

Improving the micronutrient quality of complementary foods in early childhood

Meeting report

**Expert consultation
8–9 June 2023**



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Acronyms

| | |
|--------|--|
| CONGA | Comprehensive Nutrient Gap Assessment |
| DGLV | dark green leafy vegetables |
| FCF | fortified complementary food |
| FV | fruits and vegetables |
| GAIN | Global Alliance for Improved Nutrition |
| HF | home fortification |
| HKI | Helen Keller International |
| ICP | International Comparison Program |
| IYCF | infant and young child feeding |
| LMIC | low- and middle-income countries |
| LNS | lipid-based nutrient supplement |
| LSHTM | London School of Hygiene and Tropical Medicine |
| MNF | Micronutrient Forum |
| MNP | micronutrient powder |
| PDH | Positive Deviance/Hearth |
| RUTF | ready-to use therapeutic foods |
| SBCC | social behavior change communication |
| SQ-LNS | small-quantity lipid-based nutrient supplement |
| UNFSS | United Nations Food Systems Summit |
| UNICEF | United Nations Children's Fund |
| WFP | World Food Programme |
| WHO | World Health Organization |
| WVI | World Vision International |



Scope of the Consultation

Over the past two decades, notable gains have been achieved in rates of exclusive breastfeeding: from 2000 to 2019, in all low- and middle-income regions except the Middle East and North Africa, rates rose from 35% to 49%. Unfortunately, the same cannot be reported for the quality of diets of children in the complementary feeding age (6–23 months of age [UNICEF 2021]). Achieving healthy diets for children in this age group remains a challenging scientific, programmatic, political, economic, and human rights issue in global development. UNICEF’s report *Fed to Fail* provides a sobering summary of this lack of progress. The low consumption of nutrient-rich foods is of particular concern: 71% of children 6–23 months do not receive minimally diverse diets. Half of children are not eating the most nutrient-rich foods; for example, 41% do not consume fruits and vegetables, and 55% are not eating eggs, fish, and meat (UNICEF 2021).

In this context, the Micronutrient Forum organized an expert consultation on 8–9 June 2023, bringing together more than 30 experts to reflect on priorities and key activities in order to align and catalyze food-based actions to improve the micronutrient quality of the diets of older infants and young children. This meeting was timely, as the World Health Organization (WHO) is working on guidelines for complementary feeding to be published before the end of 2023, and UNICEF and WHO have taken initial steps to establish a Global Collective on Complementary Feeding later in 2023.

The main objectives of this consultation were the following:

- Identify gaps in the existing evidence base on food-based complementary feeding practices.
- Examine pivotal barriers and enablers influencing policy adoption and program execution.
- Outline research, policy, and program implementation priorities for supporting complementary feeding interventions.

The consultation focused on animal- and plant-source food groups, given the evidence on their role in improving nutritional intakes and outcomes of children 6–23 months old, and on home fortification solutions. Owing to time limitations, several relevant topics for complementary feeding were not addressed in the consultation, though these topics merit dedicated sessions in the future.

In scope: Food-based and home fortification solutions

The consultation focused on the following categories:

- Unprocessed and minimally processed animal-source foods: meat, aquatic foods, eggs, and dairy
- Unprocessed and minimally processed plant-source foods: fruits, vegetables, nuts, seeds, and legumes
- Home fortification products: micronutrient powders (MNPs) and small-quantity lipid-based nutrient supplements (SQ-LNSs)

The consultation included nutrients such as choline and essential fatty acids within the scope of “improving the micronutrient quality” of complementary feeding diets. Though not officially classified as micronutrients, these nutrients are essential and required in relatively small amounts, in contrast to the macronutrients (carbohydrates, proteins and indispensable amino acids, and other lipids).



Out of scope

Experts agreed that future consultations will need to address other relevant topics, including the following:

- Composition, use, and promotion of commercially produced fortified complementary foods
- Consumption of unhealthy and/or ultraprocessed foods and beverages
- Nutrition counseling and social behavior change communication to promote evidence-based complementary feeding interventions
- Complementary feeding in emergency and humanitarian contexts
- Food contamination and food safety

Prior to the expert consultation, an evidence summary and a mapping of the activities and priorities of key actors in the field were prepared. [Both documents are available online.](#)

Participants agreed to discuss the following questions for each food group:

- **Impact:** What is known, and what are the main knowledge gaps on the impact of using this food group in complementary feeding on child outcomes? Which knowledge gaps should be prioritized, and what are the next steps?
- **Uptake by households:** What are the main barriers and corresponding knowledge gaps that prevent caregivers and households from using nutritious food groups?
- **Interventions:** What are the main barriers and corresponding knowledge gaps that prohibit implementation and scale-up of interventions to overcome household barriers? What should be prioritized, and what are the next steps?
- **Enabling environment:** What are the main policy and environmental barriers that prohibit implementation and scale-up of optimal complementary feeding? What do stakeholders need, what are the priorities, and what are the next steps?

This consultation highlighted the critical barriers to and enablers of effective food-based actions to improve the micronutrient quality of the diets of older infants and young children as well as the priority research questions for evidence-based food-based and home fortification interventions to improve the micronutrient quality of complementary feeding in early childhood.

Barriers and enablers

- Availability
- Accessibility
- Acceptability
- Affordability
- Safety
- Perishability
- Caregiver time
- Caregiver knowledge
- Convenience
- Gender and household dynamics



Setting the Scene

Session Presenters: Grainne Moloney and Linda Shaker (UNICEF), and Alissa Pries (WHO)

The key findings of the [Fed to Fail](#) report (UNICEF 2021), which highlights the importance of nutritious foods in early child diets in low-and middle income countries (LMICs), were presented by Grainne Moloney and Linda Shaker. The consequences of poor diets and feeding practices in early life are visible in the age distribution of stunting and wasting. The eight main findings highlighted by the report are summarized in the figure.

UNICEF's [Child Food Poverty](#) report (UNICEF 2022) focuses on children facing severe food insecurity. Globally, approximately 139 million infants and young children are living in food poverty (consuming fewer than five food groups, the minimum for dietary diversity). Of these, 60 million are suffering from severe food poverty (consuming extremely poor diets consisting of at most 2 food groups). This figure represents nearly 1 in 3 children (31%) aged 6–23 months.



To advance the implementation of adequate complementary feeding practices in early childhood, in February 2020 UNICEF released programming guidance for improving children's diets during the complementary feeding period (6–23 months) and included 10 recommended actions in the *Fed to Fail* report. The programming guidance articulates interventions and approaches for improving the availability, accessibility, affordability, and consumption of nutritious and safe complementary foods. In addition, this programming guidance describes the most recent evidence on improving complementary feeding, explores the determinants and drivers of older infants and young children's diets, and presents

action frameworks for delivering nutrition results for children through the food, health, water and sanitation, and social protection systems. It also provides guidance on monitoring and evaluating complementary feeding programs and outcomes.

Upcoming UNICEF work related to complementary feeding

- Activation of the Global Complementary Feeding Collective
- Development of Implementation Guidance on Complementary Feeding, jointly with the World Health Organization (WHO)
- Development and implementation of Complementary Feeding in Emergencies Action Plan
- Continued documentation of complementary feeding in emergency interventions

Updated WHO guidelines for

complementary feeding will be released in late 2023 and further translated into implementation and policy guidance. To inform the development of this implementation guidance, Alissa Pries and colleagues at WHO conducted a scoping review of existing tools and guidance and interviewed complementary feeding stakeholders to identify the strengths, weaknesses, and gaps in existing materials. This review will be published by WHO and UNICEF as an annotated bibliography of guidance resources, with an accompanying library.

Despite significant guidance on complementary feeding, existing materials generally fail to address *how* to implement the forthcoming WHO guidelines based on field experience in diverse contexts. To address



such gaps, UNICEF and WHO will develop new implementation guidance, with support and inputs drawn from a specially formed expert group. Among other things, the implementation guidance will cover the role of agriculture; child feeding in urban, peri-urban, and rural contexts; how to limit consumption of unhealthy and junk foods among children in this age group; the quality of commercially produced, processed complementary foods; and how to conduct monitoring and evaluation of complementary feeding interventions. The new guidance will be made more widely available and accessible than previous documents through, for instance, the use of digital platforms.



Modeling child diets: Patterns, nutrient gaps, and costs

Session Presenters: Ty Beal (GAIN), Yan Bai (World Bank), Will Masters (Tufts University), Mary Arimond and Elaine Ferguson (LSHTM)

Three different modeling exercises were presented to provide insights on key questions related to the young child diet.

First, Ty Beal addressed the following questions: *What micronutrients do older infants and young children lack in their diets? What are the top food sources of these micronutrients? Which of these foods are most affordable?* Data from 17 countries were analyzed using the Comprehensive Nutrient Gap Assessment (CONGA) (Beal et al. 2021a), and an affordability analysis was conducted for 12 of these countries to determine the most intrinsically micronutrient-dense available foods to address priority micronutrient gaps (Beal et al. 2021b; White et al. 2021).

Common micronutrient gaps found across Eastern and Southern Africa and South Asia include iron, vitamin A, zinc, folate, vitamin B12, and calcium. The certainty of evidence of these gaps varies by country but is generally higher in South Asia and for iron and vitamin A (and in South Asia, zinc) and lower in Eastern and Southern Africa, especially for zinc, vitamin B12, folate, and calcium. The top intrinsically micronutrient-dense (i.e., unfortified) food sources of these priority micronutrients are organ meats, small fish, dairy, ruminant meat, eggs, shellfish (bivalves and crustaceans), fish, and dark green leafy vegetables.

The affordability of food sources that contribute significantly to micronutrient intakes is quite different when considered in terms of their micronutrient contribution than it is in terms of their per-unit mass or energy. Different nutrients are more or less affordable depending on the unfortified food source. In general, all countries have many affordable unfortified food sources of vitamins A and B12, fewer affordable sources of folate and calcium, and few, if any, affordable sources of iron and zinc. The most affordable unfortified food sources of priority micronutrients are liver, small fish, dark green leafy vegetables, milk, eggs, and, in some countries, ruminant meat and groundnuts.

Second, Yan Bai and Will Masters presented a study modeling the least-cost nutrient-adequate diets for infants and young children aged 6–23 months using the latest global retail food prices and the latest guidelines for complementary feeding. Their research addressed the following questions: *What are the cost ranges of complementary feeding at a global level? What is the role of small-quantity lipid-based nutrient supplements (SQ-LNS)? What are the foods that most often minimized diet costs? What are the most limiting nutrients or dietary factors?*

The modeling uses price data from the World Bank's International Comparison Program (ICP), which collects prices for a selection of goods and services. The study takes into account the following nutrition parameters: the WHO references for energy requirements and body weight, breast milk intake (in increments of 10 g/d), recommended daily intakes for 27 macro- and micronutrients, maximum daily intakes in grams per day for 30 food groups, limited gastric capacity and a practical limit on meal frequency per day for complementary feeding, and other food preparation and nutrient retention assumptions. In addition to modeling scenarios without any fortified foods or supplements, the analysis models the impact of introducing SQ-LNS (when distributed for free to the end user) on overall complementary feeding costs.



The following conclusions were drawn from the analyses:

The cost of complementary feeding to meet nutrient needs is not uniformly affordable to the poor.

- Where available, solid or semi-solid foods of sufficient nutrient density for adequate complementary feeding typically cost about \$2 a day.
- The primary cost drivers are animal-source foods and legumes, in addition to starchy staples, oil, and vegetables or fruits.
- Modeling higher breast-milk intake reduces complementary food costs to a threshold beyond which greater breast-milk intake raises the need for high-cost, high-nutrient-dense, complementary foods.
- Complementing breast milk and low-cost staple foods requires expensive items such as dark green leafy vegetables, red/orange fruits and vegetables, eggs, and animal liver.

Providing SQ-LNS allows caregivers to meet infant needs with family foods at a much lower cost.

- Complementing breast milk with SQ-LNS makes gradual introduction of more widely available, lower-cost family foods sufficient to meet nutrient requirements.
- The family foods required in addition to breastfeeding and SQ-LNS are available in all countries and typically cost less than \$1 a day for the small amounts needed.
- To achieve healthy complementary food diets, dietary diversity, including frequent consumption of fruits and vegetables, is still required, even when SQ-LNS is provided.
- The costs of manufacturing and distributing SQ-LNS vary but are likely to be less than the costs of the foods otherwise needed, offering a cost-effective form of nutrition assistance targeting infants.

Finally, a food pattern modeling exercise was carried out to support the revision of updated WHO guidance on complementary feeding. Unpublished results were presented by Mary Arimond and Elaine Ferguson. They used the Optifood tool to address the following research questions: *Can target nutrient needs be met using unfortified foods in best-case food patterns? What do these food patterns look like, and what happens when certain food groups or subgroups are eliminated? What happens if the amount of starchy staple foods is increased?*

The modeling parameters used to select the best-case food pattern scenarios allowed generous but realistic amounts of food subgroups (g/week) in the simulated diets. This means that all food groups were considered to be available, generous but feasible maximum quantities and frequencies of consumption were included, and diversity of food subgroups was high.

While the findings could not be shared before publication, Arimond and Ferguson reported that the overall conclusions regarding animal-source foods align with evidence from other modeling exercises. The Optifood modeling includes a larger number of micronutrient targets than the other modeling exercises, and results indicate a more important role for diverse vegetables, including as first foods. The best-case food patterns, which include ample amounts of diverse vegetables and diverse plant- and animal-source protein foods, can meet most of the nutrient targets for infants and young children except for iron. When animal-source foods and vegetables are eliminated from the food patterns, nutrient deficits arise.

The three modeling exercises presented in this session confirm the important role of animal-source foods in all age groups, as well as fruits and vegetables in the older age group (12–23 months), in ensuring micronutrient intakes. However, the affordability of these foods remains a discussion point.



Researchers agreed to exchange the food lists and list of constraints. Discussion points related to the modeling results presented in this session included the following:

- The models assume that nutrient supplements are provided at no cost to the household, which reduces household costs for nutritious complementary foods. However, the retail cost and scale-up costs (e.g., production, transportation, distribution, social behavior change communication) of these supplements or any foods required in complementary feeding need to be covered by the government or other sources.
- Bioavailability is an important factor that is only partially considered in the modeling.
- Foods that are bartered or gathered in nature are not included in the modeling.
- Neglected and underutilized species of foods high in micro- and macronutrients were not included in the modeling.
- Besides affordability, the supply of some nutrient-dense foods (e.g., liver) is low, and accessibility and acceptability are also key barriers. Formative research (market surveys, seasonal calendars) could be used to identify alternative food options during different seasons.



Evidence on impact of home fortification in complementary feeding on child nutrition outcomes

Session Presenters: Kay Dewey (University of California Davis)

Kay Dewey presented a strong evidence base for the two main types of home fortification products: micronutrient powders (MNPs) and small-quantity lipid-based nutrient supplements (SQ-LNS, 20g/d).

The most limiting nutrient in complementary food diets is often iron. Evidence shows that it is challenging to meet targets for iron intake by increasing intakes of animal-source foods (e.g., some small fish do not contain much iron; some meat products are difficult for older infants and young children to chew and/or do not have adequate iron density) and that home fortification is the most effective way to ensure adequate iron intakes for children under two years of age (Vitta and Dewey 2012). It is also challenging to achieve adequate intakes of essential fatty acids (EFAs) and certain minerals (e.g., zinc, calcium, potassium) in complementary food diets. In contexts with ample EFA food sources, such as fish, MNPs may be sufficient to cover the needs for iron and zinc, though MNPs usually do not contain calcium or potassium. SQ-LNS was designed to meet all these needs, including in contexts with limited EFA food sources.

MNPs and SQ-LNS have been shown to reduce anemia and iron deficiency. MNPs showed no effects on anthropometric measures or morbidity (including malaria) (Suchdev et al. 2020). SQ-LNS led to a 27% reduction in all-cause mortality among children 6–24 months old enrolled in community-based randomized trials (Stewart et al. 2019). SQ-LNS also reduced other indicators of malnutrition, such as stunting and wasting; improved child development indicators; and reduced vitamin A deficiency (Dewey et al. 2021). For most outcomes, the beneficial effects of SQ-LNS were evident regardless of region (Africa or South Asia), stunting burden, malaria prevalence, sanitation, or water quality. Combining home fortification products with other infant and young child feeding (IYCF) interventions may strengthen the enabling environment, reinforce key IYCF messages, enhance training of community health workers, and increase the demand for and delivery of their services (Locks et al. 2023). There is evidence that home fortification products do not harm IYCF practices, including dietary diversity, and that SQ-LNS do not have adverse effects on breast-milk intake (Arimond et al. 2017; Byrd et al. 2019; Jannat et al. 2019; Kumwenda et al. 2014; Lesorogol et al. 2018).

Going forward, it is essential to document the programmatic effectiveness and budgetary implications of home fortification at scale. There is a need for implementation research on effective delivery of MNPs and SQ-LNS, specifically on supply chains; cost-reducing product, packaging, and delivery designs; opportunities for local production; and motivational counseling. Furthermore, integrating SQ-LNS into primary prevention of wasting and secondary prevention of relapse into moderate or severe wasting would constitute a holistic prevention and treatment approach to wasting.

Priority knowledge gaps regarding home fortification (full list available in Annex C)

1. Document the programmatic effectiveness of home fortification *at scale* (e.g., sustainable implementation, including supply).
2. Address regulatory considerations for home fortification products through inclusion in Codex Alimentarius and inclusion of SQ-LNS in the Essential Medicine List.
3. Reduce environmental impact by developing biodegradable or recyclable packaging while maintaining product quality and shelf life.
4. Incentivize government budget allocation (e.g., *through a matching financing mechanism*).



Key barriers and enablers

- Affordability and acceptability for governments
- Availability for consumers (supply chain)

Evidence on impact of plant-source foods in complementary feeding on child nutrition outcomes

Session Presenters: All

Plant-source foods such as fruits and vegetables are recommended components of a diverse complementary food diet for children after six months of age, in addition to breast milk. Because of the high water content of these foods, however, their concentration of most micronutrients is relatively low. Yet the modeling exercises specifically highlighted the importance of subgroups such as dark green leafy vegetables, fresh beans and peas, and orange and red fruits and vegetables such as carrots, mangoes, papaya, pumpkins, and orange sweet potato. A combination of these vegetables and fruits brings multiple nutrients to the diet.

Fruits and vegetables in the complementary diet also add value by helping children develop a taste for and acceptance of these foods, which play an important dietary role later in life for gut health and the prevention of noncommunicable diseases. Several studies have shown that providing vegetables as first foods increased future vegetable intake (Moss et al. 2020; Rapson et al. 2021; Rapson et al. 2022), though strong evidence tracking these dietary patterns in the long term is lacking.

Seeds, nuts, peas, and other legumes are also good plant sources of protein and, more specifically, various indispensable amino acids, the digestibility of which depends on their food source. Legumes, especially fresh legumes, are also high in folate. The addition of cowpea to complementary feeding in Malawian infants reduced linear growth faltering in the cowpea group only (Stephenson et al. 2017). It is important to acknowledge that there is a possible gap in intake and digestibility of indispensable amino acids if breast-milk intake is low. A degree of processing or preparation is required to improve mineral bioavailability and protein digestibility, reducing antinutritional factors such as phytate, trypsin inhibitors, and saponins.

Several studies find that production diversity is important for consumption diversity, especially in areas where market access is limited, as well as for sustainability and resilience of food systems (Akhter et al. 2022; Ayenew et al. 2018; Sekabira et al. 2022; Sibhatu et al. 2015). In addition, processing and storage may be required to make fruits and vegetables more available beyond the growing season. Sustaining home production activities is challenging owing to constraints in water availability and land access for women. Fresh produce availability and affordability (for all food groups, not only plant-source foods) cannot be solved at the household level: it requires a transformative food systems approach. World Vision International (WVI) shared a successful example of an integrated program in Burundi that included but was not limited to biofortified crops, [Positive Deviance/Hearth](#) (PDH), and

Burundi country case

In collaboration with the government of Burundi and the World Bank, WVI established an integrated approach to reduce malnutrition in two health districts. Interventions included biofortification (orange-fleshed sweet potatoes, high-iron beans), kitchen gardens, home fortification with MNPs, savings groups, farmers associations, community decentralized growth monitoring, and Positive Deviance/Hearth. A before-and-after comparison showed an 8.6 percentage-point reduction in wasting in only 14 months (Basenya and Sonne 2021).



kitchen gardens. Child wasting in children under five years of age fell from 12.9% (April 2019) pre-intervention to 4.3% (June 2020) post-intervention at the height of COVID-19 (Basenya and Sonne 2021). Although the example was an integrated program that goes beyond plant-based foods, it captures essential programmatic experience in food-based approaches to improve nutrition outcomes at a large scale.

Priority knowledge gaps on plant-source foods (full list available in Annex C)

1. More information is needed on affordability, accessibility, availability, food safety, and convenience of key food subgroups in varying contexts.
2. What does consumption mean for dietary patterns and the role of plant-based foods later in life?
3. How can these interventions be scaled up and tailored to context, considering the variability of availability, acceptability for older infants and young children, and food preparation modes?
4. How can food systems elements be enhanced to increase production and cold storage chains to improve the availability, quality, safety, and affordability of fruits and vegetables?

Key barriers and enablers

- Availability
- Affordability
- Acceptability
- Perishability and food safety
- Acceptability for older infants and young children



Evidence of impact of animal-source foods in complementary feeding on nutrition outcomes

Session Presenters: Christine Stewart (UC Davis), Shakuntala Thilsted (CGIAR)

Though animal-source foods, such as eggs, dairy, fish, and meat, are among the most nutrient-rich foods for complementary feeding, evidence on their specific impact on linear growth or cognitive development in early childhood is non-conclusive or still emerging (Shapiro et al. 2019).

Eggs

Eggs are an especially good complementary food, with a high protein, lipid, and micronutrient density, including choline (important for brain development, growth). Eggs are not an especially good source of iron; hence, they need to be consumed with iron-rich complementary foods, iron-fortified products, or iron supplements. Several trials in which children were provided with one egg a day during the early complementary feeding period have yielded inconclusive results on dietary diversity, growth, and stunting outcomes (Iannotti et al. 2017; Iannotti et al. 2020; Stewart et al. 2019). Whereas eggs as a food-based intervention improve complementary feeding dietary diversity in children aged 6–23 months during a critical period in their development, the translation to improvements in linear growth or other functional outcomes depends on context-specific factors.

Overcoming egg value chain bottlenecks in Malawi

Small-scale egg farmers received training, loans, and market support to access local markets and peri-urban and urban markets for their surplus, while social marketing increased egg consumption. This turned out to be a win-win solution. Egg farmers were able to repay their loans rapidly (within three to five years) and triple their income. Consumers benefited from a reduced price and increased availability, from 2 to 9 eggs per capita per month (FAO et al. 2023).

Christine Stewart explained the above by comparing two similar studies—one in Ecuador and one in Malawi—in which children 6–9 months old were provided one egg a day for six months. While improved short-term growth was reported among young children in Ecuador (at 12–15 months of age), this effect had disappeared two years after the intervention. A similar impact on child growth was not found in the trial in Malawi, where baseline stunting rates were lower than in Ecuador. Other context-specific factors in Malawi include poor-quality water and sanitation facilities, endemic malaria, and high inadequacy of micronutrient intake (including choline). It appears that the nutrient gaps in the complementary feeding diet were filled more effectively with the addition of one egg a day in Ecuador than in Malawi, possibly because the nutrient gaps in Malawi were higher as a result of higher needs because of widespread inflammation and infection.

Whereas eggs are considered a wholesome complementary food, additional studies are needed on the inclusion of eggs as part of a balanced complementary feeding diet for infants and young children. Implementation science is needed to address key barriers in the egg value chain (cost, distribution, promotion) and to evaluate program impact on egg supply, demand, and consumption.

Aquatic foods

Fish contain high concentrations of several minerals, vitamins, polyunsaturated fatty-acids, and micronutrients that are critical for proper growth and development—notably iron, vitamin A, calcium, iodine, zinc, selenium, omega-3 long-chain fatty acids, and vitamin B12. Small fish, which are consumed



in their entirety, are especially nutrient dense compared with fish flesh or larger fish. Across fish species, however, there are huge variations in nutrient content (Bogard et al. 2015)—not all small fish are good sources of iron.

A recent systematic review looked at the impact of fish and fish-based products (including measuring consumption of fish or fish-based complementary food products in children aged 6–23 months) on nutrition and health outcomes during the first 1,000 days of life in LMICs (Byrd et al. 2022). The review did not find strong evidence for improved growth due to fish consumption in children in 10 impact evaluations that were highly heterogeneous in their design and likely underpowered to detect an effect. Results from 29 observational studies were mixed but provided evidence that adding fish to child diets is associated with improved nutrition outcomes, such as reduced risk of anemia and improved vitamin D status (Byrd et al. 2022).

In places where fish is available and affordable, this is an appropriate and acceptable complementary food for infants and young children. Dried fish and fish powders are a relatively affordable animal-source food. While fish powder is locally available and culturally acceptable in many contexts, in other settings the strong taste can limit acceptability. Acceptability can be improved by including fish powder in traditional and local recipes, such as in commonly consumed chutneys in various Asian countries.

Shakuntala Thilsted presented experiences of several fish interventions that aimed to support growth and nutrient adequacy in young children and pregnant and lactating women. For instance, the government of Odisha in India supports women in undertaking small-scale aquaculture activities, which provide fish powder and solar-dried small fish to be included in meals in childcare centers as well as food rations for adolescents and pregnant and lactating women through the government’s Supplementary Nutrition Program (WorldFish 2021).

Session discussants noted the urgent need to consolidate the evidence regarding the contribution of aquatic foods to positive complementary feeding practices. They called for a systematic research agenda to generate evidence regarding nutrition outcomes; to determine factors such as variability of nutrient content across fish species; and to address issues of accessibility, affordability, and safety.

Meat

Despite the wide support for the consumption of meat or “flesh foods” as a strategy for improving dietary quality and overall nutrition during the complementary feeding window, there are surprisingly few studies demonstrating impact on functional nutrition outcomes. One systematic review concluded that consuming meat helps maintain adequate iron or zinc status or prevent iron or zinc deficiency (strong evidence for iron, more limited evidence for zinc) during the first year of life among infants with insufficient iron or zinc stores or breastfed infants who are not receiving adequate iron or zinc from other sources (Obaggy et al. 2019). A related systematic review concludes that there is moderate evidence that consuming different amounts of meat does not favorably or unfavorably influence growth, size, or body composition (English et al. 2019).

The modeling exercises presented in this consultation highlighted the importance of organ meat, especially liver and kidney, which are among the most nutrient-dense, with high values for iron, zinc, copper, vitamin A, B vitamins, and selenium. Ruminant meat and offal meat are very high in bioavailable iron—the key nutrient that is deficient in most complementary feeding diets.



Affordability is the principal barrier to meat consumption, though supply, accessibility, and acceptability are also limiting factors. Liver is the most affordable compared with flesh meat but in some areas is sold only in large quantities (e.g., beef liver), which may put it out of reach for some households. Chicken liver is not available everywhere as families tend to consume it with the chicken.

Knowledge gaps on animal source foods ([full list available in Annex C](#))

1. More studies are needed on the inclusion of egg and egg powder as part of a balanced complementary feeding diet for older infants and young children. Implementation science is needed to address key barriers in the egg value chain (cost, distribution, promotion) and to evaluate program impacts on egg supply, demand, and consumption.
2. A broad research agenda needs to be developed on aquatic foods as part of complementary feeding, covering nutrition outcomes, nutrient content (specifically of iron) of diverse aquatic foods, product development, acceptability, affordability, bioavailability of micronutrients, and heavy metal contamination issues.
3. Meat and dairy were not extensively discussed in this expert consultation, despite their high nutrient density. Implementation science must address the barriers to using meat in complementary feeding.

Key barriers and enablers

- Availability
- Affordability
- Perishability and food safety
- Food safety
- Acceptability (texture, cultural taboos)



Conclusions and Recommendations

This expert consultation, with 31 participants from academia, research institutes, implementing organizations, and the United Nations, aimed to discuss both the existing knowledge and the gaps in knowledge on specific food groups and home fortification products used in complementary feeding of children aged 6–23 months.

The two-day meeting resulted in agreement among participants on key sets of recommendations, as outlined here.

I. Research recommendations

- **Rigorous research is needed to fill knowledge gaps on the efficacy- and implementation-related constraints of food-based and home fortification complementary feeding interventions.** This issue is particularly relevant for food subgroups, which vary significantly in terms of nutrient density. A non-exhaustive list of research questions is proposed in Annex C.
- **Study designs, protocols, and nutrition and complementary feeding outcomes should be harmonized to ensure that evidence is comparable and can be used to inform recommendations for enhancing complementary feeding.** Researchers should use the harmonized nutrient reference intakes recommended by Allen (2022), which combine standards from the European Food Safety Authority (EFSA) and the Institute of Medicine (IOM), depending on the nutrient. Participants called for a concerted effort to identify positive deviance, best practices, and success stories on complementary feeding, similar to the approach used by the Exemplars in Global Health.
- **To overcome barriers to improved complementary feeding, research is needed on promising interventions that are implemented across systems (food, health, social protection) and on the details and drivers of barriers.** For instance, what are the reasons behind the unaffordability of nutritious foods? Is it because households lack financial means, because they make other budget decisions, or because caregivers and mothers lack decision-making power over household expenditures?
- **Additional research is needed on the implementation, acceptability (by country governments), cost, and scale-up of home fortification of complementary foods with MNPs or SQ-LNS.** This work must also assess the contribution of these home fortificants to the overall diets and nutrition of infants and young children.
- **Research is needed to understand the link between complementary feeding practices in early childhood and dietary patterns later in childhood, adolescence, and adulthood.** Most research on complementary feeding practices focuses on children under age two, with significant knowledge gaps on how much family dietary patterns influence complementary feeding in the first two years of life and how much complementary feeding practices in childhood affect dietary patterns and food choices throughout life.
- **The development of a logical framework and identification of subsequent program impact pathways to achieving positive complementary feeding behaviors would help shed light on key barriers and how to overcome them in different contexts.** Across every food group, affordability, availability, and acceptability are major barriers. Other barriers differ by food group, age group, and context. For instance, barriers can vary widely between urban contexts



and rural contexts, as well as between regions, such as South Asia and Sub-Saharan Africa.

- **Research is needed to identify the most effective and innovative approaches to child feeding counseling that address the barriers to caregivers' uptake of optimal approaches to complementary feeding and that can be replicated and adapted to the context.** Such barriers might include cooking time, affordability, child's preferences, and guidance from family or experts. It would be worthwhile to organize an expert consultation focused solely on social behavior change communication. Lessons should be drawn not only from the nutrition sector but also from research on, for instance, habit formation, behavioral economics, and e-health approaches.
- **Given that excess consumption of unhealthy, ultraprocessed foods in early childhood is a growing concern across all contexts, this topic should be prioritized in research.** Although the meeting did not cover this topic, the experts recommended evaluating the evidence on the impact of commercially produced complementary food products, ranging from fortified complementary foods following Codex guidelines to ultraprocessed foods high in sugar and sodium and low in micronutrients. A separate consultation to agree on definitions of unhealthy foods and evaluate evidence on strategies aiming to reduce the marketing and consumption of these products is recommended.

II. Implementation and programming recommendations

- **Improving complementary feeding requires both home fortification and food-based complementary feeding interventions. Together, the two approaches can be complementary and potentially synergistic.** Home fortification products, if provided to households, can fill nutrient gaps in many LMICs, where healthy complementary feeding diets are often unaffordable or inaccessible. Even in high-income countries, certain micronutrient needs are met mostly through commercial fortified complementary foods.
- **Food and social protection systems should be strengthened to ensure they are more child centered and better designed to address the barriers and enablers of feeding nutrient-dense foods to children aged 6–23 months and to improve complementary feeding practices.** Actors in these systems need to be aware of what young children's diets should include. Social protection systems can support household income by providing cash, vouchers, or direct transfers of nutritious foods (including special foods for older infants and young children). Food systems can help alleviate household-level constraints to food preparation by increasing access to cooking fuel and refrigeration as well as to markets. Food systems can also make value chains more efficient by reducing waste and bottlenecks in delivering safe and affordable nutritious foods, and they can help inform consumers through front-of-pack labeling of packaged foods and supplements. Agricultural and horticultural innovations, strategies, and policies can be implemented to enhance the availability, affordability, and nonperishability of key nutritious food groups, including dark green leafy vegetables (DGLVs), peas and beans, orange and red fruits and vegetables, nuts, legumes, liver, dairy, eggs, and aquatic foods.



Advocacy and policy recommendations

- **A collective advocacy agenda with varying target audiences is necessary to build awareness and drive new evidence-based policies and investments for improved national complementary feeding programs.** This advocacy must also support monitoring of such programs to enhance learning. To be effective and sustainable, policies and guidance on health, nutrition, and agriculture need to take complementary feeding needs into account and be practical and context-specific.
- **National food-based dietary guidelines, which are central to various national policies and relevant social protection programs, should include the dietary needs of children under age two.** While national guidelines may not change behavior directly, such evidence-based guidance can help bring diverse stakeholders together and signal to policy makers, implementers, and the private sector what (and what not) to produce and market. The forthcoming WHO guidelines and accompanying user-friendly guidance documents will be useful for helping governments and other key actors decide which food groups and subgroups and which evidence-based dos and don'ts need to be incorporated based on their contextual diets.
- **Guidance and support for national and subnational governments are needed to help them cost, budget, and fundraise for improved complementary feeding programs that are coordinated and accountable across nutrition, health, and agriculture budgets.** Investments—including in sustainable financing goals, mainstreaming in annual budgets, costed development plans, resource mobilization strategies, and tracking and accountability systems—are needed to ensure that enabling health, agricultural, and social protection policies are in place, that food system transformations take the dietary needs of children 6–23 months old into account, and, most important, that existing knowledge is translated into doable action to overcome the barriers to positive complementary feeding behaviors.
- **Immediate advocacy opportunities exist to integrate and elevate the issue of poor early childhood diets, their tremendous adverse impacts, and the need for policies and investments on complementary feeding to be integrated into ongoing global food systems and food crises agendas.** Evidence-based narratives are powerful tools to drive forward advocacy efforts for sustainable financing for positive complementary feeding practices. This includes the Healthy Diets Coalition, the UN Food Systems Summit stocktaking event, the African Year of Nutrition, Nutrition for Growth in 2024, and of course the Global Collective on Complementary Feeding.



The participants in this Expert Consultation have formulated a Joint Statement to encourage the broader Global Collective on Child Complementary Feeding to take up the recommended priorities.

Expert Consultation on the Micronutrient Quality of Complementary Feeding in Early Childhood

JOINT STATEMENT OF RECOMMENDATIONS

1. We encourage governments to include specific guidance for complementary feeding of older infants and young children 6–23 months in national food-based dietary guidelines.
2. We encourage stakeholders in the food system and the social protection system to take infant and young child feeding requirements into consideration as part of their systems' policies, strategies, and programs.
3. We recommend the development of implementation guidance for programming in plain language, with concrete examples to accompany the updated WHO complementary feeding guidelines (to be published by end 2023). Countries should be encouraged to update their young child feeding policies accordingly.
4. We recommend that the various child feeding recommendations included in different WHO guidelines be aligned with complementary feeding guidelines.
5. We recommend that complementary feeding guidelines specify that dietary components that contribute to nutrient deficiencies and obesity (such as high-sugar beverages and nutrient-poor, high-fat snacks) should be avoided.
6. We encourage the integration of micronutrient-rich, affordable, and acceptable diets and practices in complementary feeding, including traditional and indigenous foods.
7. We recommend that cost, convenience, time, and availability of foods be considered when making recommendations for a healthy complementary food diet. These are highly relevant factors to low-income urban and rural families when making decisions on child feeding (and household diet).
8. We encourage governments to include complementary feeding interventions in annual budgets, costed development plans, resource mobilization strategies, expenditure tracking, and accountability systems across national budgets for food, health, and social protection systems.
9. We recommend holding additional expert convenings to review the following topics:
 - Unhealthy foods and beverages (low in micronutrient density, high in sugar or unhealthy fat)
 - Commercially produced fortified complementary foods
 - Demand creation and social behavior change communication
 - Complementary feeding in humanitarian contexts



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Annex A: Participant List

| | | |
|----|------------------------------------|--|
| 1 | Arimond, Mary | Consultant |
| 2 | Bai, Yan (<i>virtual</i>) | World Bank / Tufts University |
| 3 | Baik, Diane | World Vision International |
| 4 | Beal, Ty | Global Alliance for Improved Nutrition |
| 5 | Bhandari, Nita | Centre for Health Research and Development, Society for Applied Studies |
| 6 | Chaouki, Fadoi (<i>virtual</i>) | European Union |
| 7 | de Pee, Saskia (<i>virtual</i>) | World Food Programme |
| 8 | Dewey, Kay | University of California, Davis |
| 9 | Ferguson, Elaine | London School of Hygiene & Tropical Medicine |
| 10 | Hilton, Kennedy (<i>virtual</i>) | Nutrition International, Home Fortification Technical Advisory Group (HFTAG) coordinator |
| 11 | Houchins, Jenny | American Egg Board |
| 12 | Huybregts, Lieven | International Food Policy Research Institute |
| 13 | James, Phil | Emergency Nutrition Network |
| 14 | Klemm, Rolf | Helen Keller International |
| 15 | Kraemer, Klaus | Sight and Life |
| 16 | Lutter, Chessa | RTI International, Division of Food Security and Agriculture |
| 17 | Masters, Will (<i>virtual</i>) | Tufts University |
| 18 | Moloney, Grainne | UNICEF |
| 19 | Nyaku, Albertha | Results for Development |
| 20 | Osendarp, Saskia | Micronutrient Forum |
| 21 | Pries, Alissa | Helen Keller International |
| 22 | Rastogi, Tanuja | Micronutrient Forum |
| 23 | Rubin, Mickey | American Egg Board |
| 24 | Ruel, Marie | International Food Policy Research Institute |
| 25 | Shaker, Linda | UNICEF |
| 26 | Stewart, Christine | University of California, Davis |
| 27 | Thilsted, Shakuntala | Nutrition, Health and Food Security Impact Area Platform, CGIAR |
| 28 | Sanghvi, Tina | Alive and Thrive, FHI Solutions |
| 29 | van Liere, Marti | Micronutrient Forum |
| 30 | Weiss, Ingrid | United States Agency for International Development |
| 31 | Zlotkin, Stanley | Hospital for Sick Children, Home Fortification Technical Advisory Group |
| | | |

Annex B: Agenda of Expert Consultation Micronutrient Quality of Complementary Feeding in Early Childhood

8–9 June 2023 | IFPRI headquarters, Washington DC

| Time | Day 1—Agenda Item | Objective | Presenter | Time Allocation |
|--------------|---|---|---|-----------------|
| 9:00-9:20am | Welcome and Introductions | Introduction and framing of the consultation | Saskia Osendarp, Micronutrient Forum | 20 min |
| 9:20-11:30am | Setting the Scene | Overall framing: what are the gaps, what are the barriers, why focus consultation on HF and these food-based approaches? | Grainne Moloney, UNICEF | 25 min |
| | | Evidence on contribution of fresh food groups to nutrient intake (modeling exercise) | Mary Arimond Elaine Ferguson, LSHTM | 15 min |
| | | Micronutrient gaps and affordability in complementary feeding | Ty Beal, GAIN | 15 min |
| | | Evidence on affordability | Will Masters, Tufts Univ. | 15 min |
| | | Implementation guidance on complementary feeding | Alissa Pries, WHO | 15 min |
| 11:30-1:00pm | Discussion and Agreement on Main Questions to Be Addressed in Consultation | <p>Questions suggested as a starting point:</p> <ul style="list-style-type: none"> ▪ <i>What are the main knowledge gaps that prohibit implementation/scale-up of this intervention, to be prioritized, and what are next steps?</i> ▪ <i>What are the main policy barriers that prohibit implementation/scale-up of this intervention, to be prioritized, and what are next steps?</i> ▪ <i>What are the main implementation barriers that prohibit implementation/scale-up of this intervention, to be prioritized, and what are next steps?</i> | | 90 min |
| 1:00-1:45pm | Lunch | | | 45 min |



| | | | | |
|-------------|---------------------------------------|--|--|---------|
| 1:45-3:45pm | Home Fortification Solutions | Evidence presentation on nutrition outcomes and implementation <ul style="list-style-type: none"> Home fortification (SQ-LNS and MNPs) | Kay Dewey | 15 min |
| | | Discuss remaining knowledge gaps and main barriers to implementation of home fortification solutions to complementary feeding: | <i>Write-up of priority gaps and next steps by two volunteers</i> | 105 min |
| 4:00-6:00pm | Fruits, Vegetables, Nuts, and Legumes | Considerations based on evidence and experience Discuss remaining knowledge gaps and main barriers to implementation of plant-source solutions to complementary feeding | All <i>Write-up of priority gaps and next steps by two volunteers</i> | 120 min |

| Time | Day 2—Agenda Item | Objective | Presenter | Time Allocation |
|--------------|-------------------------------------|---|---|------------------|
| 9:00-12:30pm | Meat, Eggs, and Aquatic Foods | Evidence presentations: <ul style="list-style-type: none"> Eggs / egg powder Aquatic foods / fish powder | Christine Stewart Shakuntala Thilsted | 10 min 10 min |
| | | Discuss remaining knowledge gaps and main barriers to implementation of animal-source and aquatic food solutions to complementary feeding | <i>Write up of priority gaps and next steps by two volunteers</i> | 190 min |
| 12:30-1:15pm | Lunch | | | 45 min |
| 1:15-3:30pm | Develop Priority Roadmap | Present main priority gaps and next steps by volunteers | Volunteers | 45 min |
| | | Development of priority roadmap, with articulation of knowledge, policy and programme gaps | All | 90 min |
| 3:30-4:30pm | Formulate Action Agenda and Closing | | | 60 min |

Annex C: Priority knowledge, policy and programme gaps identified for each food group (not listed in order of importance)

Although the priority knowledge gaps, for which additional research is needed, have been identified in the main report for each of the home fortificants and food groups, the experts identified many other areas of research, which are summarized below.

The more detailed questions listed for each food group refer to the following set of general questions:

- How can dietary diversity be increased in complementary feeding?
- What food system or value chain interventions can sustainably increase the inclusion of specific animal- and plant-source foods in complementary feeding?
- Which specific foods should be included, in what amounts, for what impact on nutritional status outcomes?
- What specific strategies can be developed to enhance the affordability, availability, and acceptability of nutrient-dense foods across different age groups, contexts, and regions?
- How can interventions effectively address the different barriers faced by caregivers, considering factors such as urban vs. rural contexts and regional disparities?
- What are the key positive deviance examples and best practices in complementary feeding, and how can these be identified and shared effectively?
- How can insights from behavioral economics and e-health be effectively integrated into child feeding counseling for behavior change?

Priority gaps and research questions identified for home fortification

Impact

- What is the effectiveness of alternative delivery strategies of these supplements *at scale*, within health systems, social protection programs, community health and development programs, and humanitarian contexts?
- For each of these contexts, what is the cost-effectiveness of SQ-LNS (e.g., per DALY)?

Barriers at the household level

- **Intrahousehold sharing:** In households with more than one child, how is it possible to ensure that the SQ-LNS goes to the target child of 6–23 months?
- **Quality counseling:** How do we raise individual caregiver awareness and improve the messaging? Should we, for example, explore novel ways of counseling, build on existing habits, or try to new approaches to create desirability (an issue more relevant to MNPs than SQ-LNS)?
- **Highly food-insecure contexts:** How should home fortification products be used as part of a food ration basket or social protection package, including consideration of the needs of other household members?

Barriers in the enabling environment

- **Quality at scale**
 - Standards for the nutritional composition and contaminant standards of SQ-LNS are needed to protect quality (particularly for omega-3 fatty acids) and prevent knock-off products.
 - Product standards must be referred to in essential medicine lists and procurement guidelines.
 - Monitoring and evaluation strategies need to be better documented to determine what is effective, where, and how.



- What is the best contact point and time within the health system to encourage appropriate and effective use of SQ-LNS?
- **Food environment**
 - Can home fortification products such as SQ-LNS be marketed as a healthy alternative to ultraprocessed and sugar-sweetened foods?
 - Would a tiered, means-based pricing system for commercial home fortification products be effective in increasing affordability for the most vulnerable households?
- **Scale-up**
 - What is needed to get SQ-LNS to market? How to create market demand, and how to ensure and support local production while maintaining high quality?
 - What **financing modalities** will be effective for sustainable financing?
 - Do formulation criteria and standards need to be relaxed to achieve production at scale?
 - How can the supply chain be diversified to move away from overreliance on UNICEF?
 - How is it possible to ensure that governments budget the full costs of home fortification, including delivery costs?
- **Logistics and production**
 - How can a reliable volume and timing of supply be ensured?
 - To address **environmental issues** related to packaging, how can we avoid single-use plastics while maintaining product quality and shelf life?
 - How can we properly use marketing and labeling to reinforce which products meet the standards?
- **Integration with other interventions**
 - **How can SQ-LNS best be combined with other interventions?** There is a need for implementation guidelines regarding the decision-making process, to know whether SQ-LNS is appropriate in a certain context.

Priority gaps and research questions identified for plant-source foods

Impact

- What is the primary outcome to measure? Nutrient adequacy, nutrient intakes, dietary diversity, growth?
- How should food subgroups (DGLF, brassicas, vitamin A-rich orange vegetables, peas, and beans) be considered in measurement of dietary diversity? Which subgroups should be measured for different age groups within the 6–23 months range?
- How should we handle the inherent recall bias that occurs when outcome measures are included in counseling messaging, making it difficult to know whether we are having the effect we desire?
- There is a need for a standard study design and study protocol to ensure comparability of results across settings and to answer the same questions to generate strong evidence.
- There is a need for biomarker data because assumptions about nutrient bioavailability, specifically in plant-source foods, may be incorrect.
- How do food loss and waste impact the diets of older infants and young children?
- How can all the elements within the program pathway for these interventions be measured?
- What does introduction of this food group in the complementary feeding age of 6–23 months mean for dietary patterns in later childhood and adulthood, particularly in low- and middle-income countries?
- ~~There is a need for more evidence and data on the contribution of infant and young child healthy dietary patterns.~~



- More research is needed on the effect of fermentation on breaking down anti-nutrients and postbiotics and the relationship between the microbiome development and healthy dietary patterns among older infants and young children.

Barriers at the household level

- How to overcome the water constraint to growing fruits and vegetables, and the time it takes to fetch water for women, who are often the main actors in these intervention?
- What does it take to encourage a diverse range of vegetable consumption among older infants and young children, taking into account convenience, mother's time, and inclusion of vegetables in existing recipes?
- More information is required to overcome barriers regarding affordability, acceptability, availability, perishability, and convenience of key subgroups of plant-based foods in varying contexts.
- How can behavioral economics be used to understand the drivers of food choice and behavior change?
- What works best to overcome misconceptions related to feeding young children, such as raising awareness that early introduction of peanuts as a paste reduces risk of allergies?
- What is known about food-purchasing patterns of families over a longer period and their ability to save up for specific food-related expenses?

Barriers for interventions

- How to reduce the impact of seasonality on costs of interventions.
- How can interventions be scaled up while maintaining context-specific tailoring, including commonly consumed types of foods and commonly prepared dishes?
- How can the outcomes of certain interventions, particularly home gardening, be sustained over time?

Barriers in the enabling environment

- There is a need to establish healthy dietary patterns at a population level and for food systems change.
- Governments need to find solutions to increase production and cold storage chains so that it is possible to get vegetables to families.
- How can the national economic interest in production of certain crops be linked to those crops that are important nutritionally for older infants and young children?
- How can agricultural policies and subsidies enable healthier diets?
- How can social protection programs be leveraged to encourage and enable consumption?
- There is a need to advocate for introduction of nuts, including peanuts, at an early age to protect against allergies.

Priority gaps and research questions identified for animal-source foods

Impact

- A research agenda must be developed on aquatic foods (including different types of fish) in the context of complementary feeding. Different varieties have different nutrient content, and there is also a need for more information on heavy metal bioaccumulation risk.
- Replicable studies (standard study design) are needed on fish and eggs, both fresh and as powder, including their impacts on child growth and development.
- Better food composition data on fish are needed, as nutrient composition varies by drying process, fish species, and other factors. Small fish have greater nutrient density, possibly because all parts of the fish are consumed.
- What are the possible effects of improving egg powder by, for instance, fortifying it?



- What are the best outcomes to measure based on the context and need: dietary intake, dietary adequacy, nutrient adequacy, dietary diversity, stunting, biomarkers, or longer-term outcomes like cognitive development? The answer may be context specific. Dietary adequacy is a worthy goal in itself.
- There is a need for biomarker data because assumptions about nutrient bioavailability in certain animal-source foods may be incorrect.
- More information is needed on alternative animal-source foods such as insects or dairy.
- Research is needed on the costs and benefits of animal-source foods, especially offal, eggs, and dairy, for households.

Barriers at the household level

- Availability, affordability, acceptability, and perishability must be considered for each product. Perishability and safety are important issues for animal-source foods, specifically offal, dairy, eggs, and fish.
- Ways must be developed to improve the convenience of healthy complementary feeding at the household level.
- It will be important to overcome the barrier of unacceptability in places where fish is not commonly fed to older infants and young children. For instance, fish powder could be mixed with local and culturally acceptable ingredients, such as turmeric in Bangladesh or tamarind in Cambodia.

Barriers for interventions

- How can the challenges around supply chains for small fish, offal meat, eggs and dairy be overcome? Examples include women's self-help groups and egg production hubs.
- How can the trade-offs for producers between using animal-source foods to feed children aged 6–23 months or selling them to generate income be overcome?

Barriers in the enabling environment

- Global and national dietary recommendations need to take the nutrient density of different animal-source foods into account.
- The food environment is crucial for supply of nutritious foods and needs to be part of this discussion. For example, by increasing the flock sizes of laying chickens, increased egg production will lead to higher availability and affordability of eggs, and the subsequent surplus can be transformed into egg powder.
- National nutritional guidelines need to include recommendations for early introduction of eggs and nuts to minimize the risk of food allergy development.