COMPREHENSIVE NUTRIENT GAP ASSESSMENT (CONGA)

FINDINGS FOR CHILDREN 6–23 MONTHS IN **ZAMBIA**

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WHY IS CONGA NEEDED?

After a child's first six months, nutrient requirements exceed what breastmilk alone can provide. To meet growing nutrient needs and ensure proper growth and development, along with breastfeeding, infants should be introduced to nutrient-dense solid, semi-solid, or soft foods at six months of age (1,2). Despite this, only 22% of infants and young children aged 6–23 months in Zambia consume a diet meeting the minimum recommended number of food groups (3), increasing their risk of micronutrient deficiencies and growth faltering.

Identification of nutrient and dietary gaps during the complementary feeding period is essential to inform policies and programs designed to improve child health and nutrition. However, nationally-representative data specific to young children are usually only available for select nutrients and infrequently collected. Lower quality evidence can help fill data gaps, particularly when multiple sources point to the same nutrients of concern or dietary issues. Yet decision makers have little guidance on how to locate and interpret the evidence to identify the magnitude and significance of nutrient gaps in child diets, given the wide range of indicators used, diversity of data sources and population characteristics, and differences in severity of associated health outcomes. A Comprehensive Nutrient Gap Assessment (CONGA) meets this need by collating the evidence and rating the burden of nutrient gaps[1] and certainty of evidence. This brief summarizes the main food and micronutrient gaps identified from a CONGA conducted in Zambia and key policy and programmatic actions required. There are several other nutrients that may be limited in the diets of young children, including omega-3 fats (e.g., DHA) and specific essential amino acids (i.e., the quality of protein). The CONGA method can be extended in the future to these and others as more data becomes available.

KEY MESSAGES

- Based on available evidence, **iron**, **zinc**, **vitamin B_{12}**, **calcium**, **vitamin A**, and **folate** are micronutrients of concern among young children in Zambia.
- **More research** is required on **other nutrients** which may also represent important gaps in young children's diets in Zambia.
- The best food sources of micronutrients of concern in Zambia are **chicken liver** (iron, vitamin A, zinc, vitamin B_{12}, folate), **small dried fish** (calcium, vitamin A, vitamin B_{12}, zinc, iron), **beef liver** (vitamin A, vitamin B_{12}, iron, folate), **dark green leafy vegetables** (iron, folate, calcium, vitamin A), **dried beans** (zinc, folate, iron), **groundnuts** (zinc, folate), **fresh fish** (vitamin B_{12}, vitamin A), and **chicken** (zinc).
- **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, palatability, and desirability make sufficient consumption from accessible diverse foods infeasible.

1 Micronutrients investigated via CONGA include iron, vitamin A, zinc, calcium, iodine, Vitamin B_1 (thiamine), niacin, vitamin B_{12}, vitamin B_6, folate, and vitamin C.

HOW DOES CONGA WORK?

We reviewed and summarized findings from nationally representative and quality sub-national surveys, grey literature, and journal articles related to infant and young child feeding practices, micronutrient deficiencies, dietary intake, household consumption and expenditure, and the food supply. Experts reviewed this evidence to rate the burden of gap (none, low, moderate, or high) and certainty of available evidence (low, moderate, or high) for 11 micronutrients commonly lacking in young children's diets.[2] We then identified the most nutrient-dense, locally available food sources of micronutrients of concern based on food composition data and local price data.

WHAT DID CONGA FIND IN ZAMBIA?

Based on available evidence, micronutrients of concern[3] during the complementary feeding period in Zambia are **iron**, **zinc**, **vitamin B_{12}**, **calcium**, **vitamin A**, and **folate** (Table 1). The annex describes specific evidence considered for all ratings. We summarize consequences of deficiencies in micronutrients of concern and justifications for their ratings below.

Table 1. Nutrient gaps and evidence ratings for children 6–23 months in Zambia[4]

	Iron	Zinc	Vit B_{12}	Ca	Vit A	Folate	Iodine	Vit B_1	Niacin	Vit B_6	Vit C
Gap burden	High	High	High	High	Mod	Mod	Low	Low	Low	Low	Low
Evidence certainty	Mod	Mod	Mod	Mod	Mod	Mod	Low	Low	Low	Low	Low

Iron

Iron deficiency is a primary cause of anemia and can result in cognitive impairment, decreased work productivity, and death (4). Data reveal inadequate iron consumption during the complementary feeding period and for women of reproductive age, and a subnational survey indicates high prevalence of iron deficiency and anemia in young children.

Zinc

Zinc deficiency in children is associated with poor health, increased risk of diarrhea, and impaired cognitive and motor development (5,6). Data indicate low consumption of foods rich in zinc during the complementary feeding period and high levels of inadequate zinc intake in both children and women of reproductive age. A subnational survey indicates high prevalence of zinc deficiency in young children.

Vitamin B_{12}

Vitamin B_{12} deficiency in infants has immediate and long-term consequences including anemia, developmental regression, and depression during adulthood (7,8). Data indicate low consumption of foods rich in vitamin B_{12} during the complementary feeding period and high levels of inadequate vitamin B_{12} intake in children. A subnational survey found nearly universal deficiency of vitamin B_{12} in children under five.

2 Iron, zinc, iodine, vitamin A, calcium, folate, vitamin C, vitamin B_{12}, thiamine, niacin, and vitamin B_6.

3 Micronutrients of concern are those with at least a moderate burden gap *and* moderate certainty of evidence. There may also be other important nutrient gaps, but evidence is limited.

4 Ca, Calcium; Mod, Moderate; Vit, Vitamin.

Calcium

Calcium deficiency increases risk of rickets, but the broader health implications of deficiency in young children are poorly understood (9). Data reveal very low availability of calcium in the national food supply, very low consumption of calcium-rich foods during the complementary feeding period, and highly inadequate calcium intake for both children and women of reproductive age. However, no biochemical data was available to indicate the level of deficiency.

Vitamin A

Vitamin A deficiency has severe consequences, even with mild deficiency, including night blindness, increased susceptibility to infections, and death (10). Data indicate low consumption of vitamin-A rich foods during the complementary feeding period and inadequate vitamin A intake for both children and women of reproductive age. The most recent (subnational) estimate of vitamin A deficiency indicates a problem of severe public health significance for young children in Zambia.

Folate

Folate deficiency in infants and young children can have immediate and long-term consequences, including anemia, hindered brain development, and adult depression (7). Data indicate inadequate folate intake in children and women of reproductive age. High prevalence of folate deficiency found in children under five in a subnational survey suggests this has resulted in a demonstrable biochemical impact on young children.

Other micronutrients

Burdens of iodine, niacin, and vitamins B_1, B_6, and C gaps were based on low certainty evidence. More data is needed to generate higher quality evidence on the burden of these nutrient gaps in Zambia.

WHAT CAN BE DONE TO ADDRESS THESE GAPS?

Recommended actions to address each nutrient gap in Zambia are summarized in Table 2. The best complementary food sources of micronutrients of concern are **chicken liver** (iron, vitamin A, zinc, vitamin B_{12}, folate), **small dried fish** (calcium, vitamin A, vitamin B_{12}, zinc, iron), **beef liver** (vitamin A, vitamin B_{12}, iron, folate), **dark green leafy vegetables** (iron, folate, calcium, vitamin A), **dried beans** (zinc, folate, iron), **groundnuts** (zinc, folate), **fresh fish** (vitamin B_{12}, vitamin A), and **chicken** (zinc) (Table 2). More research is needed to understand the primary barriers to consuming these foods, like limited availability, accessibility, affordability, or desirability. **Biofortified** and **fortified** foods (including fortified complementary foods), **point-of-use fortification** products like micronutrient powders and lipid-based nutrient supplements, and supplements can also help fill nutrient gaps. **Continued breastfeeding** rates in Zambia are high at one year of age but decrease to < 50% by age two years (3). Efforts to improve continued breastfeeding rates should be prioritized to help fill vitamin A and calcium gaps. Improving the **quality** of **pregnant** and **lactating women's diets** can also improve their children's nutrition through improved birth outcomes, nutrient transfers at birth, and more nutrient-dense breast milk (11).

Table 2. Recommended actions to address complementary feeding gaps in Zambia

Nutrient gap	Recommended actions to increase dietary intake
Iron	• Assess and ensure availability, accessibility, affordability, and desirability of natural foods rich in iron, including **chicken liver**, **dried fish**, **beef liver**, **pumpkin leaves**, **beef**, and **beans**, as well as **iron-biofortified** and **fortified** foods. • Ensure **adequate coverage** and **quality** of large-scale **iron fortification**. • Consider **micronutrient powders** and/or **supplementation**.[5]
Zinc	• Assess and ensure availability, accessibility, affordability, and desirability of natural foods rich in zinc, including **small dried fish**, **beef**, **chicken liver**, **chicken**, **groundnuts**, **eggs**, **beans**, and **sour milk**, as well as **zinc-biofortified** and **fortified** foods. • Ensure **adequate coverage** and **quality** of large-scale **zinc fortification**. • Consider **micronutrient powders** and/or **supplementation**.
Vitamin B_{12}	• Assess and ensure availability, accessibility, affordability, and desirability of natural foods rich in vitamin B_{12}, including **beef liver**, **chicken liver**, **small dried fish**, **fresh fish**, **beef**, **eggs**, and **fresh** and **sour milk**, as well as **vitamin B_{12}-fortified** foods. • Ensure **adequate coverage** and **quality** of large-scale **vitamin B_{12} fortification**. • Consider **micronutrient powders** and/or **supplementation**.
Calcium	• Improve rates of **continued breastfeeding**. • Assess and ensure availability, accessibility, affordability, and desirability of natural foods rich in calcium, including **small dried fish**, **rape greens**, and **fresh** and **sour milk**, as well as **calcium-fortified** foods. • Consider calcium-containing **micronutrient powders** and/or **supplementation**. • Collect **biochemical** and **dietary data** in young children.
Vitamin A	• Improve rates of **continued breastfeeding**. • Assess and ensure availability, accessibility, affordability, and desirability of natural foods rich in vitamin A, including **beef liver**, **chicken liver**, **carrots**, **small dried fish**, **fresh fish**, **rape greens**, **pumpkin**, **eggs**, and **fresh** and **sour milk**, as well as **vitamin A-biofortified** and **fortified** foods. • Ensure **adequate coverage** and **quality** of large-scale **vitamin A fortification**. • Consider **micronutrient powders** and/or continued **supplementation**.[6]
Folate	• Assess and ensure availability, accessibility, affordability, and desirability of natural foods rich in folate, including **chicken liver**, **beef liver**, **beans**, **spinach**, **groundnuts**, **okra**, **eggs**, and **oranges**, as well as **folate-fortified** foods. • Consider **micronutrient powders** and/or **supplementation**.

5 Some potential risks have been associated with supplemental iron in children with adequate iron status. Products with low iron doses may be more appropriate in this context.

6 Vitamin A toxicity can occur if excess is consumed over long time periods. Vitamin A supplementation programs should review status and dietary intake regularly.

CONCLUSION

There is clear evidence of significant complementary feeding gaps in iron, zinc, vitamin B_{12}, vitamin A, calcium, and folate in Zambia. There may also be other important gaps, but evidence is limited. The best food sources of micronutrients of concern that are relatively available in Zambia are chicken liver, small dried fish, beef liver, dark green leafy vegetables, dried beans, groundnuts, fresh fish, and chicken. These foods need to be available, accessible, affordable, and desirable as complementary foods to be consumed in adequate quantities by young children. Other approaches to fill gaps for micronutrients of concern should also be considered, including biofortification, fortification, and supplementation, particularly where food insecurity, social norms, palatability, and desirability make sufficient consumption from accessible diverse foods infeasible. Continued breastfeeding should be encouraged and can help young children consume enough vitamin A and calcium.

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ANNEX

Key evidence used to inform ratings[7]

Iron	High burden gap	Moderate certainty evidence

Biochemical data: In the 2008 FCMS in the Northern and Luapula provinces, among children 6–59 m, 4% had serum ferritin < 15 µg/L, 22% had serum ferritin ≥ 15 µg/L *and* C-reactive protein > 5 mg/L, and 15% had serum ferritin ≥ 15 µg/L *and* Alpha-1-acid glycoprotein > 1 g/L (1). Among children 6–59 m, the total prevalence of iron deficiency was reported to be 35%, iron deficiency anemia 27%, and anemia 59% (1).

Dietary data: 49% of children 6–23 m consumed iron-rich foods in the past 24 h nationally in the 2013/14 DHS (down from 63% in 2007). Consumption of fortified baby foods also increased from 0–20% between 2007 and 2013/14 (2,3).

Nutrient intake in children: The 2008 subnational FCMS found that 69% of children 6–23 m consumed inadequate iron (1).

Nutrient intake in WRA: A survey in two rural villages in the Rufunsa District of Eastern Zambia in 2016/17 assessed nutrient intake in WRA (using EARs). Inadequate iron intake was found in 37% of both lactating and non-lactating WRA (4).

Food supply nutrient availability: The amount of iron available in the food supply estimated to be inadequate for 4% of the national population in 2011 (5).

Zinc	High burden gap	Moderate certainty evidence

Biochemical data: Zinc deficiency (serum zinc < 8.7 µmol/L or < 9.9 µmol/L) was assessed in two provinces in 2008 in the FCMS, and prevalence in children under 5 y was found to be 22–34% depending on the time blood was collected (1).

Dietary data: 37% children 6–23 m consumed meat, fish, or poultry in the past 24 h nationally in the 2013/14 DHS (down from 57% in 2007) (2,3).

Nutrient intake in children: The 2008 subnational FCMS found that in the Northern, Muchinga and Luapula provinces 89% of children 6–23 m consumed inadequate zinc (1).

Nutrient intake in WRA: A survey in two rural villages in the Rufunsa District of Eastern Zambia in 2016/17 assessed nutrient intake in WRA (using EARs). Inadequate zinc intake was found in 86% of lactating WRA and 34% of non-lactating WRA (4).

Food supply nutrient availability: The amount of zinc available in the food supply estimated to be inadequate for 0% of the national population in 2011 (5).

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7 DHS, Demographic and Health Survey; EAR, Estimated Average Requirement; FCMS, Food Consumption & Micronutrient Survey; h, hours; Mod, Moderate; m, months; WRA, women of reproductive age (15–49 years); y, years.

Vitamin B_{12}	High burden gap	Moderate certainty evidence

Biochemical data: Vitamin B_{12} deficiency (serum vitamin B_{12} < 150 pmol/L) was 97% among children < 5 y in two provinces in the 2008 FCMS (1).

Dietary data: Among breastfed children 6–23 m, 37% consumed meat, fish or poultry, 5% consumed animal milk, 4% consumed other dairy products, and 17% consumed eggs in the past 24 h nationally in the 2013/14 DHS (2,3).

Nutrient intake in children: The 2008 subnational FCMS found that in the Northern, Muchinga and Luapula provinces 66% of children 6–23 m consumed inadequate vitamin B_{12} (1). A small study in two rural villages found inadequate vitamin B_{12} intake (using EARs) in 62% of children 3–5 y in 2010 and 71% of children 5–7 y in 2012 (6).

Nutrient intake in WRA: Inadequate vitamin B_{12} intake (using EARs) was found in 38% of lactating WRA and 37% of non-lactating WRA in two rural villages in the Rufunsa District of Eastern Zambia in 2016/17 (4).

Food supply nutrient availability: The amount of vitamin B_{12} available in the food supply estimated to be inadequate for 6% of the national population in 2011 (5).

Calcium	High burden gap	Moderate certainty evidence

Dietary data: Animal milk was consumed by 4% of breastfed children 6–23 m,[8] and cheese, yogurt, or other milk products were consumed by 5% of breastfed children 6–23 m in the past 24 h nationally in the 2013/14 DHS (no change from 2007). Consumption of both animal milk and other dairy products was only slightly higher in non-breastfed children, but the sample size of this population group was notably small (2,3).

Nutrient intake in children: The 2008 subnational FCMS found that in the Northern, Muchinga and Luapula provinces 84% of children 6–23 m consumed inadequate calcium (1).

Nutrient intake in WRA: Inadequate calcium intake (using EARs) was found in 100% of both lactating and non-lactating WRA in two rural villages in the Rufunsa District of Eastern Zambia in 2016/17 (4).

Food supply nutrient availability: The amount of calcium available in the food supply estimated to be inadequate for 96% of the national population in 2011 (5).

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8 The estimates for consumption of animal milk are for all children 6–23 months, however, it has been recommended that children under 12 months of age do not consume milks (flavoured or plain) (7).

Vitamin A	Moderate burden gap	Moderate certainty evidence

Biochemical data: Vitamin A deficiency prevalence (serum retinol corrected < 20 µg/dL) was assessed in two provinces in the 2008 FCMS, and prevalence in children under 5 y was found to be 26% (after correction using the Thurnham method) (1).

Dietary data: 75% of children 6–23 m consumed vitamin A-rich foods in the past 24 h nationally in 2013/14 (a slight decrease from 84% in 2007) (2,3).

Nutrient intake in children: The 2008 subnational FCMS found that in the Northern, Muchinga and Luapula provinces 64% of children 6–23 m consumed inadequate vitamin A (1). In addition, 50% of children 23–59 m also consumed inadequate amounts (1). A 2009 study in two rural districts collected intake data in two seasons and found that inadequate vitamin A intake was < 1% in both children 2–3 y and 4–5 y of age (8).

Nutrient intake in WRA: Inadequate vitamin A intake (using EARs) was found in 99% of lactating WRA and 91% of non-lactating WRA in two rural villages in the Rufunsa District of Eastern Zambia in 2016/17 (4).

Food supply nutrient availability: The amount of vitamin A available in the food supply estimated to be inadequate for 1% of the national population in 2011 (5).

Supplementation: National vitamin A supplementation coverage for children 6–59 months was 77% per the 2013/14 DHS (up from 60% in 2007) (2,3).

Folate	Moderate burden gap	Moderate certainty evidence

Biochemical data: Folate deficiency (serum folate < 4 ng/ml) was 84% in children < 5 y in two provinces in the 2008 FCMS (1).

Nutrient intake in children: The 2008 subnational FCMS found that in the Northern, Muchinga and Luapula provinces 47% of children 6–23 m consumed inadequate folate (only 9% in children 24–59 m) (1). A small study in two rural villages found inadequate folate intake (using EAR) in 92% of children 3–5 y in 2010 and 95% of children 5–7 y in 2012 (6).

Nutrient intake in WRA: Inadequate folate intake was found in 91% of lactating WRA and 75% of non-lactating WRA in two rural villages in the Rufunsa District of Eastern Zambia in 2016/17 (4).

Food supply nutrient availability: The amount of folate available in the food supply estimated to be inadequate for 0% of the national population in 2011 (5).

Iodine	Low burden gap	Low certainty evidence

Biochemical data: National prevalence of insufficient iodine intake (urinary iodine concentration < 150 µg/L) was 26% in pregnant women aged 15–49 years (of any gestational period) in 2013 (9).

Household iodized salt coverage: 95% of households found to have iodized salt in the 2013/14 DHS (2), however, per a 2013 iodine survey, 19% of households had adequately iodized salt (15–40 ppm iodine) while 76% of household salt had excessive iodine content (> 40 ppm iodine) (9).

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Vitamin B_1 (thiamine)	Low burden gap	Low certainty evidence

Dietary data: 67% of breastfed children 6–23 m consumed grains (whole grains contain moderate amounts of thiamine) in the past 24 h nationally in the 2013/14 DHS (down from 79% in 2007) (2,3).

Nutrient intake in children: The 2008 subnational FCMS found that in the Northern, Muchinga and Luapula provinces 23% of children 6–23 m consumed inadequate thiamine (only 3% in children 24–59 m) (1). A small study in two rural villages found inadequate thiamine intake (using EARs) in 93% of children 3–5 y in 2010 and 83% of children 5–7 y in 2012 (6).

Nutrient intake in WRA: Inadequate thiamine intake was found in 97% of lactating WRA and 78% of non-lactating WRA in two rural villages in the Rufunsa District of Eastern Zambia in 2016/17 (4).

Food supply nutrient availability: The amount of thiamine available in the food supply estimated to be inadequate for 0% of the national population in 2011 (5).

Niacin	Low burden gap	Low certainty evidence

Dietary data: 37% children 6–23 m consumed meat, fish, or poultry (the highest sources of niacin) in the past 24 h nationally in the 2013/14 DHS (down from 56% in 2007) (2,3).

Nutrient intake in children: The 2008 subnational FCMS found that in the Northern, Muchinga and Luapula provinces 51% of children 6–23 m consumed inadequate niacin (only 7% of children 24–59 m) (1). A small study in two rural villages found inadequate niacin intake (using EARs) in 65% of children 3–5 y and 66% of children 5–7 y in 2010 (6).

Nutrient intake in WRA: Inadequate niacin intake was found in 28% of lactating WRA and 22% of non-lactating WRA in two rural villages in the Rufunsa District of Eastern Zambia in 2016/17 (4).

Food supply nutrient availability: The amount of niacin available in the food supply estimated to be inadequate for 0% of the national population in 2011 (5).

Vitamin B_6	Low burden gap	Low certainty evidence

Nutrient intake in children: The 2008 subnational FCMS found in the Northern, Muchinga and Luapula provinces that only 1% of children 6–23 m consumed inadequate vitamin B_6 (1). A small study in two rural villages found inadequate vitamin B_6 intake (using EARs) in 78% of children 3–5 y in 2010 and 60% of children 5–7 y in 2012 (6).

Nutrient intake in WRA: Inadequate vitamin B_6 intake was found in 90% of lactating WRA and 36% of non-lactating WRA in two rural villages in the Rufunsa District of Eastern Zambia in 2016/17 (4).

Food supply nutrient availability: The amount of vitamin B_6 available in the food supply estimated to be inadequate for 18% of the national population in 2011 (5).

Vitamin C	Low burden gap	Low certainty evidence

Nutrient intake in children: The 2008 subnational FCMS found that in the Northern, Muchinga and Luapula provinces 58% of children 6–23 m consumed inadequate vitamin C (1).

Nutrient intake in WRA: Inadequate vitamin C intake was found in 55% of lactating WRA and 51% of non-lactating WRA in two rural villages in the Rufunsa District of Eastern Zambia in 2016/17 (4).

Food supply nutrient availability: The amount of vitamin C available in the food supply estimated to be inadequate for 16% of the national population in 2011 (5).

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Contact
Global Alliance for Improved Nutrition (GAIN)
Rue de Varembé 7
1002 Geneva, Switzerland

T: +41 22 749 18 50
E: info@gainhealth.org
www.gainhealth.org

gain Global Alliance for Improved Nutrition

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