

A Belgian consensus-statement on growing-up milks for children 12–36 months old

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Abstract Growing-up milks (GUM) are milk-based drinks with low protein and added minerals and vitamins intended for children 12–36 months. Since the advantages of GUM are heavily debated, we reviewed the literature. A literature search was done using the classic databases (Pubmed, Embase, Cochrane) on the use of GUM in 12- to 36-month-old young children. Only limited data are available. GUM have a highly variable composition as their marketing is not regulated. Nevertheless, all papers conclude that GUM help to cover nutritional requirements of 12- to 36-month-old infants. *Conclusion:* Appropriate intakes of macro- and micronutrients in 1- to 3-year-old children have long-term health benefits. Present diets offered to toddlers do in general not meet the requirements. Supplemented foods are therefore helpful, of which GUM is a possibility.

Keywords Growing-up milks (GUM) · European Food Safety Authority · Toddlers · Population Reference Intake

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Abbreviations

EFSA	European Food Safety Authority
ESPGHAN	European Society of Paediatric Gastroenterology, Hepatology and Nutrition
GUM	Growing-up milk
NPNS	National Pre-school Nutrition Survey
PRI	Population Reference Intake
RDA	Recommended Daily Intake
WHO	World Health Organisation

Introduction

The regulatory status of growing-up milk (GUM) is currently under review in the European Union in the context of the proposed revision of Directive 2009/39/EC of the European Parliament and of the Council of 6 May 2009 on Foodstuffs intended for Particular Nutritional Uses (PARTNUTS). The

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European Commission has recently requested the European Food Safety Authority (EFSA) to provide advice on the need for such milks for young children and their nutritional composition [12]. The EFSA launched in October 2013 an official Scientific Opinion on the feeding of 1- to 3-year-old children under the heading “Growing-up formula: no additional value to a balanced diet, says EFSA.”

Nutritional requirements of toddlers between 1 and 3 years have been reviewed by the World Health Organisation (WHO) underlining that this period of life requires a specific protein/energy ratio differing from that of newborns and infants [13]. The question is whether the nutritional needs of 1- to 3-year-old children can easily be covered by a balanced diet consisting of natural unmodified and unfortified foods such as unmodified milk or not. There is abundant scientific evidence that cow’s milk is an important nutrient for children 1–3 years old, for example because of its high calcium content. Compared to adults, toddlers do have specific and high needs of intake per kg body weight or per kcal energy intake of specific nutrients such as iron, vitamin D.

The EFSA statement [12]

The EFSA statement contains a somehow ambiguous message. This is what EFSA put on its webpage: “The use of milk-based ‘growing-up’ formula does not bring additional value to a balanced diet in meeting the nutritional requirements of young children in the European Union. EFSA’s scientific experts could identify ‘no unique role’ for young-child formula (commonly called ‘growing-up formula’) in the diet of young children (those aged 1–3), concluding that it is no more effective in providing nutrients than other foods that constitute the normal diet of young children.”

However, in the same document, it is said that “Intakes of protein, salt, potassium and dietary fibre are not at levels that are cause for concern, but the generally high energy intakes may contribute to unfavourable increases in body weight. They also concluded that intakes of a range of micronutrients, including calcium, magnesium and vitamin C, were likely to be high enough to reach dietary requirements. However, consumption of omega-3 fatty acids, iron, vitamin D and iodine (in some European countries) among infants and young children is low. The Panel notes that particular attention should be paid to ensure the appropriate supply of omega-3 fatty acids, iron, vitamin D and iodine to infants and young children who either have or are at risk of having inadequate status in these nutrients.”

Methods

The databases Medline, Cochrane, and Embase were searched for keywords “growing up milk”, “toddler”, “nutrition”, “dietary intake” for publications between 1990 and 2014.

Dietary intake in 1- to 3-year-old children

At present, European member states have different recommendations for dietary intake in young children. Most countries recommend adequate intakes, but do not always mention minimal and upper levels. These recommended intakes should be harmonized over Europe.

EFSA mentions that the dietary intake in many 1- to 3-year-old children of vitamin D, iron, omega-3 fatty acids and iodine is below the requirements, and “that particular attention should be paid to ensure the appropriate supply” of these nutrients [11]. According to EFSA, the Population Reference Intake (PRI) for protein is 1.14 g/kg/day at the age of 1 year, 0.97 at 2 years and 0.90 at the age of 3 years [10]. These data refer to a minimal safe protein intake covering the needs of infants and toddlers. If expressed as protein in relation to energy, it means that at the age of 1 year, protein accounts minimally for around 5 % of total energy and 3.5–5 % at 2 and 3 years [9]. According to EFSA, there are insufficient data to establish a “tolerable upper intake level” for protein. Intakes up to twice the PRI are regularly consumed from a mixed diet and are considered safe. The “safe” upper limit proposed by Agostoni et al. [1,2] and which was confirmed by the European Society of Paediatric Gastroenterology, Hepatology and Nutrition (ESPGHAN) regards a total protein intake of “not more than 15 % of the energy.”

Data from Huybrechts showed that the mean protein intake in toddlers in the Flanders is greater than 16 % of energy intake (in 2007), which is higher than in other European countries [21]. In 2012, the dietary intake of 500 Belgian children 0–3 years old was recorded using a 3-day prospective diary and a face to face meeting with a researcher [7]. These data can be considered as representative for Belgium as the selection considered confounding variables such as, north (Flemish) and south (French speaking), occupation and socio-economic background of the mother, gender, day of the week for diary completion and age (ten groups of approximately 50 children per 3-months age category). A similar registration of dietary intake was performed 4 years earlier, with comparable results [8]. According to the 2012 questionnaire, 32.8 % of the children had a protein intake above 15 % of total energy (with a mean (SD) intake of 13.96 % (3.1 %) and a median of 13.64 % for the total population). Protein intake was at 200 % to 300 % of the recommended daily allowance (RDA) [7].

Recent French data confirm these observations: the protein intake in children drinking more than 250 ml cow's milk per day is much higher than the estimated average requirement, and significantly higher than in the group fed GUM [14].

It is well known that, in comparison to adults, toddlers have high needs (per kg body weight and/or per kcal energy intake) for specific nutrients such as iron and vitamin D. While recommended intake values are variable depending on the information source, vitamin D recommendations are less variable. The 2012 questionnaire data showed that the median vitamin D intake in Belgian toddlers was less than half the RDA (which is 400 IU/day in Belgium) and that after the age of 6 months only 10 % of the children was given vitamin D supplements [7]. An intake below 50 % of the RDA for vitamin D can be considered as an important nutritional shortcoming.

Still according to the 2012 Belgian data, median omega-3 and omega-6 intakes were 50 % lower than the RDA in children under 1 year old and 20–40 % below the RDA for 1 year olds [36]. Iron intake was at the minimal level of the RDA according to Belgian norms (3.9 mg/day in 12- to 36-month-old children) [7], which are lower than those of other European countries. Iodine intake was not analyzed in this study. The mean intake of Vitamin B12 in the Belgian data was estimated at 3.6 µg/day in GUM consumers, which is still well above the PRI of 0.9 µg/day [32]. In summary, according to these Belgian data, 1- to 3-year-old children have a high protein intake, a low iron intake and an insufficient vitamin D intake.

According to the French data, the intake of linoleic acid, alpha-linolenic acid, iron, vitamin C and D is less than the estimated average requirement [14].

In Ireland, nationally representative data on food consumption in young children are available from the National Pre-school Nutrition Survey (NPNS) which was carried out in 2010–2011 [20,39]. Children consuming GUM had a lower intake of protein, saturated fat and vitamin B12 than non-consumers, while the intake of carbohydrate, fibre, iron, zinc, vitamins C and D were higher in GUM consumers [25]. Walton et al. confirms the Belgian findings regarding vitamin B12 since the intake in non-GUM consumers was estimated at 5.4 µg/day and in GUM consumers also 3.6 µg/day [40].

A Dutch multicenter, observational study in 400 healthy children ages 0.5 to 3 years showed an iron deficiency (ferritin <12 µg/l) and iron deficient anaemia (also haemoglobin <110 g/l) in 18.8 % and 8.5 %, respectively [38]. The present use of formula and the visit of preschool/day care were associated with a lower prevalence of iron deficiency, and a high intake of cow's milk was associated with a higher prevalence of iron deficiency, after adjustment for age [38].

Flemish preschoolers have too low vitamin D intakes while most have adequate calcium intakes [22]. Milk (including sweetened, fortified/growth milk) was the main food source

of calcium and the second most important source of vitamin D after butter and margarine. Calcium intake was positively associated with parental education, while vitamin D intake was not [22]. Regarding iron and Vitamin D, serum parameters confirm the insufficient intake [16,18,30].

Thus, although the data on dietary intake in 1- to 3-year-old children are limited, they all lead to the same conclusion: dietary intakes in 1- to 3-year-old children do not cover dietary micronutrient requirements, and the protein intake is high.

Consequences of an unbalanced diet in 1- to 3-year-old children

There is some scientific evidence that a high protein intake during the first 2 years of life predisposes to overweight, obesity and hypertension later in life [16,22,27,34]. The ages of 12 months and 5–6 years were identified as critical ages on the basis of the results of life-course plots. At these ages, higher total and animal, but not vegetable, protein intakes were positively related to later body fatness [17]. Multiple logistic analysis in one study confirmed that protein intake at 1 year of age was associated with overweight at 5 years [35]. The study by Koletzko and coworkers [26] evaluated very high vs. high protein uptake up to the age of 1 year. A lower protein content in infant formula reduces the body mass index (BMI) and obesity risk at school age [41]. Between the age of 12 months and 5 years, there are no data on protein intake and long term consequence of weight. However, since there are several studies suggesting that high protein intake up to 1 year of age is a risk factor for later overweight, and since at least one study suggests that this is also valid at the age of 5–6 years, it is logic to extrapolate these findings for the age between 1 and 5 years, until data have contradicted that this extrapolation is erroneous. There is clear evidence as well that a too low vitamin D intake is a risk factor for many pathologic conditions such as rickets, myopathy, hyperparathyroidism, inadequate immune response, while iron deficiency causes anaemia and developmental delay.

A Belgian consensus

We agree with the statement of EFSA that “Fortified formulae, including young-child formula, are one way to increase such intakes. However, there are other efficient alternatives, such as fortified cow's milk, fortified cereals and cereal-based foods, supplements or the early introduction of meat and fish into complementary feeding and the continued regular consumption of these foods.”

It is indeed very likely that a dietician can come up with several proposals of dietary intake for 1- to 3-year-old children with “normal food” that could fulfil the requirements. In those

cases, GUM are not mandatory to cover all nutritional requirements of toddlers.

However, there are a lot of “buts” to this viewpoint. Accumulated data on dietary intake demonstrate very clearly that 1- to 3-year-old children do not eat in a uniform way and do not have a balanced diet. Large scale information campaigns should make parents aware of this problem and offer solutions. In order to feed young children a balanced dietary intake, family education and changing of the life style of many families will be necessary. Thus, although it is true that a completely balanced diet with natural food can cover dietary requirements of children between 1 and 3 years of age, this is probably not a realistic assumption in many families. Weaning style impacts on food preferences and health in early childhood [37]. Preliminary data suggest that infants weaned through a baby-led approach learn to regulate their food intake in a manner which leads to a lower BMI and a preference for healthy foods [37]. An increased incidence of different food preferences in a spoon-fed group was noticed [37].

Whether a healthy, balanced diet would be significantly more expensive than the food that is given today to young children is not known. Some data suggest that healthy eating may be an economic burden [29]. Vitamin D serostatus was inversely associated with the development of adiposity in school-age children [15]. However, the daily consumption of 500 ml of GUM will have an extra financial burden of about €180/year. Dietary adaptations, in order to correct some of the observed deficits, might result in imbalances. By giving extra meat, for instance, to increase iron intake, or extra fish to increase omega-3 intake, the protein intake which is already high will increase further (Table 1).

Let us therefore discuss the other end of the spectrum. Each of the deficient nutrients can be given as a food supplement in drops or a liquid form that has to be taken every day. This recommendation could result in the fact that many children continue to have an excessive dietary protein intake and that only the deficits are compensated. However, the 2012 Ipsos data show that only 10 % of the infants above 6 months do take vitamin D, suggesting a low compliance. In France, only 66.6 % of the prescriptions in children between 0 and 18 months of age and 41.5 % in children between 19 months and 5 years of age comply with the recommendations; 53.4 % of the prescriptions in the latter age group are below the current recommendations [28]. New Zealand findings indicate that habitual consumption of vitamin D-fortified milk providing a mean intake of nearly 4 µg/day was effective in achieving adequate year-round serum 25(OH)D for most children [19]. Vitamin D fortification with GUM prevents a decrease of 25-hydroxy vitamin D concentration during winter [20]. Also, it is very likely that this will be relatively expensive. Administration of food supplements can cause excessive intake [5].

Another option is to administer the extra requirements of vitamin D, iron, omega-3 fatty acids and iodine in food that is

daily consumed, such as cereals. However, fortified cereals do not decrease the high protein intake. Moreover, many cereals do have a high sodium content (150 mg sodium in 30 g cornflakes, what is approximately 30 % of the RDA), are sweetened and have added taste improvers such as chocolate. In other words, extra cereals would result in an excessive sodium and carbohydrate (and thus calories) intake.

Finally, there is the possibility to adapt the composition of milk, since 300–500 ml of daily milk intake is recommended in this age group. Iron status is better in toddlers receiving iron-fortified milk compared to unmodified milk [6]. In infants, a lower intake of iron and thus more anaemia was related to a poor psychomotor development [42]. In a Belgian cohort, the proportion of consumed GUM correlated significantly with the average daily amount of iron intake ($p:0.53$) [24]. Median iron intake was significantly higher in the GUM group [24]. However, there are no data that correlate a lower iron intake in toddlers to (poor) psychomotor development. Essential fatty acids consumed via the diet contribute to the development of cognitive functions [3]. Günther et al. showed that a consistent high protein intake (14–15 energy % vs. 11–12 energy %) at the ages of 12 and 18–24 months was independently related to a more than 2-fold risk of increased BMI and percentage of body fat at 7 years [18]. According to the 2012 IPSOS data on 500 Belgian toddlers, 34.20 % had a protein intake above 15 % of the energy intake (mean: 17.39 %; median 16.67 %). However, since total energy intake was 16 % above the RDI, the protein intake expressed as such is underestimated. The main sources of protein intake in these Belgian toddlers were: milk (24.3 % of all protein), meat (22.3 % of all protein) and cheese and milk products (9.0 % of all protein) in 1- to 2-year-old children and meat (26.8 % of all protein), milk (21.8 % of all protein) and cheese and milk products (8.1 % of all protein) in 2- to 3-year-old children [23]. Milk was the major protein source for 44.8 % of all 1- to 2-year-olds and for 35.5 % of all 2- to 3-year-olds. The mean protein intake was between 200 % and 300 % of the national RDI: 3.5 (1.0) mg/kg day in 12- to 24-month-olds, and 3.4 (0.9) mg/mg/day in 24- to 36-month-olds.

We calculated the effect of theoretically replacing “consumed milk (including follow-up formula and regular cow’s milk” by “GUM milk” (same volume; mean protein content of GUM on the Belgian market) in 1- to 3-year-old children, and came to the following observation: the percent of toddlers with a protein intake above 15 % was reduced from 33.3 % to 18.1 % in 1- to 2-year-olds and from 42.2 % to 18.7 % in 2- to 3-year-olds [7]. In the subgroup of toddlers with a protein intake above 15 % of energy, the median protein intake is 16.67 % of energy and decreases to 14.82 % by replacing “cow milk” with “GUM”. No children fell below the PRI of 5 % of total energy intake for proteins after switching to GUM. If we repeat the same exercise in only those 1- to 3-year-olds that were drinking cow’s milk, the effect of

Table 1 Composition of several milk-based foods consumed by toddlers (M. Robert. Dietetic Unit, University Children's Hospital Queen Fabiola, 2012)

	Protein (g/100 ml)	Calcium (mg/100 ml)	Phosphate (mg/100 ml)	Ca/protein (mg/g)	P/protein (mg/g)
Full-cream milk	3.4	120	92	35.5	27.1
Semi-skimmed milk	3.4	118	91	34.8	26.8
Skim milk	3.5	123	97	35.2	27.7
Full-cream yoghurt	3.9	120	92	30.0	23.6
Semi-skimmed yoghurt	3.5	114	87	32.0	24.9
Low fat yoghurt	3.4	143	109	42.0	32.1
Camembert	21.0	570	350	27.0	16.7
Edam	26.1	793	570	30.0	21.8
Soft white cheese 20 % fat	12.5	85	165	6.8	13.2
Soft white cheese 40 % fat	11.1	95	187	8.5	16.8
Soft white cheese 0 % fat	13.5	92	160	6.8	11.9
Growing up milk	1.5	91	38	60.6	25.3

switching “milk” to “GUM” in protein intake is even more pronounced: mean difference of 2.6 % of energy intake (95 % CI 2.5–3.0) in 1- to 2-year-olds and 2.3 % of energy intake (95 % CI 1.9–2.6) in 2- to 3-year-olds. In the subgroup of children who were drinking cow's milk, 44.7 % of 1- to 2-year-olds and 46.9 % of 2- to 3-year-olds had a protein intake above the upper limit. This dropped to 17.5 % and 16.8 %, respectively, after replacement of milk by GUM. According to the data from Günther et al. [18], a protein intake around 14–15 % of the energy intake will still have a 2-fold risk to develop an increased BMI.

As a consequence, a simple switch from regular milk to GUM is in many toddlers insufficient to correct an unbalanced diet.

Between 1 and 3 years of age, milk should have a reduced protein level, comparable to the protein content of infant or follow-on formulae. Moreover, cow's milk fat can be partially replaced with appropriate vegetable oils to increase the content of essential fatty acids. Long-chain poly-unsaturated fatty acids, docosahexaenoic and arachidonic acids can be added as well, whilst the content of some minerals such as calcium and phosphorus and vitamins (e.g., B2 and B12) well represented in cow milk [33], can be preserved. It has been recommended that the content of iron, iodine, zinc and the vitamins A and D should be the same in GUM as in follow-on formula [33]. However, it is likely that the content of micronutrients should be adapted to the nutritional needs of toddlers. The consumption of GUM is much lower than the consumption of follow-up formula, and toddlers have a more diversified intake of solids than 6- to 12-month-old infants. Vitamin A and zinc are provided in quite high amounts in solids. By using the same levels in GUM than in follow-up formula, there may be a risk of overconsumption. On the contrary, vitamin D is only present in very low amounts in solids. Therefore, it may even be preferable to supplement vitamin D up to the recommended

daily intake of 400 IU/day for 300 ml intake of GUM. Nutritional authorities should adopt policies aimed at improving vitamin D status using measures such as dietary recommendations, food fortification, vitamin D supplementation [4]. Ghisolfi and colleagues [14] conclude that daily intake of ≥ 250 ml GUM significantly reduces the risk for insufficient intake of alpha-linolenic acid, iron, vitamin C and D [14].

The huge differences in composition of GUM are a major weakness in the argumentation to recommend these. Since the composition of GUM is not regulated, there are GUM's on the market with a high protein content, with sweeteners, with taste modifiers, with different amounts of vitamins and iron, with and without long chain polyunsaturated fatty acids, with and without pre- and probiotics. Therefore, we recommend that the authorities develop recommendations to which a GUM should respond.

What is the downside of using GUM? The recommendation to use GUM might lead to a convenience solution for a lot of parents and might therefore deteriorate the interest in food and how it is prepared [33]. Low-income families, which have the highest risk of unbalanced diets may not have the financial possibilities to buy GUM [31]. This may result in extra burden and guilt feeling. The fact that the composition of GUM is not regulated results in having “more expensive” and “cheaper” GUM on the market. However, the “cheaper” ones do often have a higher protein content, sweeteners, taste modifiers, etc., and can therefore not be recommended. First, the cost of regular cow's milk varies. Supermarket chains do offer cheaper options than “well-known” brand names, resulting in a difference in cost of almost 50 %. In Belgium, house-brand milk costs about €0.33/500 ml while a well known company is sold at €0.46/500 ml (difference 40 %). The same GUM is not sold everywhere for the same cost, also with substantial differences. We do have examples of €0.77 or €1.00/500 ml (difference 33 %). Overall, globalising, one

could say that a “good GUM” cost twice as much as regular milk, with a difference of most of the time slightly below €0.5/day (for 500 ml/day, while the recommendation is between 300 and 500 ml/day). There may be a small saving caused by using GUM because of the higher vitamin D content. Daily supplementation with vitamin D costs only around €0.1/day. On the other hand, fresh fruits and vegetables, depending on season and provenance, have a variable cost and are sometimes expensive. Therefore, an in-depth financial discussion is out of place here.

Because of the lack of good data, the answer to the question to recommend the use of GUM or not is both a philosophic and scientific discussion.

1. GUM is not necessary; a balanced diet in young children can be achieved without GUM.
2. The composition of GUM is not regulated. Therefore, there are “good” and “bad” GUMs on the market? Since in general the “good” GUM is more expensive than the “bad” GUM, low income families may rather buy “cheap” GUM than “good” GUM. The difference in cost between a “good” GUM and regular milk is about €160/year. In that case, the GUM is in fact very expensive, since it is more expensive than regular milk and does not bring an added nutritional value. There are no data to prove or to contradict this hypothesis.
3. The use of GUM may result in a decreased interest of parents in healthy food. There are no data to prove or to contradict this hypothesis.
4. There are no data to suggest that GUM may cause adverse effects.
5. The evidence of benefit of GUM depends on the age of the child: the older the child, the lower the evidence. There is more evidence of benefit before the age of 2 years than between the age of 2 and 3 years. It is also obvious that a switch from regular milk to GUM should be considered as part of a more global approach.

Conclusion

Based on the available evidence, GUM is not required in a balanced diet of young children [32]. However, it is obvious that modern dietary habits in most families do not correspond with the recommended dietary intakes. Energy and especially protein intake in Belgian toddlers is very high, while the median intake of vitamin D, fibre and fatty acids is too low [7]. Preventive intervention campaigns should focus on alerting and informing parents about the long term consequences [33]. Therefore, the authors recommend that 1- to 3-year-old healthy children should be fed solids for their four main meals (breakfast, lunch, four o'clock snack and dinner).

In addition, toddlers should drink 300–500 ml milk or milk-based products per day, but not more. A good (no sweeteners, no taste improvers), nutritionally well balanced GUM makes it easier to fulfil dietary requirements since it reduces protein intake and increases iron, zinc and vitamin D. In order to guarantee this, authorities need to develop measures regulating the composition of GUM.

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