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## Nutrition in Toddlerhood: Challenges and Opportunities

Toddler Development
**Maureen Black (USA)**

Nutritional Landscape and Dietary Patterns in Toddlers
**Alison L. Eldridge and Elizabeth A. Offord (Switzerland)**

Vitamin D in Toddlers
**Mairead Kiely (Ireland)**

Milk as a Carrier of Fortification
**Peter S.W. Davies (Australia)**

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# Toddler Development

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**Key Messages**

- The range of skills that toddlers master from 1 to 3 years of age, including walking, talking, self-feeding the family diet, sleeping through the night, bowel and bladder control, and emotional regulation, presents both joy and challenges to parents
- Neophobia (i.e., hesitancy to try new foods) and pickiness (i.e., food selectiveness) are common examples of toddlers' drive for autonomy and are, in most cases, transitional
- Effective parents of toddlers provide age-appropriate settings and opportunities for their toddler, read their toddler's cues, and respond in a manner that is prompt, appropriate, and nurturant, although not necessarily conciliatory

Toddlerhood, the period from 12 to 36 months (ages 1–3 years), represents striking changes in children's development. Along with mastery of skills such as walking, talking, self-feeding the family diet, sleeping through the night, and bowel and bladder control, toddlers strive for autonomy as they learn to regulate their emotions. Professional organizations, including the Center for Disease Control and Prevention [1], American Academy of Pediatrics [2], United States Department of Agriculture [3], and Canadian Society for Exercise Physiology [4] provide guidelines for many aspects of toddler development.

Toddlers' motor development proceeds from the wide-based unsteady gait of an infant to a heel-toe steady stride and then to running, kicking, climbing, and jumping. Toddlers gain their motor skills through play, and most love to run and play outdoors. Playgrounds provide opportunities for toddlers to have fun while gaining skills. Canada has national guidelines for daily movement among toddlers, including ≥3 hours of physical activity (including ≥1 hour/day of energetic physical activity for toddlers >2 years) [4].

Screen time (television, movies, tablets, phones, etc.) has increased substantially among toddlers, especially older toddlers and those from low-income and ethnic minority families [5], and it is of concern because it often cuts into physical activity time. Guidelines are no screen time for young toddlers (<2 years) and ≤1 hour for toddlers >2 years of age [2, 4].

Sleep patterns consolidate during toddlerhood as toddlers sleep through the night with a mid-day nap and shift from cribs to beds. The American Academy of Pediatrics recommends that toddlers receive 11–14 h of sleep daily with bedtime before 9:00 PM [2]. Toddlers who receive less than the recommended amount of sleep are at increased risk for excess weight gain, emotional dysregulation, impaired growth, injuries, and lower academic achievement [6]. In addition, shortened nighttime sleep increases the likelihood of next-day sedentary behavior [7]. With the exception of sleeping, toddlers should not be sedentary or inactive for more than 1 h at a time [4].

Learning occurs through play as toddlers explore by touching and trying to figure out how things work. Toddlers' cognitive skills increase from piling blocks to building structures. By age 2, toddlers can solve simple puzzles, such as putting a round piece in a round hole. Parents can promote

toddlers' learning by playing with them and providing basic play materials, including homemade and common household items. Make-believe play is an important part of toddlers' development: they imitate what they see, such as pretending to cook or eat. Toddlers' language skills progress from single-word approximations to two- and three-word phrases. By age 3, most toddlers can speak in short sentences clearly enough for non-family members to understand them. Parents can promote their children's language and cognitive skills by reading with them daily, beginning with simple picture books. Engaging toddlers by having them point to pictures in books and talk about stories lets them be active participants and learn to love reading.

As toddlers transition to the family diet, they learn to self-feed, first with fingers and then with utensils. Self-feeding is often messy, but it helps toddlers regulate their intake and develop a sense of independence. Neophobia (i.e., hesitancy to try new foods) and pickiness (i.e., food selectiveness) are common examples of toddlers' drive for autonomy and are, in most cases, transitional. Children's willingness to eat is facilitated by daily routines, including predictable times for meals, naps, play, and bedtime, along with responsive feeding. Responsive feeding includes parents' serving and eating healthy food and snacks, recognizing and responding to toddlers' signals of hunger and satiety, avoiding pressuring toddlers, and involving toddlers in food preparation.

Toddlerhood is a transitional period for both children and parents. Toddlerhood can be both joyful and challenging as children acquire new skills and assert their independence through their propensity to say "No" and "I do it myself." Effective parents provide age-appropriate settings and opportunities for their toddler, read their toddler's cues, and respond in a manner that is prompt, appropriate, and nurturant, although not necessarily conciliatory. Responsive parenting ensures that toddlers receive the guidance and nurturant care that they need to develop their physical and emotional well-being.

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# Nutritional Landscape and Dietary Patterns in Toddlers

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**Key Messages**

- Dietary fiber, vitamin D, and potassium are generally below recommendations in the diets of young children across different countries
- Other nutrient gaps are country-specific, depending on food availability and local dietary habits
- Dietary intake data are needed to identify appropriate foods and beverages to provide the necessary nutrients

Toddlers and young children should be able to get all the nutrients they need from an adequate and diverse diet. Unfortunately, this is not the case in many countries around the world. Even in countries with an adequate food supply, young children need a variety of nutrient-dense foods and beverages to get the nutrients they need [1].

How do we assess nutrient adequacy in young children? Organizations like the World Health Organization and the World Bank focus primarily on iron, zinc, vitamin A, and iodine in children <5 years of age [2, 3]. While these nutrients are critically important for child development, growth, and health, the deficiency data do not give us a view on the full complement of nutrients available in the diet. Detailed dietary intake data are required to provide a more robust picture of overall food consumption, nutrient intakes, and dietary patterns, and complement these biological endpoints when looking for nutrient gaps or excesses.

Where do comprehensive dietary intake data come from? Many countries conduct national nutrition and health surveys, so they can monitor dietary intakes, nutritional issues, food security, and child growth. Nestlé Research contributes to the body of knowledge on child diet through studies like the Feeding Infants and Toddlers Study (FITS) and Kids Nutrition and Health Study (KNHS) [4], either by analyzing data from national surveys [5, 6] or conducting our own studies when national survey data do not exist [7, 8].

What can we learn about toddler diets from individual country data? Let us take a look at four FITS and KNHS countries as examples: China [8], Mexico [5], the Philippines [6], and the United States [7]. Table 1 compares the percent of young children falling below recommendations for several nutrients of concern, with darker shading showing greater risk for inadequacy. While there are nutrients that are lacking almost universally, like dietary fiber, vitamin D, and potassium, other nutrients of concern differ by country. For example, young children in the US generally consume milk and dairy products and, consequently, few (8.1%) fall below recommendations for calcium [7]. In contrast, 66% of all young children in the Philippines have calcium intakes below recommendations [6], related to low milk and dairy food consumption.

*Table 1. Percent of young children falling below recommendations for fiber, total fat, calcium, iron, potassium, and vitamin D – A comparison of China, Mexico, the Philippines, and United States.*

| Nutrient[1] | China | Mexico | Philippines | United States |
|---|---|---|---|---|
| Age in months | 24–35.9 | 24–47.9 | 24–35.9 | 24–47.9 |
| Fiber | >90[3] | 82 | >90[3] | 92 |
| Fat[2] | 45[3] | 25 | 75[3] | 40 |
| Calcium | 48 | 22 | 66 | 8 |
| Iron | 13 | 3 | 75 | 4 |
| Potassium | 30[3, 4] | 93 | 75[4] | 95 |
| Vitamin D | NA[5] | 71 | >90[3] | 83 |

Values are percent at risk for inadequate intake.
[1]Fiber and potassium were based on adequate intake levels (used as the recommended average daily intake when there is not enough data to establish a recommended dietary allowance). Calcium, iron, and vitamin D were based on estimated average requirements (the average daily nutrient intake level which is the best estimate of individual requirements). Intakes were compared with local recommendations and may differ by country.
[2]Less than 30% of daily energy.
[3]Value estimated from intake distributions.
[4]In China, 30% are below local recommendations for potassium (set at 900 mg/day) and in the Philippines, 75% are below the local recommendations (set at 700 mg/day); however, >90% would be below the adequate intake used in the USA and Mexico (3 g/d).
[5]Vitamin D was not available in the food composition tables for children <4 years of age, but we color-coded the cell to match the 88% below estimated average requirements reported for 4- to 8-year-olds.

An in-depth view of dietary intake can help to focus education and fortification efforts to target the nutrients of greatest need on a country-by-country basis. In addition, understanding local dietary patterns can help to identify the foods and beverages most relevant to help alleviate these gaps.

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# Vitamin D in Toddlers

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**Key Messages**

- Young children are at risk of low vitamin D intakes and status
- National surveys, prospective cohorts, and dietary intervention studies have shown that fortification of foods consumed by toddlers is a safe and effective approach to increasing their vitamin D intakes and status
- Dose-response trials in 1 to 3-year-olds are still needed to estimate the actual vitamin D requirement among toddlers

## Background

Young children and toddlers (1–3 years) are at risk of nutrient deficiencies due to their limited appetite relative to their high requirements for growth and development. Vitamin D has been identified as a risk nutrient for toddlers in many countries. Vitamin D is a fat-soluble vitamin that is obtained from a combination of skin synthesis during sunshine exposure and from the diet. As it has a key role in the regulation of calcium and phosphorus metabolism, vitamin D is critical for healthy bone growth and development in childhood. Prevention of very low vitamin D status is also important for robust immune function.

## Vitamin D in the Diets of Young Children

Due to the extended winter period, people resident at high latitudes need to obtain sufficient vitamin D from the diet for prevention of vitamin D deficiency. Foods containing substantial amounts of naturally occurring vitamin D are limited and not consumed on a regular basis by young children. Small but important amounts of vitamin $D_3$ are found in commonly consumed staple foods, such as meat, dairy, and eggs. Vitamin $D_2$ (ergocalciferol) can be obtained from irradiated mushrooms. Depending on regional legislation, some foods are fortified with vitamin D, including milk, infant formula, yogurt, spread, cheese, juice, bread, and breakfast cereals. In addition, vitamin D is available as a dietary supplement, either as vitamin $D_2$ or vitamin $D_3$.

## Recommended Intakes of Vitamin D in Toddlers

Current recommendations for individual intakes of vitamin D in Europe and North America vary between countries, from 10 to 20 µg/day (400 to 800 IU), shown in Table 1. Based on adult recommendations, these are the intakes of vitamin D that will achieve circulating 25-hydroxyvitamin D (25(OH)D) concentrations (the biomarker of vitamin D status) of 25–50 nmol/L, for the prevention of adverse bone health outcomes.

## Intakes of Vitamin D among Toddlers Relative to Recommendations

Vitamin D intakes among young children are generally between 2 and 9 µg/day, including countries with mandatory or voluntary vitamin D fortification [1]. While nutritional supplements can be important contributors to vitamin D intake, current rates of supplement use among toddlers are often low [2, 3]. Key food sources of vitamin D in toddlers are vitamin D-fortified milks, formula, breakfast cereals and yogurts, meat, and eggs [4]. Even in countries where voluntary fortification with vitamin D is widespread, almost all children have intakes of vitamin D below 10 µg/day [3].

*Table 1. Summary of current individual vitamin D recommendations in toddlers*

| Agency | Region | Individual intake, µg/day | 25(OH)D target, nmol/L |
|---|---|---|---|
| European Food Safety Authority, 2016[1] | EU | 15 | 50 |
| Scientific Advisory Committee on Nutrition, 2016[2] | UK | 10 | 25 |
| NORDEN, 2012[3] | Nordic countries | 10 | 50 |
| German Nutrition Society, 2012[4] | DACH countries | 20 | 50 |
| Institutes of Medicine, 2011[5] | US/Canada | 15 | 50 |

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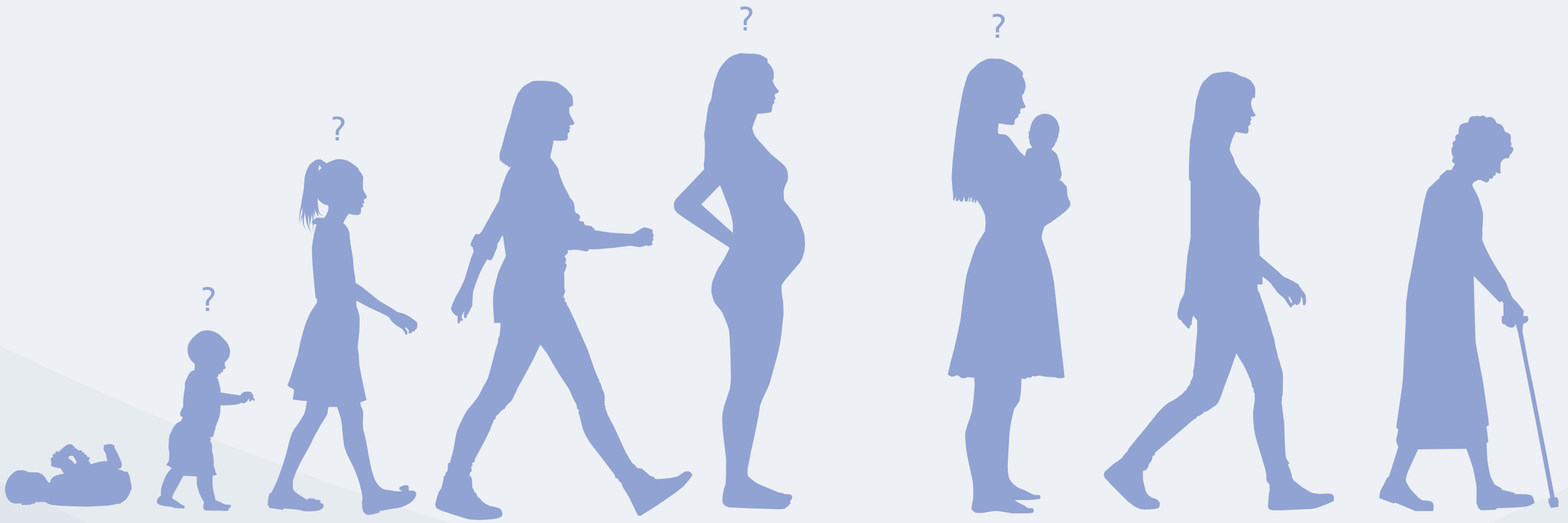
## Is There Evidence for Low Vitamin D Status among Toddlers?

Evidence for extensive low vitamin D status is mixed, and it seems that average 25(OH)D concentrations among children decrease with increasing age, possibly due to reducing milk intake. In the UK National Diet and Nutrition Survey among 1.5- to 3-year-olds, the prevalence of year-round plasma 25(OH)D concentrations <25 nmol/L was 8% [5]. In a study of 741 toddlers



Dietary recommendations for vitamin D contain many population gaps

from the prospective Cork BASELINE Birth Cohort, the year-round prevalence of serum 25(OH)D <25 nmol/L was 1.6%, and 4.6% were <30 nmol/L, which increased to 8.6% during the winter months (November to April) [1]. In this cohort, over a quarter of the children had a 25(OH)D concentration <50 nmol, which reached almost half the study cohort in winter. Apart from season, consumption of at least 5 µg/day of vitamin D and consumption of fortified infant formula were the main determinants of circulating 25(OH)D. In Montreal in 2013, El Hayek et al. [6] reported that despite 95% of 508 preschoolers having vitamin D intakes <10 µg/day, plasma 25(OH)D was >50 nmol/L in 88% of them, which was likely due to the dual effect of fortified milk provision and skin synthesis.

### Ways to Improve Intakes/Status of Vitamin D

The current dietary supply of vitamin D is not sufficient to close the large gap between dietary intakes and recommendations for vitamin D in toddlers, and many children are at risk of low vitamin D status during this growing period. While vitamin D-containing supplements can increase vitamin D intakes and status, this is only true for supplement users. From a public health policy perspective, food fortification with vitamin D is likely to be the best option for increasing vitamin D intakes and status across the population distribution. Milk and milk products are widely consumed among toddlers, and there is abundant evidence from large observational studies [1–4, 6, 7], trials [8], and a recent systematic review of trials [9] that consumption of vitamin D-fortified milk or formula increases vitamin D intake and status, without the risk of excessive intakes or adverse effects.

In summary, dose-response randomized controlled trials in children aged 1–3 years are still required to estimate the vitamin D requirement of young children and to make evidence-based recommendations. From a public health nutrition perspective, fortified foods provide a feasible solution to ensuring an adequate dietary supply of vitamin D in toddlers.

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# Milk as a Carrier of Fortification

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**Key Messages**

- There are good data to show that preschool children, especially those in the 1- to 3-year age bracket, are at risk of inadequate intakes of a number of important vitamins and minerals, notably iron and vitamin D
- Ultimately, nutritional education and securing better supply and availability of appropriate foods should address this important issue
- Nevertheless, until that can be achieved, there is good evidence to show that fortified milk, including young child formulas, can make a significant contribution to an appropriate nutrient intake at this important time in a child's growth and development

Children aged between about 1 and 3 years are undergoing a significant period of nutritional transition from a milk-based diet, be that breast milk or an appropriate infant formula, to the consumption of an increasing amount and variety of family foods. This period is, however, a time when many children are at risk of inadequate nutrient supply especially in developing countries and disadvantaged populations in other countries. Moreover, neophobia (i.e., hesitancy to try new foods) and/or "picky eating" are also common at this time [1].

Young child formulas (YCF) have been marketed since around 1990 and are often seen as a solution to preventing inadequate nutrient supply in such children. The need for YCF is not universally accepted, as it is believed by many that the nutritional needs of children aged 1 to 3 years can be easily covered by a "balanced diet," at no extra financial cost to families, and in an ideal world, this would be the case. Nevertheless, a recent review assessed the literature for available evidence of dietary nutrient intakes relative to reference nutrient intake across the globe [2]. Twenty-three publications from 19 different countries, including both developed and developing countries, met the review criteria. The authors concluded that many nutrients were often limited in many children, from many countries, notably vitamins A, D, $B_{12}$, and C, folate, calcium, zinc, iron, iodine, and docosahexaenoic acid.

Matsuyama et al. [3] undertook a systematic review and meta-analysis of randomised controlled trials of what they referred to as "fortified milks," which included YCF, against control milks, which was often standard cow's milk. Fifteen articles sourced from 5 major international databases met the eligibility criteria that included that the population studied be otherwise healthy children aged between 6 and 47 months and that outcomes were growth parameters and biochemical markers. The use of fortified milk compared with control milk had a small nonsignificant effect on body weight gain over the study period (mean difference = 0.17 kg; 95% CI: 0.02–0.31 kg). However, it is noteworthy that the risk of anaemia was reduced in the fortified milk groups (OR = 0.32; 95% CI: 0.15–0.66). Iron deficiency, which can lead to anaemia, is reported as being the most common micronutrient deficiency in the world [4]; and so, clearly many young children are not receiving adequate amounts of dietary iron. As noted by Matsuyama et al. [3], efforts to raise public awareness of the importance of iron-rich complementary foods are essential. Nevertheless, availability of such foods can be scarce in some developing countries.

Very recently in 2018, the results of a randomised controlled trial of a YCF versus cow's milk in Australia and New Zealand have been reported [5]. After having consumed either the YCF or cow's milk for 12 months between the ages of 1 and 2 years, the YCF group had a lower total protein intake and higher iron, vitamin D, vitamin C, and zinc intake at 2 years of age with the differences for iron, vitamin C, and vitamin D reaching statistical significance. As reported by Suthutvoravut et al. [2], micronutrient deficiencies in young children are widespread, and whilst nutritional education and availability of appropriate foods are the key to overcoming this global problem, as was concluded by Matsuyama et al. [3], there is evidence that fortified milk can be effective also, under certain circumstances.

*Table 1. Percentage of toddlers consuming below the estimated average requirement for iron and vitamins C and D after 12 months of intervention [5].*

| | **Cow's milk** | **Young Child Formula** | ***p* value** |
|---|---|---|---|
| Iron<br>(Mean intake, mg/d) | 24%<br>(5.8) | 1,5%<br>(10.2) | $p < 0.0001$ |
| Vitamin C<br>(Mean intake, mg/d) | 86%<br>(19.3) | 9%<br>(60.3) | $p < 0.0001$ |
| Vitamin D<br>(Mean intake, µg/d) | 23%<br>(4.4) | 9%<br>(7.2) | $p < 0.0001$ |

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