offering different foods on a daily basis;
- introducing coarse textures from eight months and not after 10 months by varying the textures of the foods offered and by adapting the size and hardness of the pieces to the child's abilities. However, due to the risk of choking, small cylindrical or spherical foods that are resistant to crushing, such as peanuts, other nuts and grapes, should not be offered whole;
- eating in a calm and friendly environment without distractions (such as screens), in which parents do not force the child to eat but encourage them to taste, for example by consuming the food themselves;
- not using favourite foods as a reward or comfort: this reinforces the child's attraction to these often very sweet foods;
- increasing familiarity with new foods, without necessarily making the children taste them.

In order to maintain the ability of newborns and young children to regulate their own energy intake according to their needs, the CES stresses the importance of respecting the child's hunger and satiety cues, regardless of their age. It is therefore recommended that the child not be forced to finish his bottle or plate. At the table, it is advisable to serve a small amount of the dish first and then to offer it again if the child is still hungry. The degree to which energy intake is meeting needs can be verified by regularly monitoring the increase in the child's height and weight.

[17] These measures apply to the children examined here, from birth to three years, without prejudice to their application to older ages.

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 under the PNNS for different types of populations: the adult population, children aged three to 17 years, postmenopausal women and the elderly, and pregnant or breastfeeding women. 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, social or environmental considerations, only nutritional risk considerations and recommendations for the prevention of foodborne microbiological risks.

The work carried out is the scientific foundation needed for formulating dietary guidelines for children under three years of age. It included research into studies on the relationship between food consumption and health in this population. The data obtained were considered insufficient as a basis for dietary guidelines for children under three years of age. The work then drew on the work of health agencies and learned societies, as well as on hearings with the French Paediatric Society and experts specialising in dietary behaviour, particularly during complementary feeding. This evidence was then compared with the nutritional intake data and complementary feeding practices observed in France. All this work enabled the CES on "Human Nutrition" to make recommendations. These recommendations also include those of the CES on "Assessment of the biological risks in foods" (BIORISK) on the prevention of microbiological risks, and the recommendations from the infant total diet study (iTDS) on the prevention of risks associated with chemical contaminants.

The Agency's work led it to recommend a significant change in the dietary recommendations established under the previous PNNS, namely the change in the recommended age of complementary feeding, which is now between four and six (completed) months. This work places greater emphasis on scientific data on complementary feeding practices that promote dietary diversity in later life.

ANSES thus recommends:

- exposing children repeatedly to a variety of foods;
- introducing coarse textured foods from eight months and not after 10 months;
- paying closer attention to the context of the meal, in particular by avoiding exposing children to screens;
- respecting the child's hunger and satiety cues, regardless of age;
- not introducing high-sugar foods such as confectionery, sugar-sweetened beverages or cakes early, and limiting their consumption in order to promote healthy eating habits in adulthood.

In addition, according to a recent European Commission study[18] on babyfoods[19] available on the European market, some food categories (particularly the biscuits and rusks group) and many products can contribute to considerable total sugar intakes in children, which underlines the importance of establishing sugar content criteria that should be monitored to ensure that these products are suitable for consumption by young children.

[18] Feeding infants and young children: An analysis of national food-based dietary guidelines and specific products available in the EU market. 2018. Grammatikaki E, Wollgast J., Caldeira S. Analysis carried out in order to prepare a delegated act governing the nutritional composition of these products, within the framework of Directive 2006/125/EC. https://ec.europa.eu/jrc/sites/jrcsh/files/processed_cereal_baby_food_online.pdf

[19] Processed cereal-based foods and baby foods (excluding formula) for infants and young children (under three years of age)

Pending the possible introduction of regulations governing the sugar content of products specially designed for young children, ANSES therefore recommends that parents exercise vigilance regarding the sugar content of the foods they offer their child.

Dr Roger Genet

KEYWORDS

Préparations infantiles, préparations pour nourrissons, préparation de suite, allaitement, diversification alimentaire, néophobie alimentaire, textures, exposition répétée, nutriment, aliment

Infant formula, follow-on formula, breastfeeding, complementary feeding, food neophobia, texture, repeated exposure, nutrient, food

GLOSSARY

Age in completed months: the whole number of months lived by the child at a given time

Full-term infant: a child born after at least 37 weeks of amenorrhoea

Premature child: a child born before 37 weeks of amenorrhoea

Growing-up milk: the common name for milk products intended for young children as defined by the Ministerial Order of 30 March 1978 laying down the provisions relating to certain milk products intended for a particular diet. They are intended for children from 12 months of age or older. Many of them meet the composition criteria for follow-on formula.

Formula: the generic term used in this document to refer to infant formula, follow-on formula and "growing-up milk".

Infant formula: according to European Parliament Regulation (EU) No 609/2013, it is food intended for use by infants during the first months of life and satisfying by itself the nutritional needs of such infants until the introduction of appropriate complementary feeding. Infant formula is intended to replace breast milk until the infant begins receiving full meals without milk. In everyday language, the term "first infant milk" is sometimes used.

Follow-on formula: according to European Parliament Regulation (EU) No 609/2013, it is a food intended for use by infants when appropriate complementary feeding is introduced and which constitutes the principal liquid element in a progressively diversified diet of such infants. This type of formula is used when the infant begins to have at least one full meal a day without milk. In everyday language, the term "second-stage milk" is occasionally used.

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.

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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, diet quality

Members

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

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

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 and pathophysiology of water- and fat-soluble vitamins and iron

Mr Jean-François HUNEAU – Professor (AgroParisTech) – Speciality: human nutrition, nutritional needs and dietary reference values

Ms Emmanuelle KESSE-GUYOT – Research Director (INRA, UMR Inserm U1153/INRA U1125/CNAM/University of Paris 13/CRESS) – 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 in Epinal, Nancy Regional University Hospital) – Speciality: allergology, general practice

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

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

Mr Stéphane WALRAND – University Professor-Hospital Practitioner (University of Clermont Auvergne – Gabriel Montpied University Hospital in Clermont-Ferrand) – Specialities: pathophysiology, protein metabolism, amino acids, vitamin D, fatty acids

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

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 Anne MORISE – Scientific and Technical Project Leader – Nutritional Risk Assessment Unit, Risk Assessment Department – ANSES

Ms Pauline KOOH – Scientific and Technical Project Manager – Foodborne Risk Assessment Unit – Risk Assessment Department – ANSES (for aspects relating to microbiological risks)

Scientific contribution

Ms Anne MORISE – Scientific and Technical Project Leader – Nutritional Risk Assessment Unit, Risk Assessment Department – ANSES

Ms Ariane DUFOUR – Scientific and Technical Project Manager – Methodologies and Studies Unit – Risk Assessment Department – ANSES

Administrative secretariat

Ms Virginia SADE – Risk Assessment Department – ANSES

HEARINGS WITH EXTERNAL PERSONS

French Paediatric Society

Mr André BRIEND – Research Director (Institute of Research for Development, Marseille) – Speciality: infant nutrition

Mr Christophe DUPONT – University Professor-Hospital Practitioner (AP-HP Necker Hospital – Sick Children, Paris) – Specialities: paediatrics, allergology

Mr Jean-Philippe GIRARDET – University Professor-Hospital Practitioner (AP-HP Armand Trousseau Hospital, Paris) – Specialities: paediatrics, child nutrition

Mr François FEILLET – University Professor-Hospital Practitioner (Nancy Regional University Hospital, Brabois Hospital) – Specialities: paediatrics, hereditary metabolic diseases

Mr Emmanuel MAS – University Professor-Hospital Practitioner (Children's Hospital, Toulouse) – Specialities: paediatrics, gastroenterology, lipids

French Centre for Taste and Feeding Behaviour (CSGA), Dijon, France

Ms Sylvie ISSANCHOU – Research Director (INRA) – Specialities: dietary behaviour

Ms Sophie NICKLAUS – Research Director (INRA) – Specialities: dietary behaviour

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 7.

Table 7. 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 and maintain 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 use-by date (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 8.

Table 8. Main diseases or complications that may occur in specific populations

Susceptible population groups	Diseases or complications related to foodborne pathogens
Children aged 0-5 years	Neonatal infections related to *Cronobacter* spp. or *Salmonella*. Infant botulism related to *Clostridium botulinum* spores. Haemolytic and uraemic syndrome related to enterohaemorrhagic *E. coli*. Severe dehydration associated with gastroenteritis (*Yersinia*, *Vibrio, Rotavirus, Cryptosporidium*).

The exclusion of some foods by susceptible populations reduces the risk of infection. The main foods to be avoided are shown in Table 9.

Table 9. List of foods to be avoided for children from birth to five years of age

Population categories	Foods to be avoided
Children aged 0-5 years	Honey (infants under one year of age). All raw or undercooked meat (cook minced meat and minced meat products thoroughly). Raw milk and cheeses made from raw milk (with the exception of hard pressed cheeses such as gruyère or comté). Raw eggs and products containing raw or undercooked eggs. Raw shellfish, raw fish.

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/fr/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 for each 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				
Clostridium botulinum	Foodborne botulism: no susceptible population identified Infant/intestinal botulism: Infants (<12 months), adults having undergone digestive surgery or suffering from intestinal carcinomas, chronic lesions of the intestinal mucosa, anatomical or functional intestinal anomalies, chronic inflammation, or following antibiotherapy	Low-acid preserved foods. Honey (for infants under 12 months of age) Foods most often involved in botulism outbreaks: home-made preserves and traditionally-made products (preserved fruit and vegetables, preserved beef, uncooked, salted and dried delicatessen meats, salted and dried fish, fish marinades).	– When preparing preserves: ○ Preparation hygiene: careful cleaning of fresh produce, preparation of meat, cleanliness of containers or packaging ○ Compliance with manufacturers' sterilisation instructions ○ For hams: compliance with salt and nitrite concentrations – For commercial food products: ○ Compliance with the cold chain ○ Compliance with cold storage instructions and use-by dates – **Do not give honey to infants under 12 months of age.**	Revision 2018
***Cronobacter* spp.**	Infants under two months of age, stunted and/or premature infants, very young children, the elderly, immunocompromised subjects or those with a severe underlying disorder.	Powdered formula for infants, young children or the elderly	– Basic hygiene rules – 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.	Revision 2018
Enterohaemorrhagic *E. coli* (EHEC)	Young children, the elderly	Inadequately cooked minced beef, unpasteurised dairy products, fresh produce (lettuce, spinach; sprouted seeds) unpasteurised products of plant origin (apple juice), contaminated water	– Basic hygiene rules – Thorough washing of produce (fruits and vegetables and aromatic herbs), peeling if possible – **For children under 10 years of age and the elderly:** ○ **Cook minced meat and minced meat products thoroughly** ○ **Do not consume raw milk and cheeses made from raw milk**	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**	Revision 2018

			children and pregnant women should not eat raw or undercooked eggs	
Yersinia enterocolitica **/** ***Y. pseudotuberculosis***	*Y. enterocolitica*: children under 10 years of age *Y. pseudotuberculosis*: people over 60 years of age Subjects with iron overload, cirrhosis, diabetes and immunosuppression are predisposed to develop a severe deep-rooted form or sepsis	Pork, raw milk, fresh produce, mixed salads	– Basic hygiene rules – Cook pork thoroughly – Wash vegetables thoroughly – Infected people should avoid handling food	Revision 2018
Viruses				
Rotavirus	Children under five years of age.	Bivalve shellfish, fresh produce, water, any type of food handled ready-to eat or undercooked foods.	– Basic hygiene rules – Infected subjects should avoid handling food – Wash fresh produce thoroughly – Avoid consuming shellfish that do not come from authorised and inspected areas of production, unless they have been thoroughly cooked	April 2012
Parasites				
Cryptosporidium **spp.**	Immunocompromised people with bile duct damage Young children	Water; bivalve shellfish, fruits and vegetables (salads, carrots, radishes, etc.)	– Basic hygiene rules – Wash vegetables thoroughly, cook food if washing conditions cannot be applied due to a lack of drinking water – **Other recommendations, especially for immunocompromised people and young children, and in countries with low levels of hygiene:** do not drink untreated surface water or water from an uncontrolled well or source; avoid consumption of fresh unpasteurised fruit juice, ice whose origin or preparation methods are unsafe, or raw shellfish that do not come from authorised and inspected areas of production	Revision 2018

ANNEX 3

Table 10. Calcium-contributing foods (mg/day and %) among low (first quartile of consumption) and high (fourth quartile of consumption) calcium consumers from 12 to 35 months of age who are not breastfed

	Low calcium consumers (1st quartile)		High calcium consumers (4th quartile)	
	mg/d	%	mg/d	%
Infant formula	3.1	0.6%	0.0	0.0%
Follow-on formula	4.8	0.9%	4.0	0.4%
Infant milk drinks	13.5	2.5%	6.0	0.6%
Growing-up milk	81.2	15.4%	130.0	12.9%
Dairy desserts intended specifically for infants (e.g. yoghurt, petit-suisse, fromage blanc, etc.)	5.1	1.0%	7.5	0.7%
Other dairy desserts specifically for infants (e.g. pudding, cream-based dessert, etc.)	3.4	0.6%	5.0	0.5%
Infant cereals	3.6	0.7%	12.4	1.2%
Infant biscuits	1.4	0.3%	3.5	0.4%
Infant milk and/or vegetable soup	0.4	0.1%	1.8	0.2%
Infant vegetables alone or vegetables and/or starches	2.7	0.5%	5.8	0.6%
Infant meat only	0.0	0.0%	0.0	0.0%
Infant vegetables/meat	2.6	0.5%	2.5	0.2%
Infant vegetables/fish	0.6	0.1%	1.1	0.1%
Infant fruit desserts and fruit purées	0.8	0.2%	0.8	0.1%
Infant fruit or vegetable juices, non-dairy flavoured beverages	0.0	0.0%	0.1	0.0%
Infant vanilla or cocoa powders	0.0	0.0%	0.3	0.0%
Infant miscellaneous	0.0	0.0%	0.1	0.0%
Normal milk	91.1	17.3%	347.2	**34.5%**
Milk drinks and flavoured milks	0.1	0.0%	0.0	0.0%
Milk from other animals and plant-based drinks	0.6	0.1%	0.0	0.0%
Dairy products[20]	97.5	**18.5%**	145.8	14.5%
Other dairy desserts[20]	14.6	2.8%	21.5	2.1%
Cheeses	33.4	6.3%	100.7	10.0%
Breakfast cereals and cereal bars	12.3	2.3%	9.7	1.0%
Bread	11.0	2.1%	13.5	1.3%
Biscuits	21.1	4.0%	27.0	2.7%
Soups	11.6	2.2%	17.8	1.8%
Vegetables alone other than potatoes	18.8	3.6%	39.2	3.9%
Potatoes alone	4.5	0.8%	4.0	0.4%

[20] This product type differs from the similar product type above insofar as it is not specifically intended for infants.

	Low calcium consumers (1st quartile)		High calcium consumers (4th quartile)	
	mg/d	**%**	**mg/d**	**%**
Starches	4.2	0.8%	4.7	0.5%
Meat and ham	3.0	0.6%	4.0	0.4%
Eggs	2.2	0.4%	2.2	0.2%
Fish	2.8	0.5%	5.3	0.5%
Deli meats other than ham	1.6	0.3%	1.1	0.1%
Mixed dishes	13.9	2.6%	15.5	1.5%
Fruits	21.7	4.1%	24.1	2.4%
Fruit and vegetable juices	16.2	3.1%	12.9	1.3%
Sodas, nectars, syrups, flavoured beverages	3.1	0.6%	1.0	0.1%
Vegetable fats	0.0	0.0%	0.0	0.0%
Animal fats	0.2	0.0%	0.3	0.0%
Confectionery	4.2	0.8%	5.4	0.5%
Salt	0.0	0.0%	0.0	0.0%
Sauces	1.1	0.2%	1.6	0.2%
Drinking water	12.2	2.3%	17.8	1.8%
Chocolate powders for breakfast	1.2	0.2%	3.4	0.3%
Other	0.3	0.1%	0.3	0.0%
TOTAL	**527.6**	**100.0%**	**1006.7**	**100.0%**

Source: Nutri-Bébé Study, SFAE 2013 – processed by ANSES
Grey boxes: food groups contributing at least 5% of total intake. In bold, the principal contributing food.

Table 11. Iron-contributing foods (mg/day and %) among low (first quartile of consumption) and high (fourth quartile of consumption) iron consumers from 6 to 11 months of age who are not breastfed

	Low iron consumers (1st quartile)		High iron consumers (4th quartile)	
	mg/d	%	mg/d	%
Infant formula	0.5	9.2%	0.1	0.7%
Follow-on formula	1.5	**31.1%**	5.3	**45.2%**
Infant milk drinks	0.3	6.3%	0.4	3.5%
Growing-up milk	0.1	2.2%	1.1	9.7%
Dairy desserts intended specifically for infants (e.g. yoghurt, petit-suisse, fromage blanc, etc.)	0.1	1.1%	0.0	0.3%
Other dairy desserts specifically for infants (e.g pudding, cream-based dessert, etc.)	0.0	0.1%	0.0	0.0%
Infant cereals	0.6	12.0%	1.4	11.6%
Infant biscuits	0.0	0.8%	0.1	0.6%
Infant milk and/or vegetable soup	0.0	0.7%	0.0	0.1%
Infant vegetables alone or vegetables and/or starches	0.2	4.2%	0.2	1.9%
Infant meat only	0.0	0.1%	0.0	0.0%
Infant vegetables/meat	0.4	8.1%	0.3	2.2%
Infant vegetables/fish	0.1	2.1%	0.1	1.2%
Infant fruit desserts and fruit purées	0.2	3.2%	0.1	1.2%
Infant fruit or vegetable juices, non-dairy flavoured beverages	0.0	0.2%	0.0	0.0%
Infant vanilla or cocoa powders	0.0	0.0%	0.0	0.1%
Infant miscellaneous	0.0	0.1%	0.0	0.0%
Normal milk	0.1	1.4%	0.0	0.0%
Milk drinks and flavoured milks	0.0	0.0%	0.0	0.0%
Milk from other animals and plant-based drinks	0.0	0.0%	0.0	0.0%
Dairy products	0.1	2.2%	0.1	0.7%
Other dairy desserts	0.0	0.1%	0.1	0.6%
Cheeses	0.0	0.0%	0.0	0.1%
Breakfast cereals and cereal bars	0.0	0.9%	0.0	0.1%
Bread	0.0	0.3%	0.0	0.1%
Biscuits	0.1	2.0%	0.1	0.6%
Soups	0.1	1.0%	0.2	1.9%
Vegetables alone other than potatoes	0.2	3.4%	1.5	12.9%
Potatoes alone	0.1	1.3%	0.1	1.0%
Starches	0.0	0.3%	0.0	0.2%
Meat and ham	0.1	1.0%	0.1	0.5%
Eggs	0.0	0.0%	0.0	0.3%
Fish	0.0	0.3%	0.0	0.2%
Deli meats other than ham	0.0	0.1%	0.1	0.6%

	Low iron consumers (1st quartile)		High iron consumers (4th quartile)	
	mg/d	**%**	**mg/d**	**%**
Mixed dishes	0.0	0.4%	0.0	0.3%
Fruits	0.1	1.2%	0.1	0.6%
Fruit and vegetable juices	0.0	0.0%	0.0	0.1%
Sodas, nectars, syrups, flavoured beverages	0.0	0.0%	0.0	0.0%
Vegetable fats	0.0	0.0%	0.0	0.0%
Animal fats	0.0	0.0%	0.0	0.0%
Confectionery	0.0	0.0%	0.0	0.1%
Salt	0.0	0.0%	0.0	0.0%
Sauces	0.0	0.2%	0.0	0.0%
Drinking water	0.0	0.1%	0.0	0.0%
Chocolate powders for breakfast	0.1	2.0%	0.1	0.9%
Other	0.0	0.0%	0.0	0.0%
TOTAL	**4.9**	**100.0%**	**11.8**	**100.0%**

Source: Nutri-Bébé Study, SFAE 2013 – Processed by ANSES
Grey boxes: food groups contributing at least 5% of total intake. In bold, the principal contributing food.

Table 12. Iron-contributing foods (mg/day and %) among low (first quartile of consumption) and high (fourth quartile of consumption) iron consumers from 12 to 35 months of age who are not breastfed

	Low iron consumers (1st quartile)		High iron consumers (4th quartile)	
	mg/d	%	mg/d	%
Infant formula	0.0	0.0%	0.0	0.0%
Follow-on formula	0.0	0.0%	0.2	2.2%
Infant milk drinks	0.0	0.7%	0.4	3.6%
Growing-up milk	0.1	1.7%	4.9	**42.1%**
Dairy desserts intended specifically for infants (e.g. yoghurt, petit-suisse, fromage blanc, etc.)	0.0	0.0%	0.0	0.2%
Other dairy desserts specifically for infants (e.g pudding, cream-based dessert, etc.)	0.0	0.0%	0.0	0.0%
Infant cereals	0.1	3.9%	0.9	7.9%
Infant biscuits	0.0	0.6%	0.1	0.4%
Infant milk and/or vegetable soup	0.0	0.2%	0.0	0.2%
Infant vegetables alone or vegetables and/or starches	0.0	1.0%	0.1	1.0%
Infant meat only	0.0	0.0%	0.0	0.0%
Infant vegetables/meat	0.1	3.0%	0.2	1.5%
Infant vegetables/fish	0.0	0.6%	0.1	0.7%
Infant fruit desserts and fruit purées	0.0	0.7%	0.1	0.6%
Infant fruit or vegetable juices, non-dairy flavoured beverages	0.0	0.0%	0.0	0.0%
Infant vanilla or cocoa powders	0.0	0.3%	0.0	0.4%
Infant miscellaneous	0.0	0.0%	0.0	0.1%
Normal milk	0.2	4.6%	0.0	0.1%
Milk drinks and flavoured milks	0.0	0.0%	0.0	0.0%
Milk from other animals and plant-based drinks	0.0	0.4%	0.0	0.0%
Dairy products	0.1	3.8%	0.1	1.0%
Other dairy desserts	0.1	1.9%	0.1	1.0%
Cheeses	0.0	0.8%	0.0	0.2%
Breakfast cereals and cereal bars	0.1	3.1%	0.4	3.8%
Bread	0.1	4.0%	0.2	1.9%
Biscuits	0.4	11.2%	0.5	4.0%
Soups	0.1	3.2%	0.2	1.8%
Vegetables alone other than potatoes	0.3	8.4%	1.2	10.8%
Potatoes alone	0.1	4.2%	0.2	1.4%
Starches	0.1	2.8%	0.1	0.8%
Meat and ham	0.2	7.2%	0.4	3.3%
Eggs	0.0	1.3%	0.0	0.4%
Fish	0.0	1.4%	0.1	0.5%
Deli meats other than ham	0.1	1.7%	0.1	0.8%

	Low iron consumers (1st quartile)		High iron consumers (4th quartile)	
	mg/d	**%**	**mg/d**	**%**
Mixed dishes	0.2	5.7%	0.1	1.3%
Fruits	0.1	3.7%	0.2	1.3%
Fruit and vegetable juices	0.0	1.1%	0.0	0.2%
Sodas, nectars, syrups, flavoured beverages	0.0	0.3%	0.0	0.0%
Vegetable fats	0.0	0.0%	0.0	0.0%
Animal fats	0.0	0.0%	0.0	0.0%
Confectionery	0.1	2.8%	0.2	1.4%
Salt	0.0	0.0%	0.0	0.0%
Sauces	0.0	0.9%	0.0	0.2%
Drinking water	0.0	1.0%	0.0	0.1%
Chocolate powders for breakfast	0.4	**11.7%**	0.3	2.5%
Other	0.0	0.0%	0.0	0.1%
TOTAL	**3.4**	**100.0%**	**11.5**	**100.0%**

Source: Nutri-Bébé Study, SFAE 2013 – Processed by ANSES
Grey boxes: food groups contributing at least 5% of total intake. In bold, the principal contributing food.

Table 13. Sodium-contributing foods (mg/day and %) among low (first quartile of consumption) and high (fourth quartile of consumption) sodium consumers from 12 to 35 months of age who are not breastfed

	Low sodium consumers (1st quartile)		High sodium consumers (4th quartile)	
	mg/d	%	mg/d	%
Infant formula	0.7	0.1%	0.5	0.0%
Follow-on formula	6.1	1.0%	0.0	0.0%
Infant milk drinks	6.4	1.1%	5.4	0.3%
Growing-up milk	73.5	12.2%	27.8	1.7%
Dairy desserts intended specifically for infants (e.g. yoghurt, petit-suisse, fromage blanc, etc.)	5.7	0.9%	0.8	0.0%
Other dairy desserts specifically for infants (e.g pudding, cream-based dessert, etc.)	3.6	0.6%	0.5	0.0%
Infant cereals	1.5	0.3%	0.5	0.0%
Infant biscuits	0.9	0.1%	0.3	0.0%
Infant milk and/or vegetable soup	6.9	1.1%	1.9	0.1%
Infant vegetables alone or vegetables and/or starches	17.3	2.9%	3.1	0.2%
Infant meat only	0.0	0.0%	0.0	0.0%
Infant vegetables/meat	37.9	6.3%	12.3	0.7%
Infant vegetables/fish	13.0	2.2%	3.5	0.2%
Infant fruit desserts and fruit purées	1.0	0.2%	0.2	0.0%
Infant fruit or vegetable juices, non-dairy flavoured beverages	0.0	0.0%	0.0	0.0%
Infant vanilla or cocoa powders	0.4	0.1%	0.2	0.0%
Infant miscellaneous	2.7	0.4%	0.5	0.0%
Normal milk	59.8	9.9%	86.1	5.2%
Milk drinks and flavoured milks	0.0	0.0%	0.0	0.0%
Milk from other animals and plant-based drinks	0.8	0.1%	0.0	0.0%
Dairy products	34.1	5.6%	42.0	2.5%
Other dairy desserts	4.7	0.8%	14.6	0.9%
Cheeses	34.2	5.7%	102.2	6.2%
Breakfast cereals and cereal bars	5.3	0.9%	29.2	1.8%
Bread	24.1	4.0%	82.3	5.0%
Biscuits	35.5	5.9%	136.4	8.2%
Soups	12.0	2.0%	70.8	4.3%
Vegetables alone other than potatoes	50.6	8.4%	98.0	5.9%
Potatoes alone	11.6	1.9%	35.2	2.1%
Starches	19.2	3.2%	50.1	3.0%
Meat and ham	44.0	7.3%	134.5	8.1%
Eggs	3.2	0.5%	3.4	0.2%
Fish	11.2	1.8%	48.8	2.9%

	Low sodium consumers (1st quartile)		High sodium consumers (4th quartile)	
	mg/d	**%**	**mg/d**	**%**
Deli meats other than ham	16.2	2.7%	84.4	5.1%
Mixed dishes	27.0	4.5%	227.1	**13.7%**
Fruits	5.1	0.8%	6.3	0.4%
Fruit and vegetable juices	0.3	0.1%	0.8	0.0%
Sodas, nectars, syrups, flavoured beverages	0.5	0.1%	1.5	0.1%
Vegetable fats	0.1	0.0%	0.3	0.0%
Animal fats	0.8	0.1%	2.1	0.1%
Confectionery	0.7	0.1%	4.0	0.2%
Salt	17.8	2.9%	198.4	11.9%
Sauces	4.6	0.8%	135.7	8.2%
Drinking water	2.6	0.4%	6.1	0.4%
Chocolate powders for breakfast	0.7	0.1%	2.8	0.2%
Other	0.1	0.0%	0.3	0.0%
TOTAL	**604.6**	**100.0%**	**1660.7**	**100.0%**

Source: Nutri-Bébé Study, SFAE 2013 – Processed by ANSES
Grey boxes: food groups contributing at least 5% of total intake. In bold, the principal contributing food.