For the most valuable in life.

Scientific dossier

Nutrient supply during toddlerhood

An overview of studies on the benefits of growing-up milk in improving nutrient supply for young children

Information for health care professionals

Contents

1. Toddler's diets and nutrient supply

A toddler's diet has a long-term effect on their health. It has been established that the "First 1,000 Days", beginning at conception and lasting until the child reaches their second birthday, are a particularly important time. In addition to their diet, various environmental factors during this time have a direct influence on a child's growth, on the development of their brain, digestive system, metabolism and immune system and on their eating habits and taste preferences.

Getting sufficient nutrients is extremely important for a toddler's healthy development and wellbeing, and it can also reduce the risk of disease later in life and of becoming overweight.

1.1 Current nutritional recommendations for toddler

The German recommendations for young children's nutrition are based on the preventive "optimised mixed diet" approach developed by the Research Institute of Child Nutrition (FKE, Forschungsinstitut für Kinderernährung) and on the reference values published by the German Nutrition Society (DGE, Deutsche Gesellschaft für Ernährung) for Germany, Austria and Switzerland. In addition, the first unified recommendations for young children's diet and exercise were published in 2013.[1]

From the age of 1, young children can and should eat at the same times as the rest of their family. A varied and balanced diet will meet their nutritional needs and include:

Ample amounts of
- liquids – ideally water or other unsweetened or sugar-free drinks
- plant-based foods such as vegetables, cereals, potatoes and fruit

Moderate amounts of
- animal-based foods such as milk and dairy products, meat, fish and eggs

Small amounts of
- sweets
- salty food and snacks
- fats with high amounts of saturated fatty acids

This weighting of food is illustrated by the nutrition pyramid (**Figure 1**).

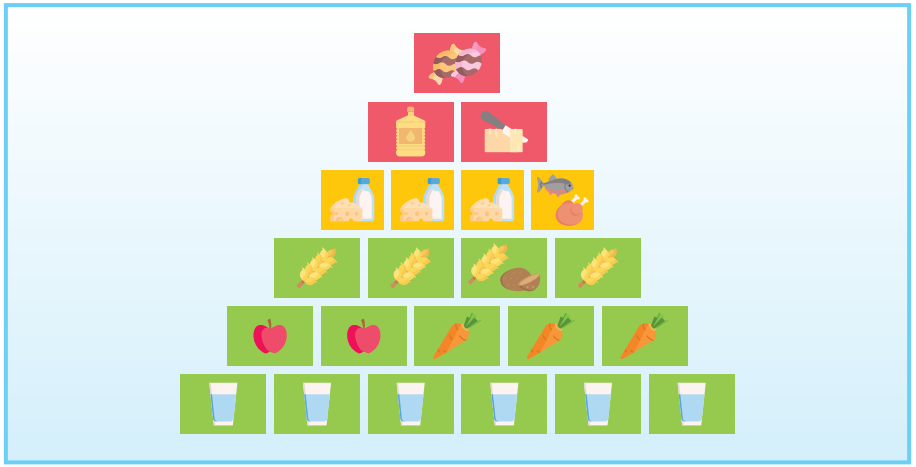

Fig. 1: Nutrition pyramid[2]

1.2 What do toddler currently eat?

As with older children and adults, nutrition recommendations for toddler are often not followed in everyday life.[3, 4] In recent years there have been a number of studies investigating the extent to which young children's actual diets compare with the nutritional recommendations. The most notable studies include:

- The **GRETA study (German Representative Study of Toddler Alimentation)** is a prospective cohort study which collected representative data on diets and nutritional intake of young children throughout Germany. Between 2008 and 2010, scientists at the Research Institute of Child Nutrition (FKE, Forschungsinstitut für Kinderernährung) used 7-day reported estimates to record quantities and nutrients consumed in 525 households with children aged between 10 and 36 months, taking into account parameters such as age, sex and social class.

- The **DONALD (Dortmund Nutritional and Anthropometric Longitudinally Designed) study** is a long-term investigation into the effects of diet on humans. Over 1,500 people have so far taken part in this open cohort study, which involves regularly collecting data from subjects (ranging from infants to adults) on eating patterns, growth, development, metabolism and health, in order to form an overall picture of the influence of diet on human health throughout childhood and into adulthood.[5]

- The **VELS (Verzehrsstudie zur Ermittlung der Lebensmittelaufnahme von Säuglingen und Kleinkindern**, engl. consumption study to determine the food intake of infants and young children), conducted by the German Federal Institute for Risk Assessment (BfR, Bundesinstitut für Risikobewertung) between June 2001 and September 2002, involved scientists collecting data from 816 infants and young children aged between 6 months and 5 years from all over Germany by asking their parents to record the food their child ate over six days. The aim of the study was to establish as accurately as possible the type and quantity of food and drinks consumed by infants and young children in Germany.[6]

The results of these studies showed that young children's eating patterns and nutrition, as is also the case for adults, largely **do not** follow the recommendations. The following are some of the poor nutritional habits which become established during early childhood and continue throughout the rest of childhood and adolescence.

Too few plant-based foods
Toddler do not eat enough vegetables, fruit or plant-based foods rich in carbohydrates such as rice, pasta, potatoes and bread. Plant-based carbohydrates supply vitamins, minerals, important trace elements and fibres, while fruit and vegetables are an important source of phytochemicals.

Children under 2 eat the recommended amount of fruit (120 g a day) on average, but hardly any children above the age of 1 get the recommended amount of vegetables (also 120 g a day). As they grow older, the gap between the recommended amounts and the amounts they actually consume grows: the average 4-year-old only gets between 60 g and 75 g of vegetables a day rather than the recommended 200 g, while the consumption of vegetables across all age groups is more than 50 % lower in practice than the recommendations (**Fig. 2**).
Possible consequences: *micronutrient and fibre deficiency*

Too much sugar
Even at an early age, children eat too many sweets. Parents often give them sugar and sweets before they turn 1, and they eat 40 g a day on average by the age of 4.

As part of the DONALD study, between 1985 and 2016, the sugar consumption of 1,312 children and adolescents between the ages of 3 and 18 was investigated, and one of the focuses was on the amount of free sugars and total sugars in the participants' diets. The results showed a slight drop in the amount of free sugars between 2005 and 2016, although they still represented over 16 % of the subjects' daily energy intake on average (it is recommended that they should make up less than 10 % of daily energy intake).[7]
Possible consequences: *caries, development of sweet tooth, becoming overweight, diabetes*

Too much salt

Children, adolescents and adults in Germany all eat too much salt (sodium chloride). The VELS study showed that the average sodium intake in children aged between 6 months and 5 years was around three times higher than the reference values published by the German Nutrition Society (DGE, Deutsche Gesellschaft für Ernährung).[8]

Possible consequences: *high blood pressure, cardiovascular diseases*

Too many protein-rich foods

Young children eat more protein-rich foods, such as fish, sausages and cheese, than recommended.[4]

Possible consequences: *increased risk of becoming overweight and obese later in life* [9, 10]

Too many unhealthy fats

Children tend to eat unhealthy amounts of fats: even toddler consume too many saturated fatty acids and not enough polyunsaturated fatty acids. This is a result of eating food with a higher fat content such as meat, sausages, cheese and sweets, as well as the hidden fats contained in ready meals, for example.[4]

Possible consequences: *increased LDL cholesterol, which increases the risk of cardiovascular disease later in life*[11]

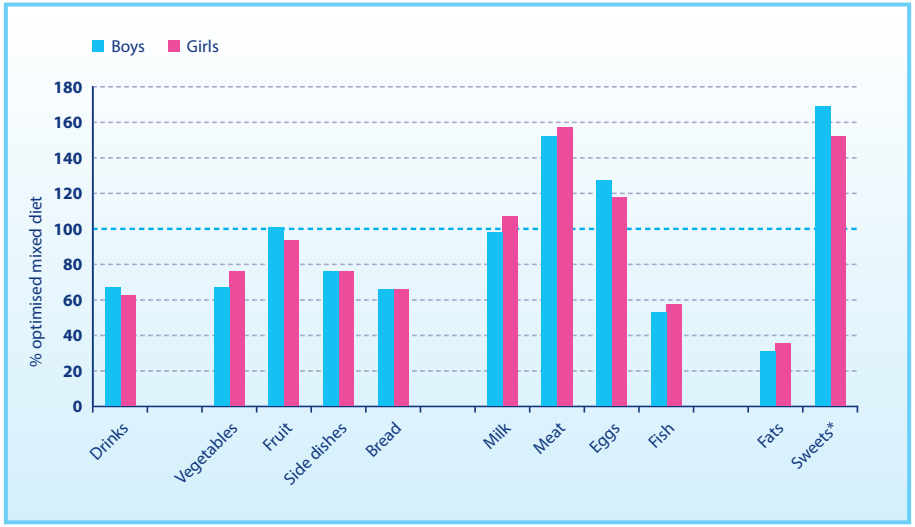

Fig. 2: Percentages of food groups consumed by subjects in the GRETA study compared to the recommended amounts for an optimised mixed diet (chart shows the average amounts consumed by boys and girls aged 1 to 3 years); *There is no recommended amount of sweets that should be consumed, so the percentage of energy intake is used (recommended: ≤7E%)[4]

1.3 How well are toddler supplied with nutrients?

An unbalanced diet can lead to deficiencies in certain nutrients (**Figure 3**). The European Food Safety Authority (EFSA) considers that most infants and young children in Europe get a good supply of nutrients, although the amounts of some nutrients supplied by their diet are below the recommendations. These include alpha-linolenic acid (ALA), docosahexaenoic acid (DHA), iron, vitamin D and iodine (in some European countries), and it is particularly important to ensure young children get enough of these micronutrients.[12]

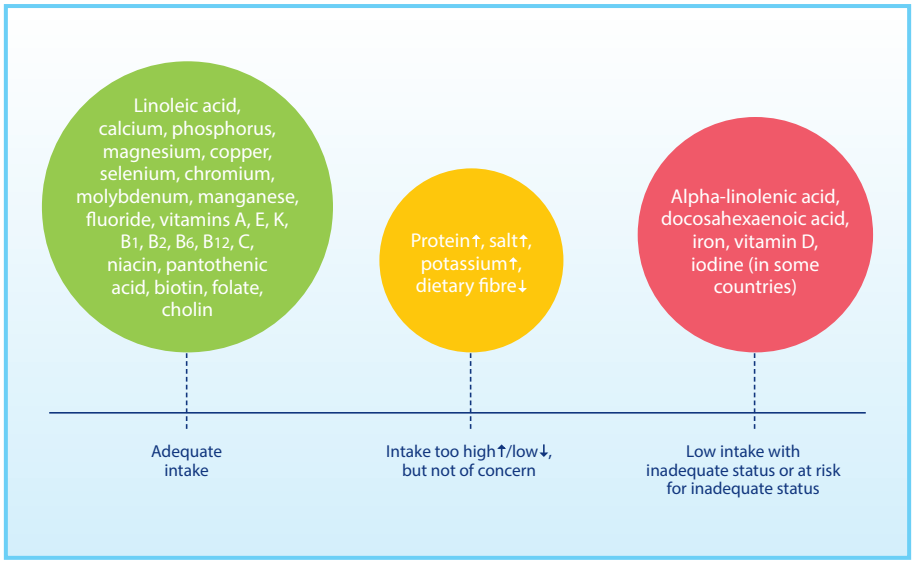

Fig. 3: Suboptimal nutrition for Europe's young children[12]

Malnutrition is a major issue around the world, particularly in less developed countries, but critical nutrients such as iron, iodine, folic acid, vitamins A, B12, D and zinc are also particularly important here.[13]

In some cases, however, children get excessive amounts of certain nutrients, primarily protein, saturated fatty acids and sodium. The following is a short overview of the most important critical nutrients.

1.4 Critical nutrients in toddler's diets

Protein
Many children get far too much protein in their diet. Protein intake is two to three times higher than the recommended amount.[9, 10]

Fatty acids
Like older children and adults, toddler eat too many saturated fatty acids and too few polyunsaturated fatty acids.[11]

Carbohydrates and sugar
Consumption of free sugars (16.3 %) is clearly higher than the recommendations (less than 10 % of daily energy intake).[7]

Iron
The DONALD study found that children aged between 1 and 3 years got less iron from their diet than recommended. A recent systematic review investigating the levels of iron in young children (aged between 12 and 36 months) across Europe found that their iron intake was nearly at the recommended levels, though there was a high degree of fluctuation in cases of insufficient iron intake: from 10 % in the Netherlands to 50 % in Austria, Finland and the UK.[12, 14, 15]

Iodine
The World Health Organization (WHO) defines an iodine concentration in urine of at least 100 µg/l as an indicator of sufficient iodine in a person's diet, and a large percentage of Germany's young children do not have this concentration. In the German Health Interview and Examination Survey for Children and Adolescents (KiGGS), 49 % of children up to the age of 2 had an iodine concentration in their urine of less than 100 µg/l, while 24 % had a concentration of less than 50 µg/l.[16] A smaller study in terms of participating young children in Dortmund confirmed that boys' average iodine concentration in urine was just 71 µg/l, while the concentration for girls was even lower at 65 µg/l.[17]

Folate
Data from the DONALD study showed that 50 % of 1 to 3-year-olds consumed less folate than recommended.[12, 15]

Vitamin D
The KiGGS study found that children up to the age of 2 frequently had an insufficient 25-hydroxyvitamin D (25-OH-Vitamin-D) serum concentration of less than 50 nmol/l (31.2 % of boys and 36.4 % of girls from non-migrant backgrounds, 40.5 % of boys and 45.5 % of girls from migrant backgrounds).[18]

The risk of insufficient vitamin D supply is particularly high for toddler, as they need around seven times more vitamin D per kilogram of body weight than adults.[19]

Vitamin D is responsible for a variety of important bodily processes (**Figure 4**). It influences bone metabolism, and more and more studies are demonstrating that it may also have preventive effects. Chronic vitamin D deficiency has been linked to increased risk of cancer, type I and II diabetes and other diseases, which means that the low levels of vitamin D consumed by young children in Germany are a cause for concern which urgently needs to be addressed.

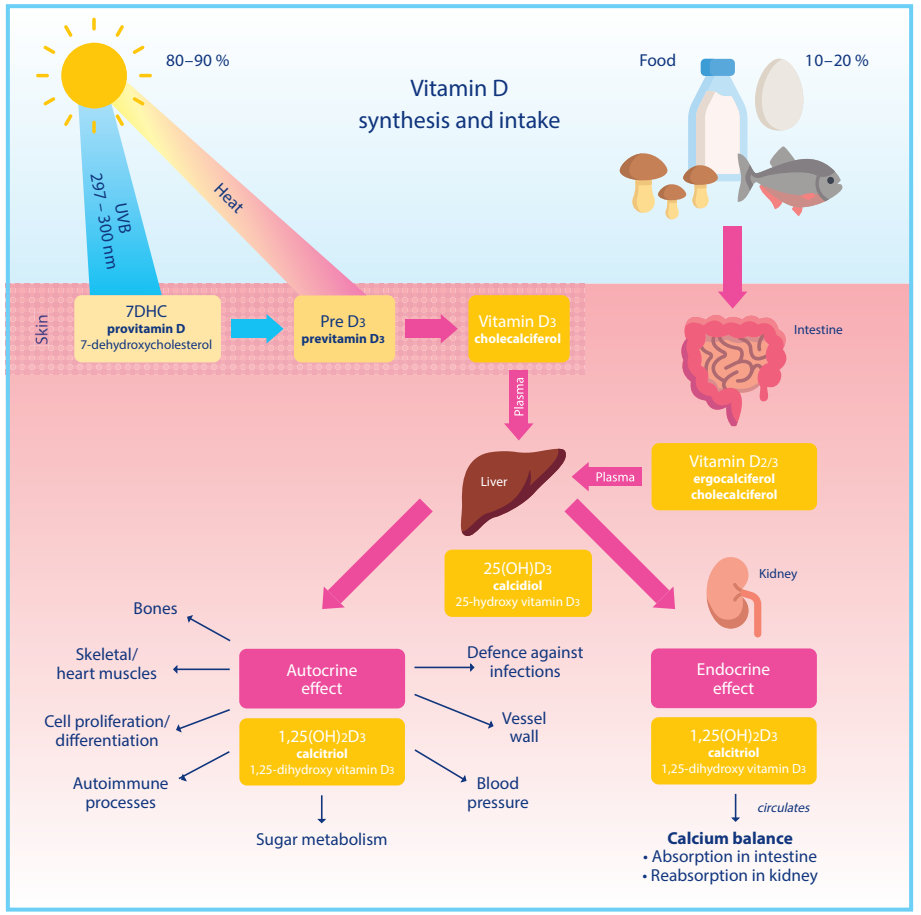

Fig. 4: How vitamin D is synthesised, metabolised and used in the human body[20]

Global epidemiological studies have shown that vitamin D concentrations of at least 20 ng/ml (equivalent to 50 nmol/l), as recommended by national and international paediatric organisations, are often not achieved in practice.

In 2012, the German Nutrition Society (DGE, Deutsche Gesellschaft für Ernährung) increased its recommendations for vitamin D from 5 µg (200 IU) to 20 µg (800 IU) a day. A six-year study (from January 2009 to December 2014) of children and adolescents investigated how much these recommendations improved the previously insufficient intake of vitamin D. **KIDS 4.0**, conducted in the German city of Mülheim an der Ruhr, studied 1,909 healthy children and adolescents between the ages of 1 and 17 and found that the median 25(OH)D serum concentration in the periods between 2009 and 2012 and between 2013 and 2014 (before and after the vitamin D recommendations were increased) showed no significant differences (17.0 vs. 16.8 ng/ml, **Figure 5**). The authors conclude that the increased recommendations for Germany, Austria and Switzerland had no influence on the vitamin D intake of children and adolescents. The prevalence of vitamin D deficiency remained unchanged when compared with previous studies.[21]

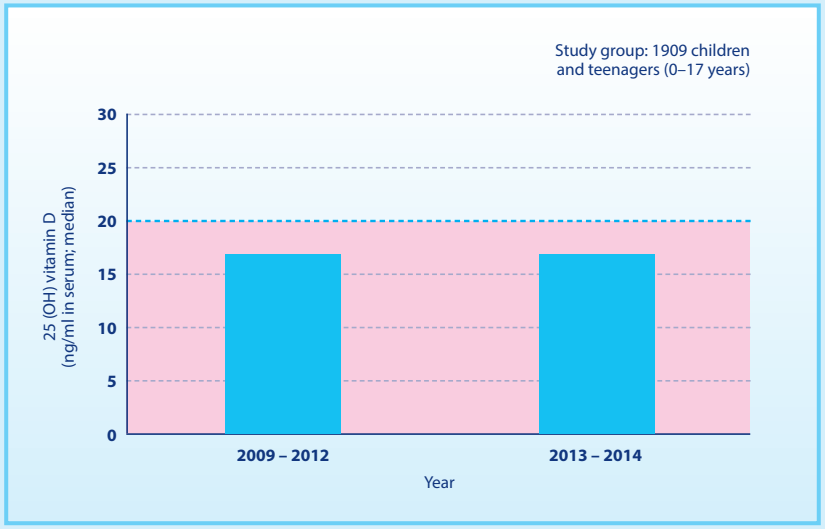

Fig. 5: Increasing vitamin D intake recommendations had no effect on children.[21]

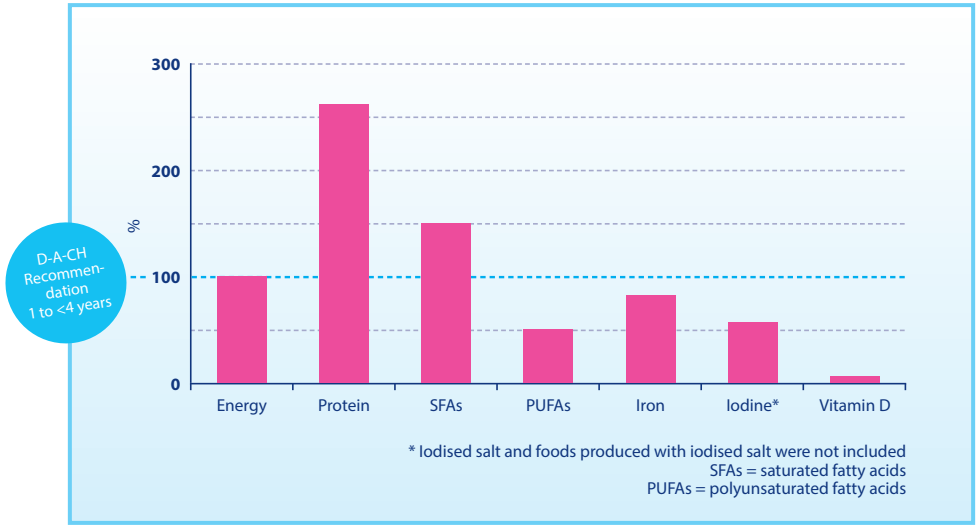

Fig. 6: Energy and nutrient supply for young children compared to the reference values for Germany, Austria and Switzerland (D-A-CH).[11]

Conclusion

Various scientific studies show that young children are not supplied with all the micronutrients and macronutrients they need (**Figure 6**). On the one hand, their intake of vitamin D, iodine, folic acid, certain fatty acids and iron is too low.

On the other hand, young children frequently consume significantly more protein, sugar and salt than recommended. Growing-up milk, developed in accordance with recommendations from medical societies, may help young children to get these important nutrients.

2. Scientific evaluation of growing-up milk

Growing-up milk was developed in response to this imbalanced nutritional intake of young children. It is specially formulated to meet young children's needs, containing large amounts of nutrients which they often do not get in sufficient quantities from their diet. Growing-up milk can be described as a "nutrient-optimised" form of cow's milk, as it replicates low-fat cow's milk in terms of the nutrients it contains.

A number of studies on humans have investigated the extent to which growing-up milk compensates for the nutrient deficiencies described above.

Data on the consumption of growing-up milk and its role in nutrition for children between the ages of 1 and 3 is limited, but the studies that have been conducted show that consuming growing-up milk has a positive influence on young children's nutrient supply.

2.1 Can growing-up milk improve the supply of critical nutrients?

The table below gives an overview of growing-up milk studies and the observed improvement in nutrient intake and supply.

Tab 1: Overview of growing-up milk studies

	Vitamin D	Iron	Vitamin C	Zinc	Protein	Alpha-linolenic-acid	Essential fatty acids	Vitamin A	Vitamin E	B vitamins
Akkermans et al. 2017 [24]	×	×								
Chouraquai et al. 2019 [27]	×		×				×	×	×	×
Hower et al. 2013 [22]	×									
Ghisolfi et al. 2013 [25]	×	×	×			×				
Lovell et al. 2019 [26]	×	×	×	×	×					
Walton and Flynn 2013 [23]	×	×								

Supply status using blood levels Calculated nutrient supply

2.2 Overview of studies on the effects of growing-up milk

These products are usually referred to as growing-up milk (GUM). However, the term "young child formula" (YCF) is also used by some studies and organisations. The terms are interchangeable.

Influence on the supply of micronutrients and macronutrients

A prospective, randomised, double-blind, controlled intervention study tested whether growing-up milk with high vitamin D content contributes to improved vitamin D supply in the winter months, and whether enriching growing-up milk with vitamin D can be regarded as safe the whole year round. Over a period of 10 months, children were given either a growing-up milk enriched with vitamin D (2.85 µg per 100 ml = 115 IU) or semi-skimmed cow's milk with a natural vitamin D content (0.03 µg per 100 ml). The vitamin D supply at the start of the study was more or less the same in both groups (21.5 vs. 18.4 ng/ml 25(OH)D in serum). **By the end of the five-month winter period, the children in the growing-up milk group had been supplied with significantly more vitamin D. Their vitamin D levels were in the ideal range (24.8 ng/ml 25(OH)D). In contrast, the levels in the children from the control group were in the subclinical deficiency range (13.6 ng/ml 25(OH)D, Figure 7).** During the summer, when we produce more of our own vitamin D in our skin, the 25(OH)D serum concentration in the growing-up milk group increased only marginally to 27.6 ng/ml, which means that growing-up milk does not lead to an excessive

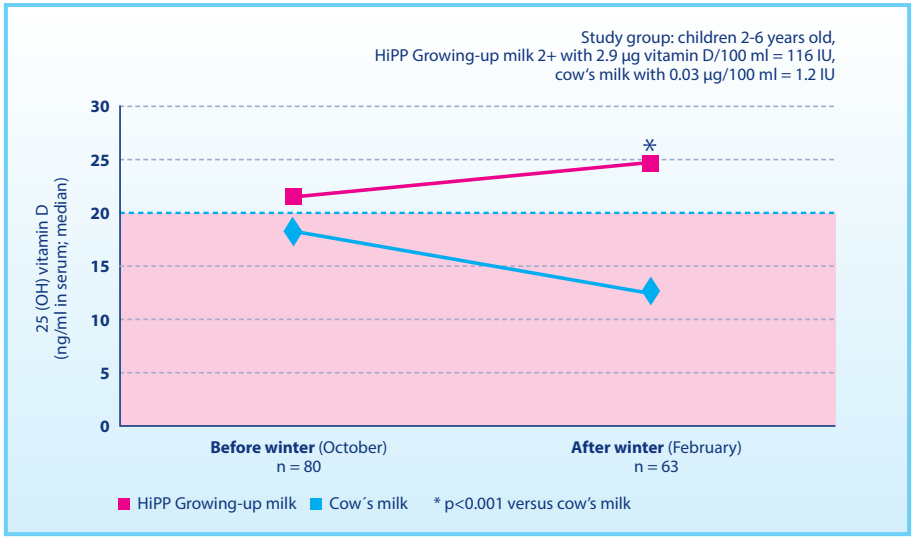

Fig. 7: Vitamin D supply when consuming growing-up milk vs. cow's milk

supply of vitamin D in summer. This first prospective, double-blind intervention study with growing-up milk in Europe showed that consuming growing-up milk with approx. 2.9 µg per 100 ml of vitamin D instead of low-fat cow's milk is a simple and safe way to prevent the drop in 25(OH)D serum concentration during the winter without increasing the 25(OH)D serum concentration to excessively high levels during the summer.[22]

A cross-sectional study of Irish toddler between the ages of 1 and 2 investigated how consuming at least 300 g of cow's milk or growing-up milk affected daily energy intake. The children were divided into two groups: the cow's milk group (n = 56) were given only cow's milk, and the growing-up milk group (n = 29) were given a combination of cow's milk and at least 100 g growing-up milk every day. The energy intake in both groups was similar. In the growing-up milk group, the supply of protein, saturated fatty acids and vitamin B_{12} was lower than in the cow's milk group. **In contrast, the children in the growing-up milk group had a higher intake of carbohydrates, fibres, iron, zinc, vitamin C and vitamin D. Most of the children who were only given cow's milk did not get sufficient amounts of iron and vitamin D. Few of the children in the growing-up milk group experienced this problem, Figure 8).** The authors conclude that consuming growing-up milk can reduce the risk of iron and vitamin D deficiencies, which often occur when consuming cow's milk.[23]

Fig. 8: Effect of milk consumption on energy and nutrient intake of young children in Ireland[23]

In a randomised, double-blind, controlled study, 318 healthy children between the ages of 1 and 3 were given either growing-up milk (1.2 mg Fe per 100 ml; 1.7 µg vitamin D per 100 ml) or non-enriched cow's milk (0.02 mg Fe per 100 ml; no vitamin D) over a period of 20 weeks. Blood samples were taken before and after the intervention, with changes in serum ferritin and in the 25(OH) vitamin D concentration established as primary and secondary outcomes. A serum ferritin level below 12 mg/l indicated iron deficiency, and 25(OH)D levels below 50 nmol/l indicated a vitamin D deficiency. The concentrations of serum ferritin and 25(OH)D in the growing-up milk group were 6.6 µg/l and 16.4 nmol/l higher respectively than in the cow's milk group **(Figure 9)**. **The probability of iron and vitamin D deficiency after the intervention was lower in the growing-up milk group than in the cow's milk group.** The authors conclude that a growing-up milk enriched with micronutrients can improve children's iron and vitamin D status.[24]

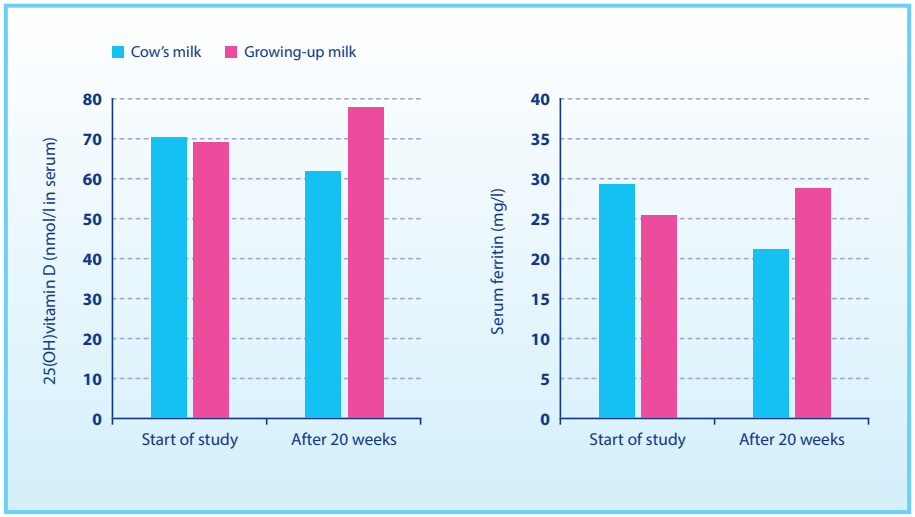

Fig. 9: Vitamin D and serum ferritin status when consuming growing-up milk vs. cow's milk[24]

To investigate adequate nutrient supply on the basis of different milks (cow's milk or growing-up milk) in early childhood, a French cross-sectional study divided children between the ages of 1 and 2 into two groups: the cow's milk group (n = 63) were given at least 250 ml cow's milk a day, and the growing-up milk group (n = 55) were given the same amount of growing-up milk.

The energy and macronutrient supply were similar in the two groups, but the protein supply was both significantly higher in the cow's milk group than in the growing-up milk group and higher than the recommended daily allowances (RDA). A high percentage of children in the cow's milk group consumed smaller amounts of linoleic acid (51%) and alpha-linolenic acid (84%) – considerably less than an adequate supply. The intake of iron (59%), vitamin C (49%) and vitamin D through their diet (100%) was less than they needed. In the opinion of the authors, foods other than milk and dairy products could not have been responsible for these differences. **Consuming cow's milk (≥ 250 ml/d) increased the risk of deficiency of alpha-linolenic acid, iron, vitamin C and vitamin D, while consuming growing-up milk (≥ 250 ml/d) significantly reduced the risk of deficiency of these nutrients.**[25]

A double-blind, randomised, controlled study called GUMLi (Growing-Up Milk „Lite") investigated the eating patterns and nutrient supply of 160 healthy 1-year-old young children in New Zealand and Australia. The food consumed by the children was investigated using a validated diet questionnaire before the study began and 3, 6 and 9 months afterwards. During the 12-month study period, the scientists examined the effect of growing-up milk compared to cow's milk on nutrient supply. The growing-up milk group had a lower protein and vitamin B_{12} intake, but their iron, vitamin D, vitamin C and zinc intake was higher. **Although consuming growing-up milk did not influence eating patterns, the children in the growing-up milk group had a lower protein intake and a higher iron, zinc, vitamin E and vitamin C intake at the age of 2.**[26]

The cross-sectional Nutri-Bébé study in 2013 used a 3-day diet record to investigate the diet and nutrient supply of 241 children who drank growing-up milk, and 206 children who did not drink growing-up milk but drank cow's milk or consumed other dairy products instead. Even though the protein and sodium intake in the growing-up milk group was lower than in the group that did not drink growing-up milk, these values were still above the quantities recommended by the EFSA. **In all age groups, the children in the growing-up milk group were significantly better supplied with essential fatty acids, vitamins C, A, D and E and all B vitamins. This also applied to iron intake, which was significantly higher in the growing-up milk group than in the group which were not given any growing-up milk (Figure 10).** The intake of DHA and ARA was similar. To reach the quantities recommended by the EFSA, at least 360 ml growing-up milk was required. The authors conclude that growing-up milk can help children get their recommended amounts of nutrients. However, the quantities of protein, sodium and vitamin A were above the EFSA recommendations, and the quantities of DHA, ARA and vitamin D were below them (**Figure 11 and 12**).[27]

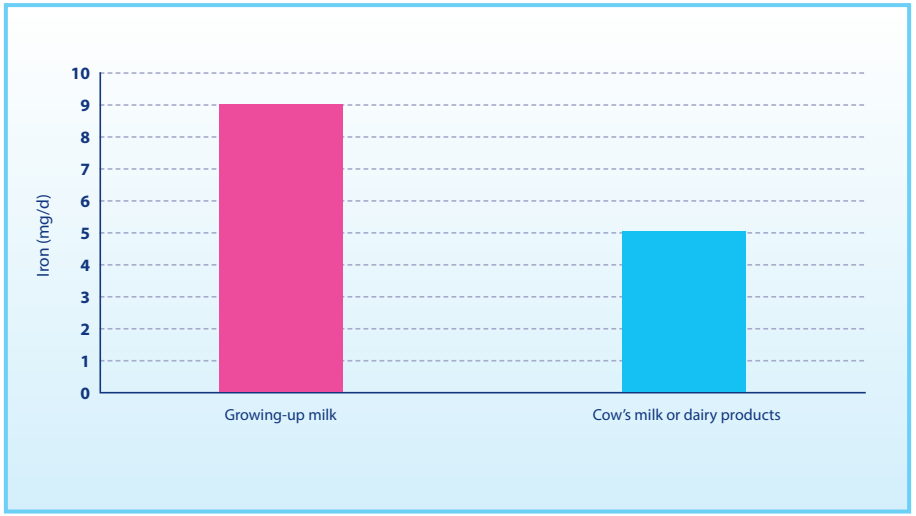

Fig. 10: Iron intake when consuming growing-up milk vs. cow's milk or dairy products[27]

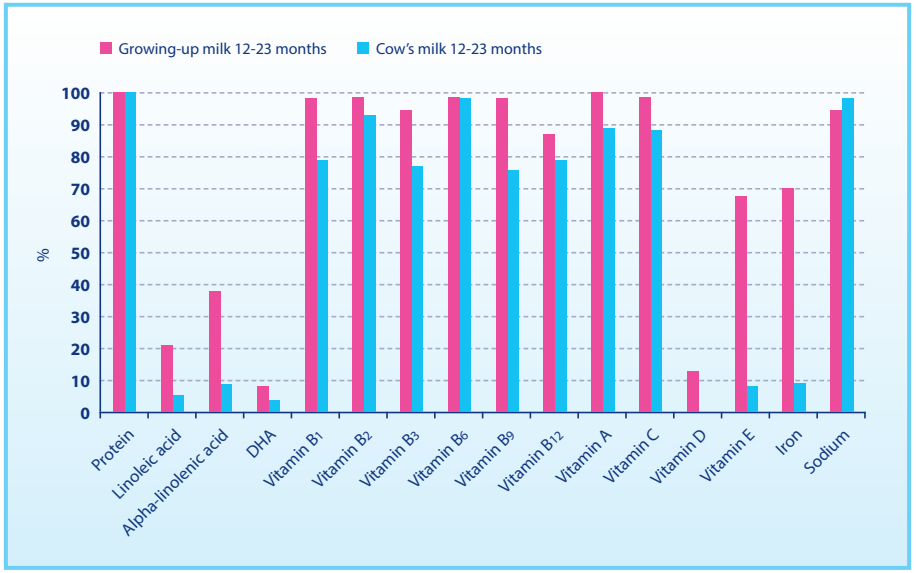

Fig. 11: Adherence to EFSA recommendations when consuming growing-up milk vs. cow's milk or dairy products at the age 12–23 months[27]

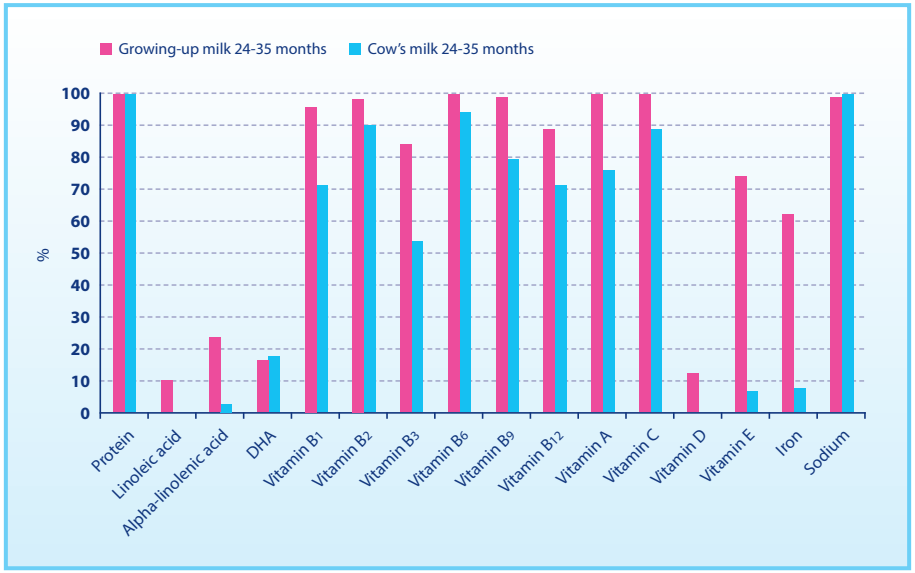

Fig. 12: Adherence to EFSA recommendations when consuming growing-up milk vs. cow's milk or dairy products at the age 24–35 months[27]

Using data from the 2008 GRETA study young children's intake of energy and 18 nutrients was investigated and evaluated on the basis of the Nutrient Quality Index (NQI). The evaluation included 525 diet records and questionnaires for children aged between 10 and 36 months (254 girls, 271 boys). For all age groups, the calculated energy intake was close to the reference value for meeting energy needs when engaged in a moderate amount of physical activity. With the exception of iron, iodine and vitamin D, the average intake of most vitamins and minerals was in line with the age-specific reference values. **However, using milk formula (infant formula, follow-on formula, growing-up milk) had positive effects: children who were given milk formula had a significantly higher NQI than children who were not given these products.** The authors believe that the positive influence of milk formula on NQI can be explained by the various ways in which these products are enriched, but also that, in the light of the good overall nutrient supply, this enrichment could be restricted to a few critical nutrients.[28]

Analyses of the 2012 Chinese Maternal and Infant Nutrition and Growth Study (MING, n = 910) also support the results of improved supply of children between 12 and 36 months of age with growing-up milk consumption, as described above.

Investigated minerals and vitamins such as vitamin A, B_6, B_{12}, C, D, E, thiamine, riboflavin, folic acid, calcium, iron, zinc and potassium showed higher intakes with growing-up milk. In addition, the intake of saturated fatty acids was lower among consumers of growing-up milk, despite a comparable total fat intake, although the authors assume a better fatty acid profile.[29]

These observations are also supported by a study from the Philippines, in which growing-up milk consumers aged 1 to 4 years were more likely to achieve an adequate supply of iron, zinc, thiamine, niacin, folate, vitamin B_6, B_{12}, C, D compared with other milk consumers.[30]

Other positive effects of growing-up milk

Three studies have also investigated other aspects in addition to the effects of growing-up milk on nutrient supply.

Effects on body composition

The GUMLi study conducted in Australia and New Zealand compared the effect of cow's milk and growing-up milk on **body composition** in 2-year-old children over the course of a year. 134 healthy 1-year-olds (67 per arm) were given either cow's milk or growing-up milk for 12 months, and the primary outcome was body fat percentage at the age of 2 (measured using bioelectrical impedance analysis). After the 12-month intervention, the difference (% body fat) between the growing-up milk group and the cow's milk group was -2.19% ($p = 0.036$). At the age of 24 months, both the fat mass and the fat mass index were significantly lower in the growing-up milk group than in the cow's milk group. **The conclusions were that the 2-year-old children who had been given growing-up milk with a lower protein content for 12 months had a lower percentage of body fat.**[31]

Effects on the immune system

A randomised, double-blind, controlled intervention study conducted in several countries investigated how much growing-up milk supplemented with prebiotics and omega-3 fatty acids (LCPs) can influence the **incidence of infections** in healthy children. Over 52 weeks, 767 healthy children aged between 11 and 29 months were divided randomly into three different groups (group 1: GUM with prebiotics/LCPs, n = 388; group 2: GUM without prebiotics/LCPs, n = 379; group 3: cow's milk, n = 37). The primary outcome was the number of infections of the upper respiratory tract or intestinal tract, as reported by the children's parents. The children in group 1 had a lower risk of developing at least one infection than the children in group 2 (299/388 vs. 313/379, $p = 0.03$), while the children in the cow's milk group developed infections more frequently than the children in the two growing-up milk groups (34/37 vs. 612/767). **This study was the first evidence that growing-up milk enriched with prebiotics and LCPs can reduce the risk of infections.**[32]

In Vietnam, scientists conducted a randomised, double-blind, placebo-controlled clinical multicentre study on the effect of growing-up milk with synbiotics on the **immune systems** of young children aged 18 to 36 months. The children were given either growing-up milk or an appropriate control formula for 5 months. The concentrations of immunoglobulin A and growth parameters including body height and weight improved significantly in the test group. Compared to the control group, the test group were less likely to suffer from vitamin A deficiency and experienced fewer health problems (respiratory tract infections and gastrointestinal problems). **The evidence suggests that growing-up milk with synbiotics supports children's immune systems and promotes healthy growth.**[33]

Are there any health disadvantages related to functional ingredients?
It seems obvious that it is a good idea to enrich young child formula with additional functional ingredients that are already used in formulae. But do these ingredients have any health benefits? One study investigated the effect of young child formulae (YCF) with different compositions on the frequency of upper respiratory tract infections and the duration of gastrointestinal tract infections. The functional ingredients investigated were bioactive proteins (immunoglobulins, lactoferrin, TGF-β), the human milk oligosaccharide 2'-fucosyllactose (HMO 2'-FL) and milk fat.[34]

Conducted in Hong Kong, this randomised, double-blind, controlled parallel group study involved selecting 461 healthy children between 1 and 2.5 years old and dividing them randomly into the following groups:

1. YCF-Ref: young child formula without functional ingredients (control group)
2. YCF-A: young child formula enriched with immunoglobulins, lactoferrin, TGF-β, 2'-FL (in the same quantities as found in breast milk) and milk fat
3. YCF-B: young child formula with lower quantities of bioactive proteins than in YCF-A
4. YCF-C: young child formula containing 2'-FL in the same quantity as in YCF-A

None of the enriched young child formulae were significantly different from the "control formula" in terms of the target parameters. Interestingly, consuming YCF-C (with HMO 2'-FL) even led to **longer duration of respiratory problems,** and the group given YCF-A also developed **more gastrointestinal infections.**

In summary, this study provides evidence that young child formulae with different combinations of bioactive proteins, 2'-FL and milk fat have no additional health benefits. On the contrary, they lead to longer duration of respiratory problems and to more gastrointestinal infections. The authors conclude from the results that the extent to which a child's diet supports their immune system decreases as they grow older.

Conclusion

Multiple scientific studies have concluded that consuming growing-up milk can improve nutrition for toddler. This applies in particular to the supply of vitamins E, C and D, omega-3 fatty acids, iron, iodine and zinc. However, the effects on health-relevant parameters have not been investigated or proven to the same extent. According to current scientific knowledge, not only do functional ingredients such as HMOs, bioactive proteins and milk fat have no additional positive health effects, they also lead to longer or more frequent infections.

3. Recommendations for composition and claims about the use of growing-up milk

3.1 National recommendations

In 2017, the German Society of Paediatrics and Adolescent Medicine (DGKJ, Deutsche Gesellschaft für Kinder- und Jugendmedizin) nutrition commission gave detailed recommendations for the composition of growing-up milk for young children (**Table 2**).[35] These values are based on the international recommendations[13], which are explained in more detail in the following section.
The nutrition commission regards growing-up milk as one of various options which can help improve nutrition for young children. These products should not be used as their sole or main source of food, but can be offered in addition to balanced meals and instead of conventional animal milk. They should be drunk from cups or beakers, rather than from a feeding bottle, in order to encourage age-appropriate drinking habits. Around 300 ml/day (1 to 2 cups), or around 15 % of total energy intake, is considered an appropriate amount.[35]

3.2 International recommendations

An international group of experts has recommended that growing-up milk should be offered together with age-appropriate food and drink and that it should make up approximately 15 % of a child's total energy intake (200 to 400 ml). The protein content should be between 1.6 and 2.7 g per 100 kcal, and the fat content should be between 4.4 and 6.0 g per 100 kcal. There should be between 9 and 14 g carbohydrates per 100 kcal, and at least 50 % of the carbohydrates should come from lactose. If other sugars are added, they should not exceed 10 % of the total amount of carbohydrates. The quantity of calcium should be 200 mg per 100 kcal, and other micronutrients should be 15 % of the amounts recommended by WHO per 100 kcal[13]

The recommendations published in the USA in 2016 for the composition of growing-up milk are similar in many respects, but different in others: the recommended daily amount of growing-up milk is 200 ml, with an energy content of between 60 and 75 kcal per 100 ml of prepared milk. The protein content should be 10 to 15 % of the milk (2.5 to 3.75 g per 100 kcal), carbohydrates 45 to 65 % (11.3 to 16.3 g per 100 kcal; added sugars < 10 %), fats 30 to 40 % (3.3 to 4.4 g per 100 kcal), saturated fatty acids < 8 %, PUFAs < 10 %.[38]

Tab. 2: Guide values for the composition of growing-up milk drinks based on cow's milk protein[35]

Nutritional information	Minimum	Maximum	Upper guide value
Energy (kcal/100 ml)	45	70	–
Protein (g/100 kcal)	1,6	2,7	–
Fat (g/100 kcal)	–	6	–
Linoleic acid (mg/100 kcal)	500	–	–
Alpha-linolenic acid (mg/100 kcal)	50	–	–
Docosahexaenoic acid (mg/100 kcal)	(Ideal value: 15)	–	–
Trans-fatty acids (% of fat content)	–	2	–
Digestible carbohydrates (g/100 kcal)	–	10	–
– of which lactose ≥ 80 %	–	–	–
Vitamin A (µg retinol equivalent/100 kcal)	60	–	180
Vitamin D (µg/100 kcal)	1,5	–	4,5
Vitamin B_{12} (µg/100 kcal)	0,15	–	0,75
Folic acid (µg/100 kcal)	20	–	100
Vitamin C (mg/100 kcal)	4,5	–	22,5
Iron (mg/100 kcal)	1	–	3
Calcium (mg/100 kcal)	185	–	not specified
Sodium (mg/100 kcal)	–	–	75
Iodine (µg/100 kcal)	12	–	36
Zinc (mg/100 kcal)	0,6	–	1,8

3.3 Claims about the use of growing-up milk

The European Society for Paediatric Gastroenterology, Hepatology, and Nutrition (ESPGHAN) has recently announced its position on this subject. Although the experts do not regard using growing-up milk as necessary, it can form part of a strategy to increase the intake of iron, vitamin D and omega-3 fatty acids and to reduce the intake of protein.[36]

A Belgian consensus position paper in 2014 concluded that growing-up milk is not required for balanced nutrition. However, many families' eating habits do not follow the recommendations that toddler aged between 1 and 3 should drink 350 to 500 ml of milk a day in addition to 4 solid meals. A growing-up milk with a good composition (no sweeteners or flavourings and a balance of nutrients) can help parents with the difficult task of giving their children a balanced, nutritious diet.[37]

The EFSA position, published in 2013, is that growing-up milk is an option for improving the intake of critical nutrients for children, such as iron, iodine, vitamin D and omega-3 fatty acids (DHA and ALA). Children's intake of these nutrients is suboptimal in certain countries, and it is important to ensure that these critical nutrients are supplied in sufficient amounts.[12]

Growing-up milk is not necessary for a balanced diet. However, growing-up milk with a suitable composition can help compensate for potential deficiencies in a child's diet while they are transitioning to eating the same food as the rest of their family. The more unhealthy their family's diet, the more valuable growing-up milk becomes.[39]

Both national and international institutes regard growing-up milk as an option to compensate for potential nutrient deficiencies in young children. Growing-up milk can play a particularly important role in ensuring balanced nutrition for children in families which do not follow the dietary recommendations when feeding their children.

4. Summary

Toddler's diets do not follow the recommendations. Their intake of protein, saturated fatty acids, sugar and salt is too high, and their intake of micronutrients such as vitamin D, iron, folic acid, iodine and polyunsaturated fatty acids is too low.

Using growing-up milk has been proven to improve the nutrient supply of young children, as it contains:

- a suitable protein content for young children
- omega-3 fatty acids (polyunsaturated fatty acids)
- specially adapted amounts of critical nutrients such as vitamin D, iron, iodine and folic acid

Although growing-up milk is not necessary as part of a toddler's diet, it can be useful as it can be integrated into their daily diet without having to change their eating patterns. The composition of growing-up milk should conform to the latest recommendations from the experts.

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Abbrevations

2'FL	2'-Fucosyllactose
ALA	Alpha-linolenic acid
BfR	German Federal Institute for Risk Assessment (Bundesinstitut für Risikobewertung)
DGE	German nutrition society (Deutsche Gesellschaft für Ernährung)
DGKJ	German society of paediatrics and adolescent medicine (Deutsche Gesellschaft für Kinder- und Jugendmedizin)
DHA	Docosahexaenoic acid
DONALD study	Dortmund nutritional and anthropometric longitudinally designed
EFSA	European Food Safety Authority
ESPGHAN	European society for paediatric gastroenterology, hepatology, and nutrition
FKE	Research institute of child nutrition (Forschungsinstitut für Kinderernährung)
GRETA study	German representative study of toddler alimentation
GUM	Growing-up milk
GUMLi	Growing-up milk "lite"
KiGGS	German health interview and examination survey for children and adolescents
LCP	Long chain polyunsaturated fatty acids
LDL	Low-density lipoproteins
MING	Maternal and infant nutrition and growth study
NQI	Nutrient quality index
VELS	Consumption study to determine the food intake of infants and young children (Verzehrsstudie zur Ermittlung der Lebensmittelaufnahme von Säuglingen und Kleinkindern)
WHO	World health organization
YCF	Young child formula

Notes

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