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Nutrient adequacy and imbalance among young children aged 1–3 years in the UK

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Abstract

Toddlers and young children in the second and third years of life (12–35 months) may be nutritionally vulnerable, especially if they eat a limited range of foods or consume a diet that is energy rich but nutrient poor. We compared dietary intakes among children aged 18–35 months from the *National Diet and Nutrition Survey* (2008–2011) and children aged 12–18 months from the *Diet and Nutrition Survey of Infants and Young Children* (2011) with UK Dietary Reference Values (DRVs) to assess potential nutrient excess or inadequacy. Multiple criteria were used [reference nutrient intake (RNI), estimated average requirements (EAR) and lower reference nutrient intake (LRNI)], and where the LRNI or EAR were unavailable they were estimated as 75% of the EAR or RNI, respectively. Compared to current recommendations, there appear to be significant shortfalls in intakes of vitamin D in young children in the UK, and supplementation, although recommended by government, is not addressing the problem because take-up is low (9–11%). Vitamin D intakes (including supplements) averaged only 55% of the RNI among children aged 12–18 months and 33% of the RNI for those aged 18–35 months, while 64% and 87% of the younger and older group, respectively, had intakes below the LRNI (estimated). Endogenous synthesis of vitamin D may be insufficient to fulfil requirements, especially in winter. Iron intakes are also suboptimal among some groups. Based on the EAR cut-point method, the estimated population prevalence of dietary inadequacy for children aged 18–35 months was 91% for vitamin D and 31% for iron. Zinc, vitamin A and iodine had estimated levels of dietary inadequacy ranging from 5% to 19%. Mean energy intakes were below the 1991 DRV for energy but above the most recent DRV issued in 2011, while protein intakes in both surveys were in excess of the RNI. Further work is warranted to identify dietary patterns associated with low micronutrient intakes and status, and to assess the best strategies for ensuring adequacy, especially among vulnerable groups. Parents and healthcare professionals should be informed as to how to minimise the risks of both nutrient deficiency and excessive energy intakes for the young children in their care. Government can facilitate provision of appropriate advice via the healthcare system and encourage provision of appropriate foods and supplements via enabling legislation. The food industry also has a role in the responsible provision of fortified foods and drinks that can address nutrient inadequacy.

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Introduction

Dietary surveys gather much useful data on intake of foods and nutrients and also on nutrient status. In terms of recording the dietary intakes of young children, the *Infant Feeding Survey* (*IFS*) is conducted every 5 years to track feeding method and weaning practices for infants up to approximately 8–10 months of life and the *National Diet and Nutrition Survey* (*NDNS*) rolling programme begins at 18 months of age, leaving a gap between the *IFS* and the start of the *NDNS*. Hence, the *Diet and Nutrition Survey of Infants and Young Children* (*DNSIYC*) was commissioned by the Department of Health and the Food Standards Agency (DH/FSA) to provide detailed information on the food consumption, nutrient intakes and nutritional status of infants and young children aged 4–18 months living in private households in the UK. Fieldwork was carried out between January and August 2011 and *DNSIYC* provides high-quality, nationally representative data that can be used alongside the *NDNS* data to provide a fuller picture of the diet and health of the UK population.

This article presents a summary of secondary analysis conducted using both the *NDNS* and *DNSIYC* to further investigate the adequacy of diets, and the nutrition status of young children aged 12–35 months, to draw attention to the potential gaps in feeding practices. The importance of good diet at this stage of life and the role of supplements and fortified foods to bridge the identified gaps is discussed.

Methods and data sources

National Diet and Nutrition Survey (NDNS)

The *NDNS* is the most authoritative source of quantitative information on the food habits and nutrient intake of the UK population aged 18 months and older (Bates *et al*. 2012). Jointly funded by the DH in England and the FSA, it is used by government to develop policy and monitor diet and nutrient intakes. The *NDNS* is now conducted annually on a rolling basis and results can be accessed online.

The sample is nationally representative of the UK population from the age of 18 months. Households are selected on a stratified random sampling basis using the postcode address file and either one adult or one child, or one adult *and* one child, are selected for the survey to ensure that there are 500 adults and 500 children in total each year. During a detailed interview with the respondent (or main carer), information is collected on socio-demographic status, health and lifestyle, after which participants are asked to record all food and drink consumed over 4 days with a detailed description of the item, method of preparation and amount (using household measures and photographs), as well as contextual information (*i.e.* when and where the item was consumed). Each food/drink item is subsequently coded from the description in the food record, and information on brand, source or recipe is provided, to allow it to be matched with food composition tables containing data on over 7000 foods. In the first 3 years of the rolling programme, 3073 respondents (55% of eligible households) completed the 4-day food diary and the sample included 185 children aged 18–35 months.

Statistical analysis

Computerised data files of years 1, 2 and 3 of the *NDNS Rolling Programme* were obtained from the UK Data Service website (www.ukdataservice.ac.uk/get-data.aspx). From individuals' data on nutrient intakes (including supplements), each child's intake as a percentage of their reference nutrient intake (RNI) was computed (DH 1991). Children were also classified with reference to the lower reference nutrient intake (LRNI), which is the level at which intakes are almost certainly inadequate for 97.5% of the population. These are the two measures conventionally used in the *NDNS* reports and by the DH to assess the adequacy of nutrient intakes in the population. In addition, the prevalence of inadequacy was estimated using the estimated average requirements (EAR) cut-point method (Carriquiry 1999; de Lauzon *et al*. 2004). This method is now widely used in other countries, including the US, to assess the population prevalence of inadequate nutrient intakes. The proportion of children with intakes below the EAR is mathematically equivalent to the proportion with intakes short of requirements, provided certain assumptions can be met. Such assumptions include that intakes and requirements should be independent, that the distribution of requirements should be symmetrical, and that the variance in requirements is smaller than the variance in intakes (Carriquiry 1999). In practice, this means that the cut-point method produces valid estimates of the population prevalence of inadequate intakes, except for energy (where intakes and requirements are more closely associated) and for iron (where the requirement distribution among women is skewed); however, for infants and young children, the estimates for iron should be more reliable. Where there was no official LRNI or EAR for a nutrient, the method of a significant recent study, which mapped low intakes of micronutrients across Europe, was adopted (Mensink *et al.* 2013). This used UK Dietary Reference Values (DRVs) as its basis and, for missing EAR or LRNI values, used 75% of the RNI and 75% of the EAR, respectively (see Table 1). The percentage of children with intakes below the LRNI or EAR as mentioned above was then calculated. Finally, energy intakes were compared with the 1991 DRVs (DH 1991) and the 2011 DRVs for energy (SACN 2011) using population mean requirement values for those aged 12–24 months and 24–36 months.

Diet and Nutrition Survey of Infants and Young Children (DNSIYC)

The *DNSIYC* was designed to complement the *NDNS* as a one-off survey providing detailed information on the food consumption, nutrient intakes and nutritional status of infants and young children in the UK population aged 4–18 months. The *DNSIYC* was conducted between January and August 2011. The survey involved an interview, a 4-day dietary diary similar to the *NDNS*, a blood sample (in those giving consent) and estimates of breastmilk intake, fluid intake and body composition. Further details and tables are available online (Lennox *et al.* 2013). Information on mean intakes as a percentage of the RNI and the proportion of children with intakes below the LRNI was extracted from tables for comparison, with the results being calculated from the *NDNS*.

Table 1 Derivation of values used in the analysis alongside comparison of UK reference nutrient intakes and European Food Safety Authority reference intakes

Nutrient	LRNI	EAR	RNI	EFSA NDA Panel (2013) RI
Calcium (mg/day)	200	275	350	600
Copper (mg/day)	0.23*	0.3†	0.4	0.4
Iodine (μg/day)	40	52.5†	70	90
Iron (mg/day)	3.7	5.3	6.9	8
Magnesium (mg/day)	50	65	85	85
Potassium (mg/day)	450	600†	800	800
Selenium (μg/day)	7	11.3†	15	20
Zinc (mg/day)	3.0	3.8	5.0	4.0
Vitamin A (μg RE/day)	200	300	400	400
Thiamin (Vitamin B_1) (mg/1000 kcal)	0.23	0.3	0.4	0.5
Riboflavin (Vitamin B_2) (mg/day)	0.3	0.5	0.6	0.8
Niacin (Vitamin B_3) (mg/1000 kcal)	4.4	5.5	8.0	9.0
Vitamin B_6 (μg/g protein)	11	13	15	0.7 mg/day
Vitamin B_{12} (μg/day)	0.3	0.4	0.5	0.9
Folate (μg/day)	35	50	70	100
Vitamin C (mg/day)	8	20	30	20
Vitamin D (μg/day)	3.94*	5.25†	7	10

Source: EFSA NDA Panel (2013).
*Calculated as 75% of EAR.
†Calculated as 75% of RNI.
EFSA, European Food Safety Authority; EAR, estimated average requirements; RNI, reference nutrient intake; LRNI, lower reference nutrient intake; RI, reference intake; RE, retinol equivalents.

Results

Energy and macronutrient intakes

Mean energy intakes among children in both age groups were below the EAR set in 1991 (4.86 and 5.15 MJ/day for girls and boys aged 1–3 years) but above the new population EAR revised by the Scientific Advisory Committee on Nutrition (SACN) in 2011 (Table 2).

Mean intake of protein was 38 and 42 g among the younger (12–18 months) and older (18–35 months) age groups, respectively. This is more than double the RNI of 14.5 g for children aged 1–3 years. As a proportion of energy, protein intakes were similar to those among adults.

In both studies, total fat intakes were at the lower end of the range recommended by the European Food Safety Authority (EFSA; 35–40%) (there are no recommendations for total fat intake for children under 5 years in the UK), while saturated fat intakes averaged 15–16% of energy, similar to adult diets. There are insufficient data on fatty acid composition to assess dietary intakes of long-chain polyunsaturated fatty acids (eicosapentaenoic acid and docosahexaenoic acid). The proportion of total fat and saturates in the diet was lower among children aged 18–35 months in the *NDNS* compared with children aged 12–18 months in the *DNSIYC*, probably reflecting decreased consumption of milk among older children. Conversely, the proportion of non-milk extrinsic sugars (NMES) rose from less than 8% of energy in those aged 12–18 months to just over 11% of energy among children aged 18–35 months, similar to the recommended level (11%). Mean daily intakes of sodium were 181% of the RNI (2.3 g of salt per day), exceeding the population recommendation for this age group of no more than 2 g of salt per day.

Micronutrient intakes

With the notable exceptions of vitamin D and iron, mean intakes of vitamins and minerals were above the RNI (Table 3 and Figs 1–3). Intakes were slightly lower among girls, in line with their lower energy intakes. Among toddlers aged 12–18 months, vitamin D intakes (including supplements) averaged only 55% of the RNI, while for children aged 18–35 months mean intakes were only 33% of the RNI. Applying an estimated LRNI derived from the method of Mensink *et al*. to the individual data in the *NDNS*, 87% of children would be below the LRNI and at potential risk of inadequacy in the winter months when sunlight is not

Table 2 Mean intake of energy, macronutrients, fibre and sodium in both age groups (g = grams per day)

		DNSIYC 12–18 months *N* = 1275	NDNS 18–35 months *N* = 185
Energy, MJ*	Mean	4.1	4.7
Energy, kcal	Mean	967	1110
Energy as % of 1991 EAR	Mean	81	93
Energy as % of new SACN EAR*	Mean	131	124
Protein, g (%E)	Mean	38 (15.6%)	42 (15.4%)
Total fat, g (%E)	Mean	38 (35.4%)	42 (34.1%)
Saturated fatty acids, g (%E)	Mean	17.5 (16.3%)	18.8 (15.1%)
Cis monounsaturated fatty acids, g (%E)	Mean	12.4 (11.5%)	13.9 (11.2%)
Cis *n*-3 polyunsaturated fatty acids, g (%E)	Mean	0.7 (0.7%)	0.8 (0.7%)
Cis *n*-6 polyunsaturated fatty acids, g (%E)	Mean	4.0 (3.7%)	4.7 (3.8%)
Trans fatty acids, g (%E)	Mean	0.6 (0.5%)	0.8 (0.7%)
Total carbohydrates, g (%E)	Mean	126 (49.0%)	149 (50.6%)
Total sugars, g (%E)	Mean	66 (25.8%)	75 (25.2%)
NMES, g (%E)	Mean	20 (7.7%)	35 (11.5%)
Sodium, mg (salt equivalent, g)		907 (2.3)	1288 (3.2)
NSP, g	Mean	7.3	8.1

*New SACN estimated average requirements (EARs): 3.0/3.2 MJ for girls/boys aged 12–24 months, 3.9/4.2 MJ for girls/boys aged 24–35 months.

%E, % energy; DNSIYC, Diet and Nutrition Survey of Infants and Young Children; NDNS, National Diet and Nutrition Survey; NMES, non-milk extrinsic sugars; NSP, non-starch polysaccharide; SACN, Scientific Advisory Committee on Nutrition.

Table 3 Mean intakes of micronutrients, by age group and comparison with dietary reference values (DRVs)

	Diet only		With supplements		As % of RNI (with supplements)	
	12–17 months Mean	18–35 months Mean	12–17 months Mean	18–35 months Mean	12–17 months Mean	18–35 months Mean
Vitamin A (retinol equivalents) (μg)	676	538	698	571	175	143
Thiamin (mg)	0.8	0.9	0.9	1.0	223	192
Riboflavin (mg)	1.5	1.5	1.5	1.5	249	249
Niacin equivalent (mg)	16	19.1	16	20	258	244
Vitamin B_6 (mg)	1.1	1.4	1.1	1.4	202	205
Vitamin B_{12} (μg)	3.6	4	3.7	4.0	732	797
Folate (μg)	144	151	144	152	206	217
Vitamin C (mg)	60	67	62	74	208	247
Vitamin D (μg)	3.4	1.9	3.8	2.3	55	33
Iron (mg)	6.4	6.4	6.5	6.6	93	96
Calcium (mg)	789	786	790	787	226	225
Magnesium (mg)	135	153	135	153	159	180
Potassium (mg)	1599	1804	1599	1804	200	225
Zinc (mg)	5.4	5.2	5.4	5.2	109	105
Copper (mg)	0.5	0.6	0.5	0.6	126	140
Selenium (μg)	22	24	22	24	145	163
Iodine (μg)	173	146	174	146	248	208

RNI, reference nutrient intake.

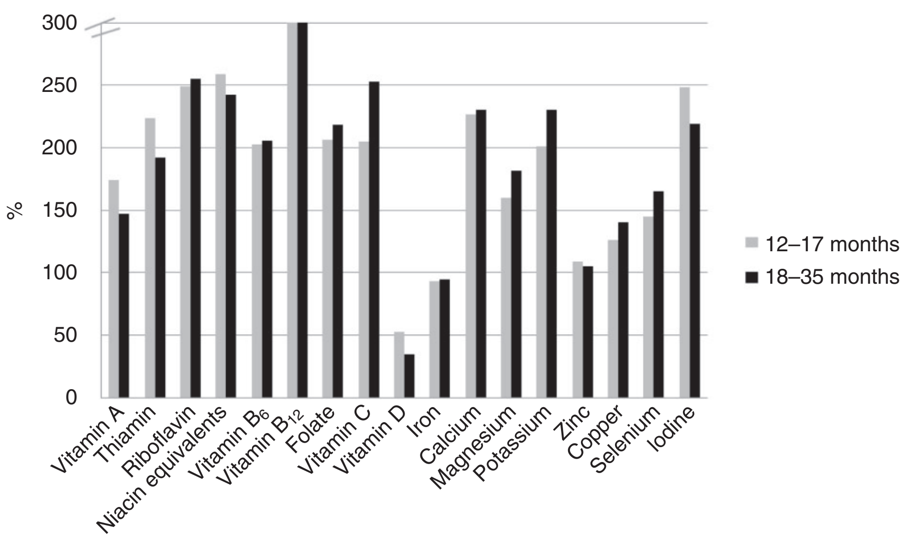

Figure 1 Mean intakes of vitamins and minerals as a percentage of reference nutrient intakes*, by age group.
*Reference nutrient intakes taken from DH (1991).

at the correct wavelength to enable vitamin D to be made in the skin. Among toddlers aged 18–35 months, 64% had vitamin D intakes below the estimated LRNI. Only 9% of younger and 11% of older children received some vitamin D from supplements during the 4-day 'food diary period'.

Thirty-nine per cent of young children aged 12–18 months received fortified milk (infant formula, follow-on formula or toddler milk) compared to 88% of infants aged 10–11 months (Lennox *et al.* 2013). Mean daily intake for consumers of toddler milk at the age of 12–18 months amounted to 342 g. Government advice states

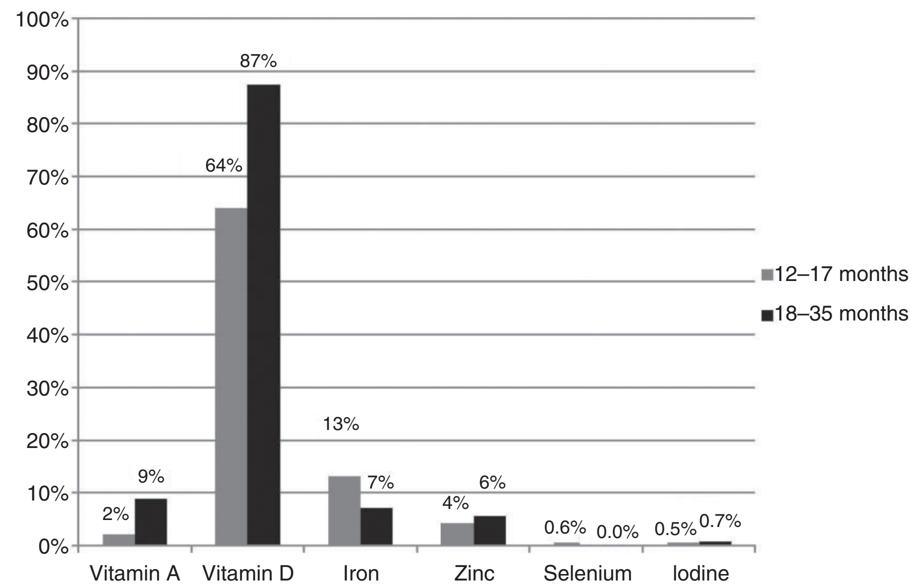

Figure 2 Percentage of children with intakes of selected nutrients below the lower reference nutrient intake (LRNI) (or estimated LRNI) (see Table 1).

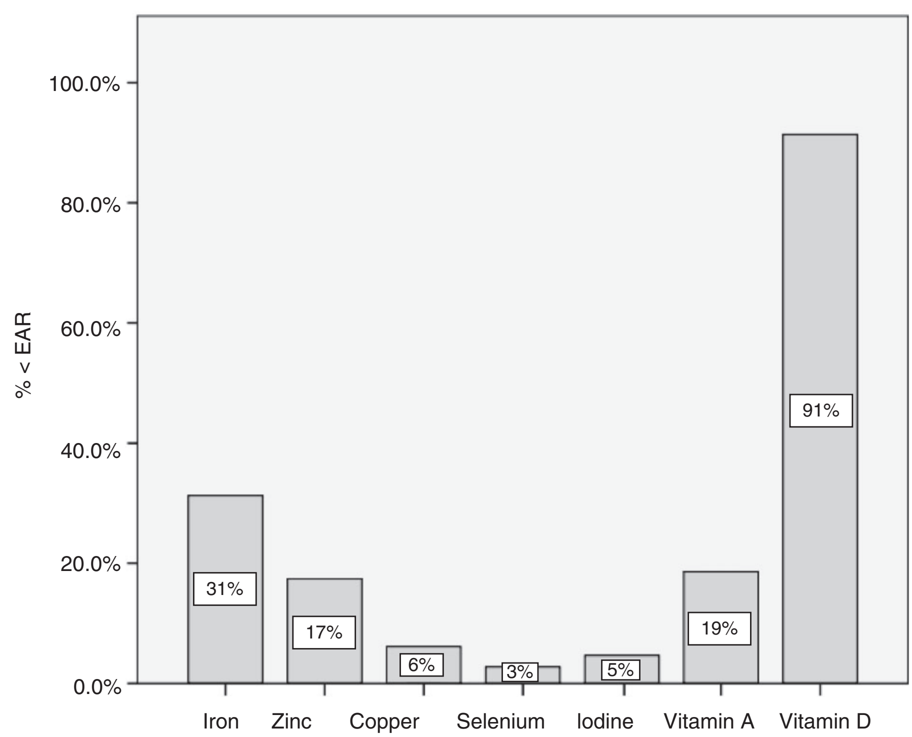

Figure 3 Percentage of children aged 18–35 months with intakes below the estimated average requirements (EAR)/estimated EAR (see Methods and data sources for details).

that supplementary vitamin drops are unnecessary for individuals with an intake of at least 500 ml/day.

Iron intakes averaged 93% of the RNI among toddlers aged 12–18 months and 96% of the RNI among older children aged 18–35 months. Among toddlers aged 18–35 months, 13% had intakes below the LRNI, with the proportion being significantly greater for South Asian (28%) and Black, Mixed and 'Other' children (defined as not belonging to the Black, Caucasian, Asian or Mixed ethnic groups; 19%) compared to Caucasian children (11%). Children from manual occupation households were also more likely to have intakes below the LRNI (17%) compared to those from managerial and professional households (8%) (Lennox *et al.* 2013). Among older children, the prevalence of intakes below the LRNI was 7%.

Mean intakes of zinc were 109% and 105% of the RNI for younger and older groups, respectively, and a small proportion (4% and 6%) had intakes below the LRNI.

Mean intakes of vitamin A were >140% of the RNI. Only 2% of those aged 12–17 months had very low intakes of vitamin A (below the LRNI), compared with 9% of those aged 18–35 months. However, 4 days of dietary recording is insufficient to draw reliable conclusions for the prevalence of vitamin A inadequacy, due to the high concentration of vitamin A in some foods and the wider day-to-day variation in intakes, compared to other nutrients.

Using the EAR cut-point method as a criterion to estimate the prevalence of inadequacy, there are shortfalls not only of vitamin D and iron, but also of zinc and vitamin A intakes in this age group. In addition, it is possible that a very small proportion of children may also be at risk of shortfall in other minerals such as copper, selenium and iodine.

Status markers

There were limited data available on micronutrient status. Results of blood analysis are not yet publically available for the *NDNS* sample and only exist for around 300 children aged 12–18 months in the *DNSIYC*. Of these, 2% had levels indicative of vitamin D deficiency and a higher risk of rickets, while according to our calculations, 31% had a plasma 25-OHD concentration below the level regarded as sufficient (50 nmol/l). In regard to iron status, 11% had serum ferritin levels indicative of low iron stores and 15% had haemoglobin levels below lower reference limits, with 2% meeting both criteria for diagnosis of iron deficiency anaemia (Lennox *et al.* 2013). Low iron stores suggest a potential problem of dietary iron insufficiency in this age group.

Discussion

While the majority of UK children surveyed in these studies appear to have adequate or more than adequate intakes of energy, protein and micronutrients, there are some areas in which the diet could be improved, notably in regard to micronutrient density.

Mean energy intakes were below the 1991 DRV for energy but above the new DRV issued in 2011. In a departure from the previous methodology, the new values are prescriptive and based on energy requirements for healthy bodyweight and growth (50th centiles of the UK-World Health Organization Growth Standards). By contrast, the former values were based on current average bodyweights, which included a proportion of overweight and obese children, resulting in higher estimated requirements. The implication is that a slight reduction in mean energy intakes might help reduce childhood obesity rates.

With regard to macronutrient composition, it is recommended that children should progress towards eating a healthy adult diet based on guidelines for adults, from 24 months onwards, although the timing should be flexible (DH 1991). Although UK recommendations for fat intake are only given for children aged 5 and above, European (EFSA) recommendations are that 35–40% of energy from fat is appropriate for the second and third years of life (12–35 months) based on practical considerations (current levels of intake, achievable dietary patterns in young children) (EFSA NDA Panel 2010). Total fat intakes were at the lower end of this range, and therefore acceptable, with the proviso that intakes of saturated fatty acids should be progressively reduced to around 11% of energy by the age of 5 years. Protein intakes in both surveys were in excess of the RNI by a factor of two- to threefold and similar, in percentage energy terms, to adult diets. Whether this is excessive for young children is uncertain but the accelerated postnatal weight gain hypothesis proposes an association between rapid weight gain (protein driven) in infancy and an increased risk of later obesity and adverse outcomes (Koletzko *et al.* 2012). In the prospective *Dortmund Nutritional and Anthropometric Longitudinally Designed Study*, a high protein intake at 12 months and 18–24 months has been associated with a higher body mass index and body fat percentage at age 7 (Gunther *et al.* 2007a, 2007b). A recent review of the Nordic Nutrition Recommendations suggested a mean protein intake of 15% of energy at 12 months (Hornell *et al.* 2013), slightly lower than the current intake among young children in the UK.

Intakes of vitamin D are particularly poor, especially in the older age group, and could lead to suboptimal status in children during the winter months or where skin exposure is limited in the summer. UK Health Departments recommend that all infants and young children aged 6 months to 5 years take a daily supplement containing 7–8.5 µg of vitamin D. It would appear that the current recommendation on use of supplements is in practice failing to address poor intakes in this population. Fortified infant milks, milk and milk products, and meat were the main food sources of vitamin D in the *DNSIYC*, but it is hard to achieve the recommended amount of 7 µg/day from diet alone. Data from the 2008 *Feeding Infants and Toddlers Study* in America show that children aged 12–35 months have mean vitamin D intakes of 8–9 μg/day (Butte *et al.* 2010; Dwyer *et al.* 2010), largely due to the routine fortification of cows' milk in the US. If endogenous synthesis in skin is high, dietary intake is less important, but plasma levels may be suboptimal for some UK children, for at least part of the year. In the *DNSIYC*, only 2% of those aged 12–18 months had plasma 25-OHD values below 25 nmol/l, but around 30% had values less than 50 nmol/l and the mean was 64 nmol/l. Given their lower intakes, it is likely that children aged 18–35 months are at greater risk of low vitamin D status than those aged 12–18 months and low status has also been noted in a high proportion of teenagers and adults in the *NDNS*. SACN is currently reviewing thresholds for vitamin D status in the UK population in relation to selected health outcomes, to use as a basis for setting DRVs for vitamin D. Meanwhile, the recent scientific opinion from EFSA's Panel on Dietetic Products, Nutrition and Allergies (NDA), based on evidence of poor vitamin D status, was that 'total vitamin D supply originating from the diet and from endogenous synthesis is insufficient for most infants and young children in Europe, depending on the season' (EFSA NDA Panel 2013).

Iron deficiency is the most commonly reported nutritional disorder during early childhood across most of Europe. Intakes of iron were below the EAR in more than 30% of children aged 18–35 months living in the UK, while 7% had intakes below the LRNI of 3.7 mg/day. The UK RNI for iron in children is lower than the EFSA reference intake (6.9 mg/day vs. 8 mg/day), and cut-offs for status markers, serum ferritin and haemoglobin also vary between countries, making inter-population comparison difficult. The *DNSIYC* food consumption data show that iron intakes decrease after 12 months as the feeding of fortified milks decreases, while cereal foods become the largest contributor of iron from 12 to 18 months, providing 41% of the daily average intake of 6.4 mg. EFSA concluded that an inadequate supply of dietary iron may increase the risk of inadequacy in this age group, although other causes of poor status should be investigated.

Low intakes of vitamin A and zinc were found in a small proportion of children. A deterioration in vitamin A intake between 18 months and 3 years has also been noted in the Avon Longitudinal Study of Parents and Children cohort (reflecting intakes in the early 1990s) and attributed to changes in the amount and type of milk consumed, as well as an increase in the proportion of 'non-core foods' (defined as processed foods with added fat or sugar) (Cribb *et al.* 2013).

Zinc intakes (of which major sources are meat and dairy products) were below the EAR for 17% of children aged 18–35 months. However, UK DRVs are higher than those in the US, which were recently revised downwards (US EAR = 2.5 mg/day, respectively) and therefore the significance of current levels of intake found in the UK is uncertain. In particular, sensitive biomarkers of zinc status are lacking, with plasma zinc having low sensitivity to indicate marginal status and being variable depending on inflammatory state, meal patterns and time of day (Krebs 2013). As a result, EFSA recently concluded that the risk of inadequate zinc intakes in infants and young children in Europe could not be quantified (EFSA NDA Panel 2013). For vitamin A and selenium, they concluded that intakes generally did not give rise to concern, but again noted the limitations of using plasma/serum concentrations to assess status (EFSA NDA Panel 2013). By contrast, iodine intake was considered to be inadequate among some subgroups and this is supported by findings of low urinary iodine concentrations among children in several European populations. Since major sources of iodine are milk and fish, suboptimal intakes may be more common among children consuming low amounts of these foods, or where (as in the UK) salt is not normally iodised. It should be noted that the UK RNI for iodine is lower than the EFSA equivalent (70 μg/day vs. 90 μg/day) and this is also the case for several other nutrients (see Table 1). Hence, our estimates of the prevalence of inadequacy are lower than would be the case using EFSA/European Union recommendations.

Further work is warranted to identify dietary patterns associated with imbalances of macronutrients and micronutrients and to assess the best strategies for filling nutrient gaps, especially among vulnerable groups. Young children have high nutrient needs relative to their body size and are in a transition period of moving from a weaning diet at 12 months to a mixed and varied diet at 36 months. In order to support continued healthy growth and development, and optimise future health outcomes, care must be taken in choosing foods and beverages of high nutrient density to ensure nutrient adequacy without providing excessive protein and energy intakes, or exceeding recommended levels of saturates, NMES and salt. Government can facilitate provision of healthy eating advice, such as the *eatwell* plate, and encourage provision of suitable foods and supplements via enabling legislation. Special attention also needs to be given to facilitate the provision and uptake of vitamin D supplements for this age group. Industry can play a role in providing foods that are micronutrient rich, as well as being lower in saturates, NMES and salt. This may include fortified products based on evidence of need and full-risk assessment.

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Conflict of interest

Sigrid Gibson is a Registered Nutritionist and Director of Sig-Nurture Ltd, an independent consultancy to government agencies, universities and the food industry. Anne Sidnell is Nutrition and Scientific Affairs Manager at Nestlé Nutrition UK and Ireland.

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