COMPREHENSIVE NUTRIENT GAP ASSESSMENT (CONGA)

MICRONUTRIENT GAPS DURING THE COMPLEMENTARY FEEDING PERIOD IN **ZAMBIA**

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For more details and full sources, see the following articles from which this brief is drawn:

- Beal T, White JM, Arsenault JE, Okronipa H, Hinnouho G-M, Morris SS. Comprehensive Nutrient Gap Assessment (CONGA): A method for identifying the public health significance of nutrient gaps. *Nutr Rev*. 2021;79(4,Suppl 1):4–15
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KEY MESSAGES

- A Comprehensive Nutrition Gap Assessment (CONGA) provides guidance on use of various types of evidence to assess the public health significance of nutrient gaps in a given population.
- A CONGA conducted on child diets during the complementary feeding period in Zambia found that, based on available evidence, there are no clear nutrient gaps.
- There are, however, potential gaps in iron, zinc, calcium, vitamin B_{12}, folate, vitamin A, thiamine, and vitamin C, but more research is needed to assess these nutrient gaps.
- The best food sources to fill the identified and potential micronutrient gaps include beef liver, chicken liver, small dried fish, beef, eggs, and dark green leafy vegetables.
- More research is needed to understand the primary barriers to consuming these foods, such as limited availability, accessibility, affordability, or desirability.
- Biofortification, fortification, and supplementation can also help fill gaps for micronutrients of concern, particularly where food insecurity, social norms, or lack of palatability or desirability make sufficient consumption from accessible diverse foods infeasible.

WHY IS ASSESSING NUTRIENT GAPS IMPORTANT FOR CHILD DIETS?

Inadequate quantity and quality of foods between 6 and 23 months of age—known as the complementary feeding period, when breast milk alone is no longer sufficient to meet the nutritional needs of infants and young children—are key causes of all forms of malnutrition, including micronutrient deficiencies, and have immediate and long-term consequences. In the short term, these consequences include increased morbidity and mortality and delayed cognitive and motor development.[1] In later childhood, adolescence, and adulthood, poor nutrition in early life can impair academic and work capacity, reproductive outcomes, and overall health, hindering economic development and contributing to the intergenerational cycle of malnutrition.[1-3] Yet young children's diets in Zambia are very poor: only 23% of children 6–23 months of age consume a diet meeting the minimum recommended number of food groups, and only 42% are fed the minimum recommended number of times per day.[4] Just over half of children 6–23 months of age (54%) in Zambia consume iron-rich foods, and 79% consume foods rich in vitamin A.[5]

Improving young children's diets in Eastern and Southern Africa can help prevent all forms of malnutrition, including micronutrient deficiencies, and is an important component of efforts to achieve the global nutrition targets of the World Health Assembly and the Sustainable Development Goals. Insight into specific problematic nutrients, along with the foods and feeding practices that can address those problems, is essential to inform policies and programmes designed to improve child health and nutrition. Evidence indicative of the burden of nutrient deficiencies or nutrient intakes is frequently available yet often underused or misinterpreted in decision-making and programme design, in part because relevant evidence often comes from disparate data sources of varying quality, representativeness, and recency. Available evidence has not been synthesized to produce a clear and comprehensive picture of the magnitude and significance of micronutrient gaps in Zambia. As a result, policies and programmes designed to improve young children's diets often omit specific reference to micronutrient gaps.

A method called Comprehensive Nutrient Gap Assessment (CONGA) was developed to fill this information gap. This approach provides guidance on how to use various types of evidence to assess the public health significance of nutrient gaps in a given population. This brief summarizes the results of a CONGA of the complementary feeding period in Zambia. After identifying micronutrient gaps, it determines the most micronutrient-dense whole-food sources available in part or all of the country to fill the identified gaps.

METHODS

The micronutrients assessed were those identified as commonly lacking in the diets of infants and young children during the complementary feeding period: iron, vitamin A, zinc, calcium, iodine, thiamine, niacin, vitamin B_{12}, vitamin B_6, folate, and vitamin C (macronutrients such as protein were excluded from the CONGA owing to limited data availability).[1] The analysis for Zambia followed the steps outlined in the CONGA methodology.[6]

Step 1: A literature search was conducted to identify information on the five types of evidence relevant for assessing nutrient gaps: (1) biological, clinical, and functional markers, (2) nutrient adequacy of individual diets, (3) nutrient adequacy of household diets, (4) nutrient adequacy of national food supplies, and (5) intake of nutrient-informative food groups (e.g., iron-rich foods) by individuals or households. Other related evidence outside of these categories was also considered. Collated data points and their associated metadata (evidence type, geographic representation, recency of data collection, age and sex representation, and sample size) were captured in a spreadsheet.[7]

Step 2: Data points were reviewed and assigned an implied nutrient gap burden score (based on suggested prevalence and mean ranges for commonly available population-level indicators from all five evidence types per the CONGA methodology).[6]

Step 3: Weight scores were systematically assigned to captured metadata to calculate an overall evidence weight score for each data point, helping to ensure that the most recent, representative, and relevant data were weighted more heavily when assessing nutrient gaps.

Step 4: A quantitative nutrient gap burden score was calculated for each nutrient using only data from the five core evidence types noted above (i.e., excluding 'other' data), data collected in 2010 or later, and data for age groups similar to children 6–23 months of age. A numerical score was calculated by using the weighted mean of the implied gap burden score (where the evidence weights are the weight scores) and assigned a label of high, moderate, low, or negligible.

Step 5: The calculated quantitative nutrient gap burden scores were reviewed alongside the totality of evidence for each nutrient, including 'other' data and additional available information for each data point (such as temporal trends for data points, where available), to determine whether the final rating assigned to the nutrient gap should deviate from the quantitative-derived rating. A final qualitative rating of high, moderate, low, or negligible was assigned to each nutrient, and any deviation from the calculated quantitative burden score was documented and explained.

Step 6: A certainty-of-evidence rating (high, moderate, low, or unknown) was established for each final nutrient gap burden score based on CONGA methodology criteria,[6] which consider the evidence weight scores from step 3 and the level of agreement between data points. These criteria-based ratings were also subjected to a final qualitative review, considering all evidence, to determine whether the final certainty rating should deviate from the criteria-based rating. Any deviations were discussed and documented.

Step 7: A group of subject matter and contextual knowledge experts reviewed the final nutrient gap burden and evidence-certainty ratings produced in steps 5 and 6, respectively. Disagreements with final qualitative ratings were discussed and critically re-evaluated. Ratings were finalized only when consensus was achieved, and documentation of additional considerations or deviations from quantitative burden scores was added.

The most micronutrient-dense available food sources for identified micronutrient gaps were determined data on using food composition and household consumption patterns.[7] Foods were also assessed for how well they met the needs for six micronutrients commonly lacking in young children's diets in Eastern and Southern Africa: iron, vitamin A, zinc, folate, vitamin B_{12}, and calcium.[8] This metric was calculated as the average percentage of daily requirements from complementary foods for these six micronutrients based on a quantity of 100 grams (g) for each food (with each micronutrient's contribution capped at 100% of daily requirements). We also calculated the portion size of each food required to achieve an average of 33.3% of micronutrient requirements (again, capped at 100% of requirements for each micronutrient)—the equivalent of 100% of requirements for two micronutrients or 33.3% of requirements for all six micronutrients—to demonstrate the ideal foods to fill two or more important micronutrient gaps simultaneously. Adjustments for differences in bioavailability between plant- and animal-source foods were made for iron and zinc.[7,9]

NUTRIENT GAPS AND EVIDENCE CERTAINTY

A total of 35 data points for the complementary feeding period in Zambia were identified for this CONGA. These included data points from a Demographic and Health Survey,* a subnational Food Consumption and Micronutrient Status Survey, and other relevant global and national sources. Less than half of these (13) fell into the five key evidence types and qualified for inclusion in the quantitative burden score.[8]

Availability of data points for the five core evidence types varied. Biological and functional markers were

* This CONGA analysis was conducted before the 2018 Demographic and Health Survey data were available. However, when the 2018 data became available it was determined that, based on evidence reported, the nutrient gap and evidence certainty ratings would not change from those derived using the 2013/14 data. Therefore, the CONGA was not updated.

identified for iron, vitamin A, zinc, iodine, vitamin B_{12}, and folate. Subnational prevalence estimates for children under five were identified for iron, vitamin A, zinc, vitamin B_{12}, and folate (albeit from 2008), and a national prevalence estimate for iodine was identified for a proxy age group. Subnational evidence on the nutrient adequacy of individual diets—also from 2008—was available for children 6–23 months of age for all nutrients except iodine from the Food Consumption and Micronutrient Status Survey. No data were identified on the nutrient adequacy of household diets. Estimates of the nutrient adequacy of national food supplies were available for all nutrients. Nutrient-informative food group estimates for individuals were available for vitamin A, iron, and iodine. There were multiple data points categorized as 'other' for several nutrients.[8]

Based on the available evidence, no clear micronutrient gaps—defined as having a burden *and* evidence certainty rating of at least moderate[8]—were identified during the complementary feeding period in Zambia (Table 1). However, potential nutrient gaps were identified for iron, zinc, calcium, vitamin B_{12}, and folate, each with a high burden gap but low-certainty evidence. Iron deficiency is a primary cause of anaemia and can result in cognitive impairment, decreased work productivity, and death.[10] Zinc deficiency in children is associated with poor health, increased risk of diarrhoea, and impaired cognitive and motor development.[11,12] Calcium deficiency increases risk of rickets, but the broader health implications of deficiency in young children are poorly understood.[13] Folate and vitamin B_{12} deficiency in infants and young children can have immediate and long-term consequences, including anaemia, hindered brain development, and adult depression.[14,15]

Vitamin A, thiamine, and vitamin C are also potential nutrient gaps, each with a moderate burden gap but low-certainty evidence. More data are needed to generate higher-quality evidence on the burden of nutrient gaps for these nutrients, as well as for niacin and vitamin B_6.[8]

AVAILABLE FOODS TO FILL NUTRIENT GAPS

Available whole-food sources in Zambia rich in six micronutrients commonly lacking in children's diets (iron, zinc, vitamin A, vitamin B_{12}, folate, and calcium) are listed in Table 2, including micronutrient densities and average share of nutrient requirements for all six nutrients. The best whole-food sources of multiple micronutrients, as measured by average share of requirements per 100 g portion, are small dried fish, chicken liver, beef liver, eggs, beef, chicken, and dark green leafy vegetables. For example, 100 g of small dried fish will achieve an average of 88% of requirements across these six micronutrients for children aged 6–23 months.[8]

TABLE 1. Nutrient gaps and evidence-certainty ratings for children 6–23 months in Zambia

Nutrient	Gap burden	Evidence certainty
Iron	High	Low
Zinc	High	Low
Calcium	High	Low
Vitamin B_{12}	High	Low
Folate	High	Low
Vitamin A	Moderate	Low
Thiamine	Moderate	Low
Vitamin C	Moderate	Low
Niacin	Low	Low
Vitamin B_6	Low	Low
Iodine	Negligible	Low

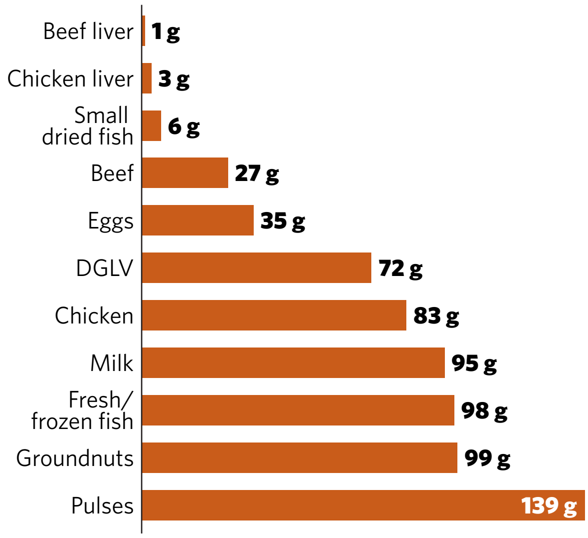

FIGURE 1. Portion size needed to achieve an average of 33.3% of micronutrient requirements for iron, vitamin A, zinc, folate, vitamin B_{12}, and calcium requirements from complementary foods. Each micronutrient's contribution is capped at 100% of daily requirements. DGLV = dark green leafy vegetables.

Figure 1 shows the portion size of each food needed to meet an average of 33.3% of micronutrient requirements across the same six micronutrients. Notably, only 1 g of beef liver, 3 g of chicken liver, 6 g of small dried fish, 27 g of beef, or 35 g of eggs are required to reach this

TABLE 2. Micronutrient density and average share of requirements per 100 g of foods high in priority micronutrients

Food	Iron (mg)	Zinc (mg)	Vitamin A (RAE)	Folate (DFE)	Vitamin B_{12} (μg)	Calcium (mg)	Average share of requirements for all six nutrients
Small dried fish	10.4	**10.0**	363	19	12.0	**2,030**	**88%**
Chicken liver	**12.3**	4.0	4,139	**569**	19.0	11	84%
Beef liver	6.5	5.3	**9,442**	253	**70.6**	6	84%
Eggs	1.2	1.1	149	44	1.1	50	59%
Beef	2.8	6.5	0	8	2.6	8	46%
Chicken	1.2	1.9	46	5	0.3	14	42%
DGLV	3.2	0.3	256	42	0.0	98	40%
Milk	0.0	0.4	46	5	0.5	113	37%
Groundnuts	1.3	2.3	0	86	0.0	57	34%
Fresh/ frozen fish	0.7	0.5	33	4	4.4	14	34%
Pulses	2.3	1.1	0	84	0.0	25	29%
Pumpkin	0.6	0.2	288	9	0.0	15	22%
Okra	0.3	0.4	14	46	0.0	77	21%

Note: These six micronutrients were selected as priorities because they are commonly lacking in young children's diets in Eastern and Southern Africa and because the consequences of observed deficiencies can be severe. All foods are in the form typically consumed. Composition data are from a combination of local and United States Department of Agriculture food composition databases.[16] Bold numbers indicate the highest nutrient density for the specified nutrient or average share of requirements. Average share of requirements for iron, zinc, vitamin A, vitamin B_{12}, folate, and calcium is shown per 100 g of food, assuming requirements from complementary foods for children 6–23 months (with each micronutrient's contribution capped at 100% of daily requirements). The proportion of nutrient requirements from complementary foods was assumed to be 0.98 for iron, 0.87 for zinc, 0.65 for calcium, 0.17 for vitamin A, 0.70 for vitamin B_{12}, and 0.60 for folate.[17] Iron and zinc requirements were adjusted for bioavailability. For iron, a value of 15% was assumed for the dietary bioavailability of animal-source foods and 10% for plant-source foods; for zinc, a value of 50% was assumed for dietary bioavailability of animal-source foods and 30% for legumes, nuts, and seeds.[18] Mg = milligram; RAE = retinol activity equivalent; DFE = dietary folate equivalent; μg = microgram; DGLV = dark green leafy vegetables.

threshold for children 6–23 months, demonstrating the importance of these nutrient-dense animal-source foods in young children's diets. Larger quantities are required, however, for other animal-source foods (chicken and milk) to achieve this threshold. While a moderate-sized portion (72 g) of dark green leafy vegetables can meet the threshold, a larger portion of fresh or frozen fish (98 g), groundnuts (99 g), or pulses (139 g) would be required to achieve the same outcome.[8]

CONCLUSIONS

To design policies and programmes to improve children's health and nutrition, it is essential to identify the nutrient and dietary gaps they face during the complementary feeding period.[19] Identifying these gaps requires reliable and representative data. Using CONGA to assess gaps during the complementary feeding period in Zambia allowed for investigation of different evidence types and sources that are not usually synthesized to assess child diets. This assessment used only existing evidence and required no primary data analysis.** The CONGA methodology also explicitly considers and accounts for instances in which data points disagree on the implied magnitude of nutrient gaps and for differences in the data points' quality or recency.

This CONGA for Zambia shows that while there were no clear gaps during the complementary feeding period owing to low-certainty evidence, potential gaps were identified for iron, zinc, calcium, vitamin B_{12}, folate, vitamin A, thiamine, and vitamin C. Increasing the quality of whole foods consumed by young children is an ideal solution to help overcome these gaps. Animal-source foods, particularly liver, small dried fish, beef, and eggs, were found to be the most nutrient-dense whole-food sources of nutrients with potential gaps in Zambia. Dark green leafy vegetables were also identified as a good source of iron, vitamin A, folate, and calcium. Alternative strategies to fill nutrient gaps include the use of biofortified foods, fortified staple foods, fortified complementary foods, point-of-use fortification products such as micronutrient powders and lipid-based nutrient supplements, and periodic micronutrient supplementation. All of these strategies may be warranted in parts of Zambia, particularly where food insecurity, social norms, or lack of palatability or desirability make sufficient consumption from accessible diverse whole foods infeasible.

Continued breastfeeding until two years of age (or beyond) also makes an important contribution to child diets. Although rates of continued breastfeeding in Zambia are high at one year (90%), they decline to 30% by two years of age.[4] Efforts to improve continued breastfeeding rates in the second year of life should be prioritized. Raising the quality of pregnant and lactating women's diets can also enhance their children's nutrition by improving birth outcomes, increasing nutrient transfers at birth, and resulting in more nutrient-dense breast milk.[20]

To achieve greater certainty about the magnitude of potential nutrient gaps, new data collection and evidence generation in Zambia should be prioritized for all 11 nutrients investigated here. Further research is also required to understand the causes of nutrient gaps, including both supply- and demand-side barriers. It is important to understand the primary barriers to consuming nutrient-dense whole foods, whether they are related to limited availability, affordability, and/or desirability. Finally, strategic actions to improve children's diets will require engagement and intervention across relevant systems, including food; social protection; health; and water, sanitation, and hygiene.

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** Other methods exist for collating and assessing a wide range of data sources in an effort to better guide policy and programming decisions on diets. For example, the Fill the Nutrient Gap exercise designed and implemented by the World Food Programme provides a comprehensive look at the environment within which observed diets are shaped but, in contrast to the CONGA, provides no estimates of nutrient gaps, their health impacts, or the certainty of the evidence reviewed.