

Call to Action: Addressing zinc deficiency through zinc fortification

More than **one billion** people are at risk of inadequate zinc intake

Zinc is an essential nutrient for immune function, child health and development, and reproductive health¹.

Yet, at least 17% of the world's population is at risk of inadequate zinc intake based on national food availability. Data from the small number of studies of plasma/serum zinc concentration (PZC) in representative population samples suggest that the risk of deficiency is likely to be even greater than indicated by food availability data². Low- and middle-income countries where diets are predominantly cereal-based and contain limited amounts of animal-source foods are particularly at risk for widespread zinc deficiency, increasing morbidity and mortality (especially from diarrhea).

In 2020, 23 out of 25 countries for which national data on PZC was available had a zinc deficiency prevalence of 20% (the recommended threshold for defining zinc deficiency as a public health issue) or higher for at least one physiological group³.



Large-scale food fortification (LSFF) is one of the most effective interventions for improving micronutrient status

PROVEN: LSFF is a fast, safe, inexpensive, and effective intervention for preventing the public health and economic impact of micronutrient deficiencies—but has been largely underutilized. When food fortification programs are implemented well and attain high coverage and quality, there is strong evidence of a significant decrease in the prevalence and burden of micronutrient deficiencies at the population level⁴.

COST-EFFECTIVE: Every \$1 invested in food fortification generates an average of \$27 in economic return from averted disease and improved earnings and work productivity⁵.

GLOBAL PRIORITY: Ranked among the top three international development priorities by the Copenhagen Consensus, LSFF has also been highlighted by the Food and Agriculture Organization (FAO) and the WHO as one of four main strategies for reducing micronutrient malnutrition^{6,7}.

IMPACTFUL: Universal salt iodization is one such example of a successful intervention that—with the commitment of national stakeholders and partners—achieved high coverage and compliance, preventing 720 million cases of iodine deficiency disorders over the past 25 years (a reduction of 75.9%) and preventing an estimated 20.5 million annual cases in newborns⁸. This intervention's impact on cognitive development and future earnings has a potential global economic benefit of close to \$33 billion and a benefit-cost ratio of 30:1^{5,8}.

From evidence to action: Zinc fortification can reduce the prevalence of zinc deficiency



New evidence from a systematic review of 59 studies that assessed biochemical and health outcomes after the provision of a zinc-fortified food or beverage found that fortification with zinc, alone or together with other micronutrients, is an efficacious and effective strategy for reducing the prevalence of zinc deficiency in low- and middle-income countries⁹.

- ▼ **Zinc fortification increased PZC with a corresponding 24-55% decrease in the prevalence of zinc deficiency⁹.**
- ▼ **Fortification with zinc and other micronutrients may increase child weight, reduce episodes of diarrhea and fever, and improve cognitive function.**
- ▼ **No adverse outcomes from food fortification with zinc were found.**

The World Health Organization (WHO) issues guidelines for fortification of staple foods with micronutrients, and these are updated periodically.

LSFF with zinc is effective, safe, inexpensive—and is a vital and feasible deficiency mitigation strategy for national policymakers and planners.



Building micronutrient resilience after COVID-19

The shock of the COVID-19 pandemic has disrupted food systems around the world, affecting food supply chains and shifting consumption from more nutrient-dense foods to relatively less expensive, less nutritious staples.

The dire consequences of COVID-19's impact on food access further underlines the importance of building micronutrient resilience against dietary diversity shocks, deepening the investment beyond short-term nutrition responses to crises.

By utilizing existing delivery platforms, food fortification can quickly expand access to vital micronutrients, protect vulnerable populations against micronutrient deficiency, and build nutritional resilience ahead of the next health crisis.

Invest in Data

There is an urgent need for more and better data on the zinc status of vulnerable populations to target and monitor zinc intervention programs effectively.

Designing and implementing effective monitoring and evaluation (M&E) is an integral component of any successful, high-quality, large-scale food fortification program.

Insufficient national ownership of fortification programs was recently voiced as a reason for the lack of adequate resources for national government-led coordination and compliance monitoring activities in countries fortifying or not fortifying with zinc¹⁰.

Ministries of health may require technical and financial support to conduct regular micronutrient surveys to identify vulnerable populations, build and integrate micronutrient-specific indicators into their existing health information systems, and conduct ongoing monitoring to evaluate and course-correct interventions where needed.



Priority Actions For Countries Where Zinc Deficiency is a Public Health Issue

► Invest in Strong Fortification Programs to Prevent Zinc Deficiency

	National Governments	Regional Bodies	Multi-lateral & Bilateral Institutions	Non-Governmental Agencies	Philanthropic Funders	Millers
Prioritize the prevention of zinc deficiency in national health and nutrition policies and strategic plans	●	●				
Invest in strengthening and communicating the business case for industry and millers to fortify staple foods with micronutrients, including zinc		●	●	●	●	
Increase awareness of the health benefits, economic returns, and benefit-cost ratios associated with food fortification, including zinc, among high-level national authorities	●	●	●	●	●	●
Advocate for zinc fortification as an effective and sustainable component of a comprehensive, evidence-based, multi-sectoral national nutrition strategy		●	●	●	●	
Designate a dedicated national coordination team with the technical know-how to design, implement, monitor, and sustain the national food fortification strategy	●					
Support a national food fortification alliance, convening local stakeholders to coordinate the development and implementation of food fortification policies and programs	●					
Ensure adequate budget for fortification regulatory monitoring and control	●					
Mobilize technical and financial resources in alignment with national zinc fortification programs		●	●	●	●	●

► Provide Targeted Technical Assistance to Ensure Successful Implementation and Delivery

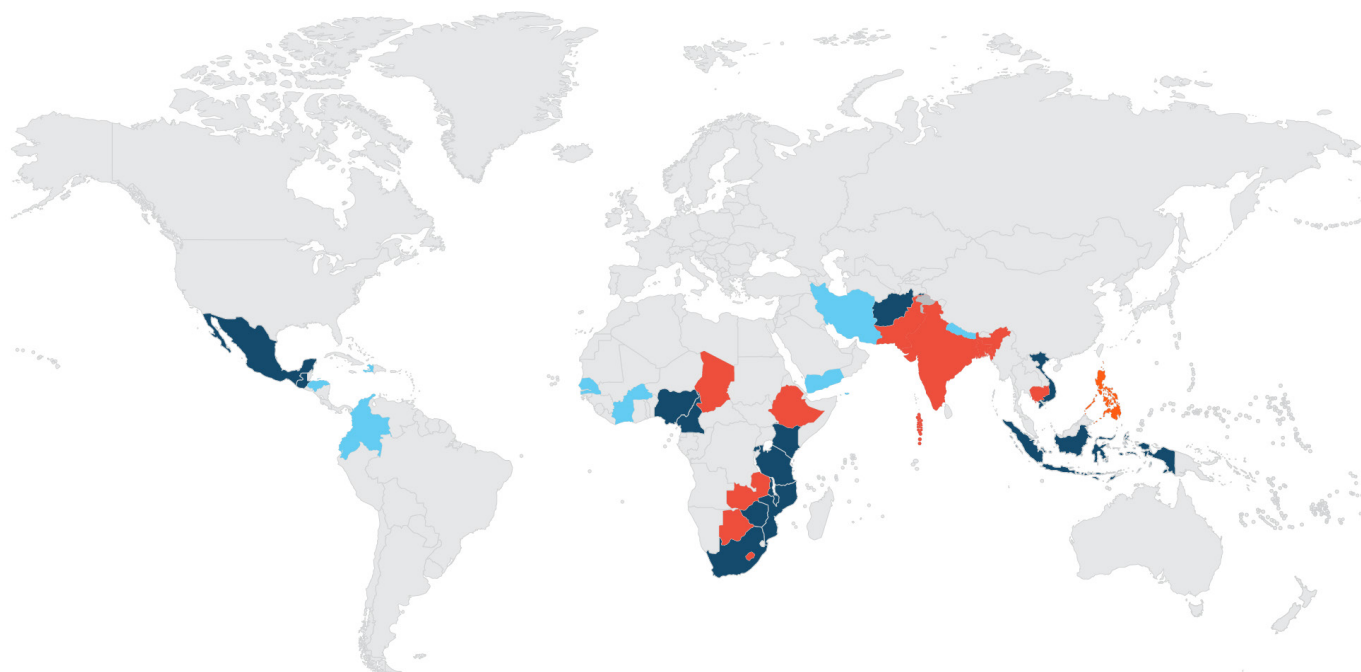
Use available evidence to expedite the revision of global guidelines and regional and national food standards to include zinc as a mandatory fortificant	●	●	●			
Prioritize applied research that closes evidence gaps around the design, implementation, and evaluation of zinc fortification strategies	●	●	●	●	●	
Deliver practical zinc-specific technical guides and tools—leveraging the expertise of pre-mix suppliers where relevant—to support national governments considering, implementing, or strengthening zinc fortification programs		●	●	●		
Design, implement, and enforce a national zinc fortification program, integrated into a national food fortification strategy and implementation plan and harmonized with other national zinc interventions	●	●	●	●	●	

► Implement Monitoring and Evaluation Approaches to Measure Impact

Incorporate Quality Assurance and Quality Control (QA/QC) activities for fortification to ensure quality and compliant fortified foods are being produced and reported						●
Conduct robust monitoring & evaluation to assess coverage, compliance, and effectiveness of zinc fortification programs	●					
Ensure regular nutrition and/or health surveys that include assessment of PZC and/or inadequate zinc intake after the launch of zinc fortification	●		●	●	●	

Close the gap: 11 priority countries where zinc fortification will have a significant and immediate impact

Countries where zinc deficiency is a public health issue



Mandatory fortification programs exist but DO NOT INCLUDE ZINC

- Burkina Faso (W)
- Colombia (W)
- Côte d'Ivoire (W)
- Ecuador (W)
- Haiti (W)
- Honduras (W)
- Iran (W)
- Nepal (W)
- Philippines (W, R)
- Senegal (W)
- Yemen (W)

NO mandatory fortification programs exist at this time

- Bangladesh
- Botswana
- Cambodia
- Chad
- Ethiopia
- India
- Lesotho
- Maldives
- Pakistan
- Zambia

Mandatory fortification programs exist and INCLUDE ZINC

- Afghanistan (W)
- Cameroon (W)
- Guatemala* (M)
- Indonesia (W)
- Kenya (W, M)
- Malawi (W, M)
- Mexico (W, M)
- Mozambique (W, M)
- Nigeria (W, M)
- Rwanda (W, M)
- South Africa (W, M)
- United Republic of Tanzania (W, M)
- Vietnam (M)
- Zambia (W, M)

M = Maize flour fortification W = Wheat flour fortification R = Rice fortification

*Wheat fortification is mandatory in Guatemala, however zinc is not included

Closing the zinc fortification gap

Zinc is not always included in micronutrient fortification standards in countries where zinc deficiency is a public health issue.

Right now, immediate opportunities for impact exist. A July 2021 analysis conducted by IZiNCG identified 35 countries where zinc deficiency is a national public health issue.[†] Eleven of these countries already have national policies on industrial fortification for processed flours and can leverage their processing infrastructure and technical capacity to include zinc. Adding zinc to their existing mandatory fortification programs (through either wheat flour, maize flour, or rice) would be a relatively low-cost, high-impact intervention to reduce their national prevalence of zinc deficiency.

Zinc is one of the least expensive micronutrient fortificants. Integrating it into these countries' existing fortification programs would be a minimal additional cost for the benefit of improved health and economic outcomes for generations ahead.

Among the remaining 24 countries where zinc deficiency is a public health issue, ten countries should consider establishing a mandatory fortification program that includes zinc, building on the experiences of the 14 countries already implementing a mandatory zinc fortification program.



Cameroon successfully reduced zinc deficiency through wheat flour fortification

- Cameroon's 2009 National Micronutrient Survey revealed zinc deficiency among 80% of the country's women and children¹⁰.
- The Ministry of Health recognized zinc and other micronutrient deficiencies as a national public health priority and—building on the evidence from their Micronutrient Survey—selected wheat flour as the most appropriate vehicle for fortification, given that women commonly and frequently consumed wheat flour.
- Fortification of all wheat flour with zinc, iron, vitamin B12, and folic acid was made mandatory in 2011 as part of an interagency effort to address hidden hunger in the country.
- After one year, the prevalence of low plasma zinc concentrations dropped from 46.8% to 28.4% among children and from 39.4% to 21.6% among women in Douala and Yaoundé.[‡]
- Cameroon deployed a data-driven approach to fortification and continued monitoring and evaluating the program to course-correct where needed and ensure its long-term success.

[‡] Baseline prevalence of deficiency differs from previous estimates due to updated method of adjusting for inflammation

[†] This analysis defined zinc deficiency as a national public health priority through two criteria: 1) the proportion of women of reproductive age or preschool children with low plasm/serum zinc concentration (PZC, the recommended biomarker to assess zinc status) is at least 20% according to available national surveys, and 2) the estimated prevalence of stunting among children under five is greater than 20% and the estimated prevalence of inadequate zinc intake is greater than 25%. Data sources: a) 2019 UNICEF-WHO-World Bank Global Database on Child Growth and Malnutrition was used for the most current national estimates of prevalence of stunting in children under five; b) FAO Food Balance sheets were used to calculate the most recent estimates on the availability of zinc in the food supply and prevalence of inadequate intake of zinc, using the methods and assumptions outlined by Wessells et al 2012; c) PZC data from national surveys were used to identify zinc deficiency, where available; d) The Global Fortification Data Exchange was used to obtain information on the presence of a mandatory fortification program in each country, which staple foods are fortified, and whether zinc is included as a fortificant in the fortification program.

IZiNCG provides technical assistance to organizations and governments to:

Use expertise to translate zinc research into useful resources and recommendations for best program and policy practice.

Fill evidence gaps for effective zinc interventions, including zinc fortification, by conducting applied research.

Create effective partnerships for improving zinc nutrition—zinc deficiency is unlikely to occur in isolation from other nutritional deficiencies and health problems.

Provide technical assistance for including zinc assessment in national surveys.

References

1. National Institutes of Health. Zinc Fact Sheet for Health Professionals [Internet]. 2020 [cited 2021 Aug 11]. Available from: <https://ods.od.nih.gov/factsheets/Zinc-HealthProfessional/>
2. Wessells KR, Brown KH. Estimating the global prevalence of zinc deficiency: results based on zinc availability in national food supplies and the prevalence of stunting. *PLoS One*. 2012;7(11):e50568.
3. Gupta S, Brazier AKM, Lowe NM. Zinc deficiency in low- and middle-income countries: prevalence and approaches for mitigation. *J Hum Nutr Diet*. 2020;33(5):624–43.
4. Osendarp SJM, Martinez H, Garrett GS, Neufeld LM, De-Regil LM, Vossenaar M, et al. Large-scale food fortification and biofortification in low-and middle-income countries: a review of programs, trends, challenges, and evidence gaps. *Food Nutr Bull*. 2018;39(2):315–31.
5. Horton S, Alderman H, Rivera JA. Hunger and malnutrition. *Global Crises, Global Solutions: Costs and Benefits*. 2009 Jul 9:305-54.
6. World Health Organization & Food and Agriculture Organization of the United Nations. Guidelines on food fortification with micronutrients. Geneva; 2006.
7. Copenhagen Consensus Center. Copenhagen Consensus 2008 - Results [Internet]. 2008 [cited 2021 Aug 11]. Available from: https://www.copenhagenconsensus.com/sites/default/files/cc08_results_final_0.pdf
8. Gorstein JL, Bagriansky J, Pearce EN, Kupka R, Zimmermann MB. Estimating the health and economic benefits of universal salt iodization programs to correct iodine deficiency disorders. *Thyroid*. 2020;30(12):1802–9.
9. Tsang BL, Holsted E, McDonald CM, Brown KH, Black R, Mbuya MNN, et al. Effects of foods fortified with zinc, alone or cofortified with multiple micronutrients, on health and functional outcomes: a systematic review and meta-analysis. *Adv Nutr*. 2021 Jun 24:nmab065.
10. Tarini A, Manger MS, Brown KH, Mbuya MNN, Rowe LA, Grant F, et al. Enablers and barriers of zinc fortification; experience from 10 low- and middle-income countries with mandatory large-scale food fortification. *Nutrients*. 2021;13(6):2051.
11. IZiNCG. Case study: addressing zinc deficiency through wheat flour fortification in Cameroon [Internet]. 2019 [cited 2021 Aug 11]. Available from: <https://www.izincg.org/izincg-case-studies>

Guidelines and resources for nutrition policymakers & program planners

WHO & FAO, 2006. Guidelines on food fortification with micronutrients. Available at: https://www.who.int/nutrition/publications/guide_food_fortification_micronutrients.pdf

WHO, 2009. Recommendations on wheat and maize flour fortification. Meeting Report: Interim consensus statement. Available at: https://www.who.int/nutrition/publications/micronutrients/wheat_maize_fortification/en/

WHO, 2016. Fortification of maize flour and cornmeal with vitamins and minerals. Available at: <https://www.who.int/nutrition/publications/micronutrients/guidelines/maize-corn-fortification/en/>

WHO, 2018. Fortification of rice with vitamins and minerals in public health. Available at: <https://www.who.int/nutrition/publications/guidelines/rice-fortification/en/>

About IZiNCG

IZiNCG is the International Zinc Nutrition Consultative Group whose primary objectives are to promote and assist efforts to reduce global zinc deficiency through interpretation of nutrition science, dissemination of information, and provision of technical assistance to national governments and international agencies. IZiNCG focuses on identification, prevention and treatment of zinc deficiency in the most vulnerable populations of low-income countries.

IZiNCG Secretariat

University of California San Francisco
5700 Martin Luther King Jr Way
Oakland, CA, USA 94609

secretariat@izincg.org

These materials were developed with support from the International Zinc Association