

Wessells KR, Singh GM, Brown KH. **Estimating the global prevalence of inadequate zinc intake from national Food Balance Sheets: Effects of methodological assumptions.** PLoS ONE 7: e50565. doi:10.1371/journal.pone.0050565 , 2012. (This article can be accessed at: [www.plosone.org](http://www.plosone.org)).

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 7: e50568. doi:10.1371/journal.pone.0050568, 2012. (This article can be accessed at: [www.plosone.org](http://www.plosone.org)).

## Introduction

Zinc is a critical micronutrient for multiple aspects of human physiology and metabolism. In populations with an elevated risk of zinc deficiency, zinc supplementation decreases morbidity from diarrhea and pneumonia, reduces all-cause mortality, and enhances linear growth and weight gain among young children (1). The primary cause of zinc deficiency is inadequate dietary intake of absorbable zinc. Total zinc uptake from the intestine depends on the amount of zinc consumed and the presence of dietary phytate, a food component which inhibits absorption of zinc and other minerals. Animal-source foods are relatively high in bioavailable zinc, but these foods are often inaccessible to lower-income groups or are consumed only in small amounts. Staple foods, such as cereals and legumes, contain a moderate quantity of zinc, but they also contain substantial amounts of phytate, so total zinc absorption from diets based mainly on these foods may be insufficient to meet physiological requirements (2). Infants and young children in lower-income settings have an increased risk of zinc deficiency, owing to their relatively high zinc requirements for growth, increased losses of zinc during common childhood infections, and inadequate intake and absorption from cereal-based complementary foods.

Plasma zinc concentrations and dietary zinc intake can be used to assess a population's risk of zinc deficiency; however, few nationwide surveys have been conducted in low-income countries using these direct assessment methods. Thus, it is not possible to estimate the true prevalence of global zinc deficiency with available information. In the research described in this edition of Nutrition News for Africa, the investigators estimated the global, regional and country-specific risks of inadequate zinc intake by comparing the availability of zinc in national food supplies with the populations' theoretical requirements for zinc. The authors also considered the prevalence of stunting (low height-for-age) among children less than 5 years old in their analyses. Because zinc is required for normal linear growth, an elevated prevalence of stunting can be considered as suggestive evidence of an increased risk of zinc deficiency in a population (3). The research described in the reviewed papers was conducted as part of the Nutrition Impact Modeling Study (NIMS), which is gathering data on the prevalence of nutritional risk factors (stunting, underweight and wasting, and vitamin A, and zinc and iron deficiencies) for child morbidity and mortality.

## Methods

To complete these analyses, the researchers used publically available information from national food balance sheets (FBS), which are assembled by the Food and Agriculture Organization of the United Nations (FAO) ([www.faostat.fao.org](http://www.faostat.fao.org)). FBS provide information on the amounts (in metric tons) of approximately 100 major food commodities that are available annually in the national food supplies of approximately 200 countries. The FBS also provide information on the average daily per capita availability of each food commodity, expressed both as food quantity (kg/capita/day) and food energy (kcal/capita/day). Using this information and food composition tables, the investigators then calculated the average per capita daily availability of zinc in the food supplies of each country (mg Zn/capita/day) and the assumed distribution of zinc intakes. Then they compared these estimated intakes with the population's theoretical zinc requirements (as proposed by the International Zinc Nutrition Consultative Group, IZiNCG), to estimate the country-specific prevalence of inadequate zinc intake. Stunting (low height-for-age) data, based on the WHO child growth standards, were obtained from a recent systematic analysis of global data (4). Associations between the estimated prevalence of inadequate zinc intake, dietary patterns, and the prevalence of stunting were also explored, using non-parametric Spearman correlations.

## Results and Conclusions

Based on FBS data from 2003-2007, the authors estimated the prevalence of inadequate zinc intake to be approximately 17% globally (range: 2 -54%), and 26% in sub-Saharan Africa (range: 9 - 54%) Because the estimates of the prevalence of inadequate zinc intake varied substantially, depending on the assumptions that were applied in different analyses, the authors emphasized that the estimated prevalence data should be used just to assign a country-specific ranking of likely risk of inadequate zinc intake, rather than stating a true prevalence of inadequate zinc intake or risk of zinc deficiency. Using this ranking approach, the authors found that 16 of the 20 countries identified as having the highest risk of inadequate zinc intake are located in sub-Saharan Africa.

The mean daily per capita zinc availability in the food supply of sub-Saharan Africa was estimated to be  $8.4 \pm 1.3$  mg/day, which was the lowest among all of the regions (global mean:  $11.4 \pm 2.5$  mg/day; mean among high-income countries:  $13.2 \pm 1.3$  mg/day). In addition to a low availability of dietary zinc, the mean phytate content of the food supply in the Africa region was high (phytate:zinc molar ratio:  $21.3 \pm 4.4$ ), which may also affect zinc bioavailability of the food supply. In Africa, only 7% of energy and 19% of zinc are obtained from animal source foods, which are relatively rich sources of zinc and do not contain phytate.

Country-specific estimates of the prevalence of inadequate zinc intake were negatively associated with the total energy and zinc contents of the national food supplies ( $r = -0.62$  and  $-0.60$ , respectively;  $P < 0.01$ ) and with the the percent of total dietary zinc available from animal source foods ( $r = -0.90$ ,  $P < 0.01$ ). The estimated prevalence of inadequate zinc intake was correlated with the prevalence of stunting (low height-for-age) in children under five years of age ( $r = 0.48$ ,  $P < 0.001$ ). All countries in sub-Saharan Africa, with the exception of Cape Verde, the Seychelles and Mauritius, had a stunting prevalence greater than 20%, the level at which the World Health Organization considers stunting to be a public health problem. Of 32 countries worldwide that had both an estimated prevalence of inadequate zinc intake  $>25\%$  and prevalence of stunting  $>20\%$ , 23 of these countries are located in sub-Saharan Africa.

## Program and Policy Implications

The investigators concluded that inadequate dietary zinc intake may be fairly common in Sub-Saharan Africa, and they recommended that the results of these analyses should motivate direct assessments of population zinc status, using biochemical and dietary indicators of risk of zinc deficiency, in countries found to have a high risk of inadequate zinc intake based on analyses of national FBS.

## NNA Editor's Comments \*\*

Due to limited resources and the perceived logistical challenges of carrying out nationally representative surveys of zinc status, very few low-income countries have completed such assessments. This lack of information has hindered better understanding of the prevalence and distribution of zinc deficiency globally, and has delayed the implementation of programs to address this nutritional problem. Contrary to prevailing opinions about the difficulty of collecting accurate information on plasma zinc concentration during national nutritional assessment surveys, this information has been collected successfully during recent surveys in South Africa (Labadarios, 2008) and Cameroon (Engle-Stone, 2012). Notably, these surveys found a prevalence of low plasma zinc concentration among young children of 45% and 81% in South Africa and Cameroon, respectively. Although limited, this information suggests that the prevalence of zinc deficiency may be widespread in Africa.

An interesting aspect of the present studies was the use of the FBS to identify countries that have an elevated risk of inadequate dietary intake of a particular nutrient. The FBS could be used similarly to assess the nutritional adequacy of national food supplies with regard to a broader array of nutrients. Moreover, the FBS can be used to identify locally produced food crops that are rich sources of the nutrients found to be present in limited amounts. This information then can be communicated to agriculture policy makers to help guide crop production choices that are sensitive to national nutritional needs. Thus, nutritionists could use routinely collected food production data to help ensure adequate nutritional quality of national food supplies.

## References

1. Brown KH, Peerson JM, Baker SK, Hess SY. Preventive zinc supplementation among infants, preschoolers, and older prepubertal children. *Food Nutr Bull.* 2009;30:S12-40.
2. Brown K, Rivera J, Bhutta Z, Gibson R, King J, Lönnerdal B, Ruel M, Sandström B, Wasantwisut E, Hotz C. International Zinc Nutrition Consultative Group (IZiNCG) Technical Document #1. Assessment of the risk of zinc deficiency in populations and options for its control. *Food Nutr Bull.* 2004;25:S99-203.
3. de Benoist B, Darnton-Hill I, Davidsson L, Fontaine O, Hotz, C. Conclusions of the Joint WHO/UNICEF/IAEA/IZiNCG Interagency Meeting on Zinc Status Indicators. *Food and Nutrition Bulletin* 28:S399-S484, 2007.
4. Stevens G, Finucane M, Paciorek G, Flaxman S, White R, et al. Trends in mild, moderate, and severe stunting and underweight, and progress towards MDG 1 in 141 developing countries: a systematic analysis. *Lancet* 380: 824-834, 2012.

5. Labadarios, et al. (2008). Folate, iron, vitamin A and zinc status of children 12-108 months and women 16-35 years old in South Africa: the national food consumption survey-fortification Baseline. Abstract 70. 2008 Nutrition congress: Evidence based Nutrition Leading the Way in Innovation. 28 September – 2 October 2008. Pretoria, South Africa p202
6. Engle-Stone R, Ndjebayi AO, Nankap M, Brown KH. Consumption of potentially fortifiable foods by women and preschool children varies by ecological zone and socio-economic status in Cameroon. J Nutr 142: 555-565, 2012.

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