



Sufficiency of Macronutrients and Micronutrients in the Indian Food Supply

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Addressing widespread malnutrition in India is a complex endeavor, in part because of the wide range of factors that determine malnutrition and its consequences. The nutrient status of an individual person is the cumulative result of a cascade of events (Figure 1). Any number of events that occur at any point in the food supply system may diminish both what is available to consumers and its nutrient density. Nutrient absorption can also be affected by health and micronutrient status, the cleanliness of water, and the mix of foods consumed.

Thus a stream of nutrients travels from their source, the national food supply, to the consumers who are the target of public health recommendations. This stream from source to consumer includes a number of “canals” through which foods and their constituent nutrients must pass, including adequate infrastructure for transportation, accessible markets/affordable prices, adequate and safe equipment, electricity, and water for storage and preparation. When micronutrients face obstacles in the stream, they are diverted or lost. Consequently, some consumers receive too few micronutrients.

To investigate this process of nutrient loss, we must begin by examining the source of the micronutrient stream, which raises two questions: Are there enough macro- and micronutrients in the Indian food supply to begin with? Has the sufficiency of nutrients in the Indian national food supply changed over time? This latter question responds to the relatively recent Green Revolution in India, which changed both the size and composition of its food supply.

To determine whether there are enough nutrients in the food supply involves estimating both the nutrient needs of a population and the

nutrient content of the food supply. Estimating the macro- and micronutrient needs of the Indian population involved collecting population demographic data and determining the nutrient requirements of population subgroups defined by age, sex, and reproductive status. Estimating the macro- and micronutrient content of the food supply involved collecting data on how much of each of a range of foods are in the food supply and on the nutrient content of each food.

Recently, the National Institute of Nutrition provided a welcome update of available data on the macro- and micronutrient content of foods (Gopalan, Rama Sastri, and Balasubramanian 1989). This publication provided a comprehensive list of plant- and animal-sourced foods native to India. We used the list of foods provided by Gopalan and colleagues as a starting point, then incorporated nutrient content data from the Bangladesh Food Composition Tables and the United States Department of Agriculture Nutrient Database to complement and support data from India.

Key results, an interpretation, and potential implications

MACRONUTRIENTS

- Our findings suggest that there is likely enough energy and protein in the Indian food supply to meet the needs of its population, but that there may not be adequate fat available. These findings raise specific concerns for some population subgroups—e.g., infants, children, and pregnant and lactating women—for whom adequate fat intake is particularly important.

THE MINERALS: IRON AND ZINC

- Our findings suggest that the iron and zinc content of the food supply remained adequate throughout the 1990–2011 period. (Figure 1) It must be noted, however, that absorption of these micronutrients was not accounted for in these analyses. It remains possible that the iron and zinc content of the food supply may need to be still higher to account for low bioavailability of iron and zinc.
- Our findings suggest that cereals, vegetables, and pulses provide most of the iron contained in the national food supply and, consequently, that the vast majority of iron in the food supply is plant-sourced, non-heme iron. Our findings also suggest that cereals provide the vast majority of the zinc contained in the national food supply.
- This finding both supports and raises further questions about the potential causes of widespread iron and zinc deficiencies and their adverse consequences in India. For example, the absorption of zinc and non-heme iron is hindered by phytic acid, and phytic acid is found in high quantity in the grains and legumes that constitute the bulk of most diets in India. However, our findings also support the importance of dietary diversity: including fruits and vegetables high in ascorbic acid (vitamin C) in the diet could facilitate the absorption of available non-heme iron.

VITAMIN A

- Our findings may explain, in part, the widespread risk of vitamin A deficiency in India: we found that the vitamin A content in the national food supply remained inadequate to meet population needs in 1990–2011. (Figure 1) However, across this time period the vitamin A content of the national food supply increased faster than the content of iron or zinc. We believe this difference indicates that a large proportion of vitamin A in the food supply was provided by animal-sourced foods and that there was a notable increase in the production of animal-sourced foods between 1990 and 2011.

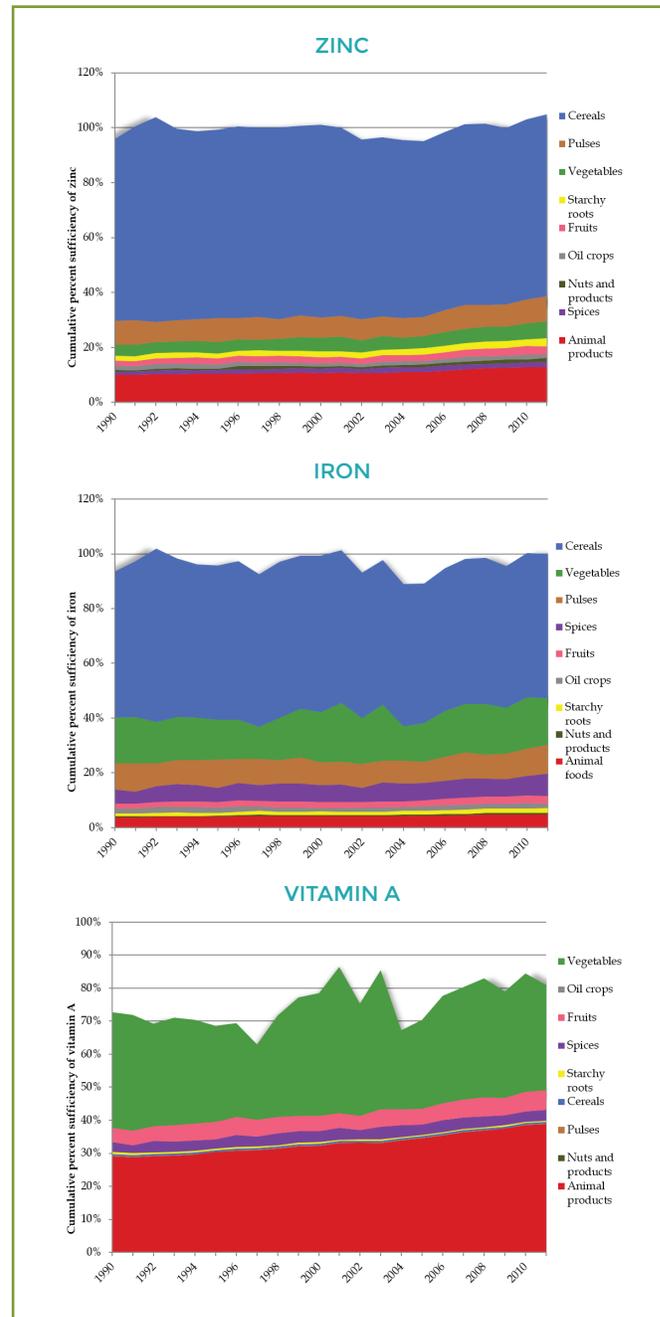


Figure 1. The nutrient stream of zinc, iron and vitamin A in the Indian food supply.

- In contrast, because a small proportion of iron and zinc in the food supply came from animal-sourced foods, this increase in production has not translated to substantial increases in iron or zinc availability. Moreover, vegetables were as significant a contributor to the vitamin A content of the food supply as animal-sourced foods.

Open questions and future directions

Creating our database necessitated using data from other countries, as available Indian data were limited in both their content and the description of their methods. Thus, to get a more complete picture of the nourishment available to Indians, Indian data must be further updated.

Furthermore, our analyses do not and cannot account for the contribution that home gardens and livestock make to individual, house, or

community food supplies. For some Indians, these unaccounted-for sources of food may compensate for the gap between needs and the nutrient availability suggested here.

As illustrated in Figure 1, the “stream” of macronutrients and micronutrients could be further investigated by connecting the data to consumer expenditure and dietary intake data.

The nutrient database created for this work provides a convenient means of identifying the most nutrient-rich foods available in the Indian food supply. In turn, the production analyses described here and the purchase and intake analyses described might translate to field research that chronicles household food storage, preparation, and consumption practices.

Translational research projects such as these may strengthen the work conducted by the TCI in the effort to reduce malnutrition and its adverse consequences.

Gopalan, C., B. V. Rama Sastri, and S. C. Balasubramanian. 1989. “Nutritive Value of Indian Foods, Rev. ed.” Revised and updated by B. S. Narasinga Rao, Y. G. Deosthale, and K. C. Pant. National Institute of Nutrition, Indian Council of Medical Research, Hyderabad, India.

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