



# The potential impact of climate change on zinc nutrition

## Zinc is an essential nutrient for optimal health, growth and development

Zinc is an essential nutrient for immune function, child health and development, and reproductive health (1). Within populations, infants, young children and pregnant women who consume diets with a low zinc content and/or bioavailability are at greatest risk of zinc deficiency.

An estimated 15% of the global population (1.1 billion individuals) is at risk of inadequate zinc intake (2). Based

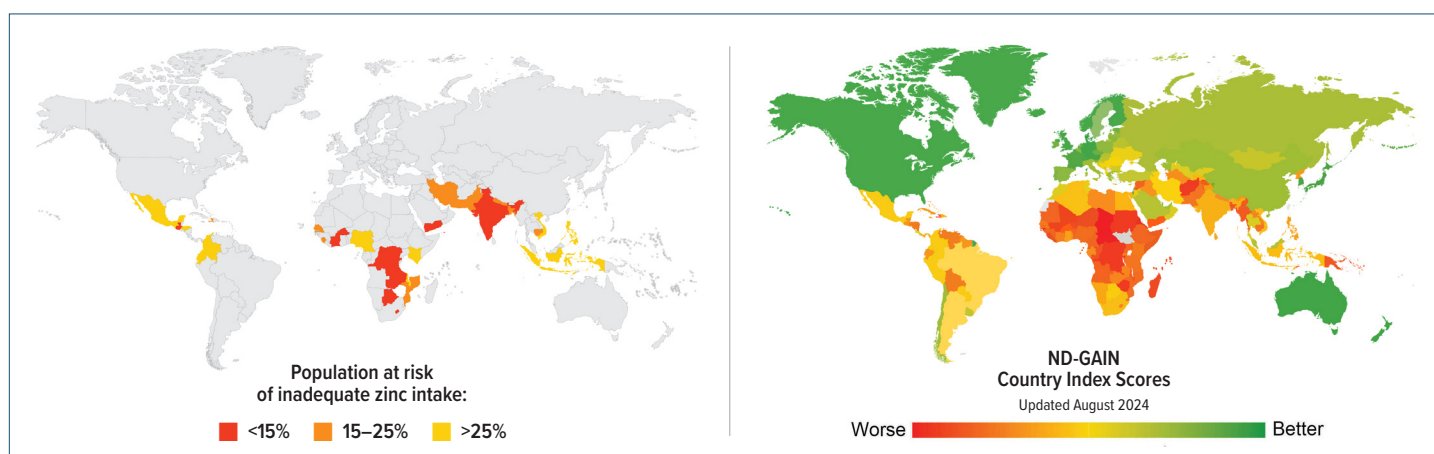
on available biochemical, food consumption and child growth data, zinc deficiency is estimated to be a public health problem<sup>1</sup> in 40 low- and middle-income countries (LMICs).

A disproportionate number of these individuals live in countries at high vulnerability and low readiness to adapt to the negative effects of climate change (Figure 1).



### KEY MESSAGES

- ▶ Zinc deficiency is estimated to be a public health problem in 40 low- and middle-income countries.
- ▶ Malnutrition, including deficiencies of zinc and other essential micronutrients, is considered one of the five major adverse health impacts of climate change.
- ▶ Climate change is likely to reduce the zinc content of staple crops and reduce the availability of and access to important food sources of zinc.
- ▶ Climate change is predicted to increase rates of diarrheal disease in some areas, which is likely to exacerbate the risk of zinc deficiency.
- ▶ Climate change adaptation strategies that protect zinc nutrition include large-scale food fortification and biofortification, alternative animal source foods, underutilized crops, breastfeeding, targeted supplementation for vulnerable group such as young children and pregnant women, and zinc as part of diarrhea treatment.



**Figure 1.** Estimated percentage of the population at risk of inadequate zinc intake in 40 LMICs where zinc deficiency is considered to be a public health problem<sup>1</sup>, compared to the ND-GAIN Index score<sup>2</sup>.

<sup>1</sup> Zinc deficiency was considered a public health problem in LMICs where the percentage of the population at risk of inadequate zinc intake due to inadequate zinc in the national food supply was >25% and the prevalence of stunting among children less than 5 years of age was >20%, or where the percentage of pre-school children or women of reproductive age with low plasma zinc concentration was > 20% according to available national surveys.

<sup>2</sup> The ND-GAIN Index score combines the country's vulnerability to climate change (exposure, sensitivity and capacity to adapt) with a country's readiness to adapt (ability to leverage investments and convert them to adaptation actions) (3).

## Climate change will negatively impact health and nutrition outcomes



Climate change caused by humans has resulted in higher temperatures across land, sea, and atmosphere, as well as increased frequency of extreme weather events such as heatwaves, extreme precipitation, droughts, and tropical cyclones. These changes are already directly affecting 3.3-3.6 billion people (4). Malnutrition is viewed as one of the five major adverse health impacts of climate change (5). By 2050, climate change is expected to cause an additional 4.8 million undernourished children and 250,000 additional annual deaths from undernutrition, malaria, diarrhea and heat stress (6).

Climate change is likely to affect nutritional status through multiple pathways and systems, including influencing people's food security, disease risk and patterns, water and sanitation environments, and choices about how to allocate time to their livelihoods and to caregiving (7,8). Importantly, climate change will not affect everyone equally. Since many LMICs already have high burdens of multiple forms of malnutrition, and fewer household-, community- and national-level resources to cope with shocks, there are justified concerns that climate change and extreme weather events may seriously slow or even reverse progress against malnutrition (9).

## What do we know about the impact of climate change on zinc nutrition?

### FOOD SYSTEM-RELATED IMPACTS

#### Decreased zinc content of staple crops

Climate change leads to increased concentrations of atmospheric carbon dioxide (CO<sub>2</sub>), which in turn, can lower the content of zinc in important food crops. A modelling study found that an additional 138 million people — primarily residing in Africa and South Asia — will be placed at new risk of zinc deficiency by 2050 (10). Another model predicted that in the presence of increasing CO<sub>2</sub> concentrations, decreasing zinc and iron concentrations of crops would induce an additional 126 million disability-adjusted life years globally between 2015 and 2050 (11).



Projected future climate change will increasingly affect food quantity, quality, and safety, with low-income consumers, particularly women and children, most vulnerable to these effects (13). For example, droughts and other environmental consequences of climate change will result in decreased crop yields and reduced availability of livestock (14,15), and rising sea temperatures and ocean acidification will have negative impacts on seafood production (14). In addition, rising temperatures and rainfall are expected to increase food waste for perishable food, including meat and eggs (16).

#### Reduced availability of and access to important dietary sources of zinc

Animal-source foods, especially meat, organ meats and shellfish, are the richest sources of dietary zinc. Despite their high phytate content limiting zinc absorption, cereals and legumes are also important sources of zinc in low- and middle-income countries due to their high consumption (12).

Reduced agricultural and fisheries production will cause income and livelihood losses for farmers and fisherfolk, which combined with increased prices of these important sources of zinc, are likely to contribute to more people becoming at risk of inadequate zinc intakes (13–15).

## OUTCOMES ASSOCIATED WITH ZINC STATUS

### More diarrheal disease may exacerbate the risk of zinc deficiency



Diarrhea causes increased zinc losses, and thereby increases susceptibility to zinc deficiency (1). Demographic and Health Survey data from 43 LMICs between 2009 and 2019 showed that extreme floods, floods lasting more than two weeks, and floods preceded by drought, were associated with an increased risk of diarrhea among children among children younger than five years (17). Moreover, changes in temperature due to global climate change can and may already be increasing the incidence of bacterial diarrhea in LMICs (18).

### The incidence of adverse birth outcomes will increase



Zinc is critical for normal fetal growth and development, and zinc requirements increase during pregnancy (1). Indeed, zinc deficiency during pregnancy is associated with adverse pregnancy outcomes, specifically preterm

birth (19). Babies who are born too soon or too small have higher rates of morbidity and mortality due to infectious disease and impaired immunity (20). Climate change is expected to have a substantial impact on adverse pregnancy and birth outcomes. For example, a meta-analysis found the odds of stillbirth rose by 5% per 1°C increase in temperature (21), and in Pakistan, heat stress during the second trimester were associated with a higher risk of preterm birth (22).

### More children under five years of age will become stunted



Zinc deficiency is associated with stunting among young children in LMICs (23). A modelling study estimated that climate change will lead to a relative increase in moderate stunting of 1–29% in 2050 compared to a future without climate change. Climate change will have a greater impact on rates of severe stunting, which are estimated to increase by 23% in sub-Saharan Africa and 62% in South Asia (24).

## Zinc-specific adaptation measures

### POPULATION-LEVEL APPROACHES

#### Scale up large-scale food fortification and biofortification



Large-scale food fortification (LSFF) with zinc alone or together with other micronutrients, led to a 24–55% decrease in the prevalence of zinc deficiency with no adverse outcomes reported (25). If LSFF of staple foods with zinc was adopted and/or optimized in all 40 countries where zinc deficiency is a public health problem, the percentage of the population at risk of inadequate zinc intake could be reduced by 50% (2).

In areas where the proportion of industrially processed of cereal flours is low, biofortification

provides an alternative strategy, with trials of biofortified wheat demonstrating an increase in zinc intake in Bangladesh and Pakistan (26,27). Novel fortification vehicles such as salt and bouillon cubes may also be considered as an alternative to fortified cereal flours (28).

#### Explore alternative animal source foods



Many edible insects are rich sources of zinc, and land, water and energy use, and greenhouse gas emissions are generally lower for insect production compared to commonly eaten animals (29).

## Support the production of underutilized and indigenous crops



Within current global food systems, only three crops (rice, maize, and wheat) contribute some 60% of calories consumed by humans (30).

However, many indigenous crops have higher nutritional value than the dominant staples and

concomitantly show better resilience to climate variability and shocks. For example, millet contains more zinc per 100g compared with rice, requires substantially less water to produce, and is highly tolerant to climate extremes and can be germinated to reduce its phytate content (12).

## TARGETED APPROACHES – PREVENTIVE

### Strengthen initiatives to promote, protect and support breastfeeding



Breastfeeding is one of the most effective ways to ensure child health and survival and is an excellent source of highly bioavailable zinc.

However, contrary to WHO recommendations and despite progress over the past decade, fewer than half of all infants are exclusively breastfed for the first six months of life (32).

whose complementary foods are not meeting dietary zinc requirements (33).

### Increase access to Multiple Micronutrient Supplements (MMS) during pregnancy



MMS includes 15mg of zinc together with other micronutrients and reduces the risk of stillbirth, preterm birth, low birthweight and small for gestational age births (34,35). Moreover, a study conducted in Pakistan found that the negative impacts of heat on birth length were, in part, mitigated in women receiving SQ-LNS with zinc and other micronutrients before pregnancy, suggesting potential interactions between heat stress and nutritional status of the mother (22).

### Micronutrient powders (MNP) and small-quantity lipid-based nutrient supplements (SQ-LNS) for extra zinc to young children



MNPs and SQ-LNS are excellent options for increasing the zinc and micronutrient intakes of children between six and 23 months of age

## TARGETED APPROACHES – TREATMENT

### Increase access to treatment of diarrhea with zinc and oral rehydration solution (ORS)



Treatment of childhood diarrhea with zinc and ORS is a WHO Essential Nutrition Action for improving maternal, newborn, infant and young child health and nutrition. Globally, only 15% of children have access to ORS + zinc during illness, and access is often lowest where the burden is highest (36).

### 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.

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