The Journal of Nutrition
Editorial

See corresponding article on page 597.

Using Double-Fortified Salt to Reduce Iron Deficiency Anemia in India

Jan Werner Schultink

Executive Director of the Iodine Global Network

In this issue of *The Journal of Nutrition*, Makkar et al. (1) use a modeling approach to assess the benefit-to-cost ratio of reducing iron deficiency anemia in India through salt fortified with both iodine and iron.

Fortification of staple foods or condiments is a cost-effective, and probably underutilized, strategy to address common deficiencies in vitamins and minerals (2). Globally, it has been proven to be highly effective to fortify salt with small amounts of iodine to virtually eliminate the once very common and serious public health problem of iodine deficiency disorders (3). Furthermore, the fortification of wheat flour is a widely practiced strategy to combat iron and folate deficiency. Both these strategies were judged to have very good benefit-to-cost ratios of 30:1 and 8:1 for iodine and iron, respectively (4). As pointed out by Makkar et al. (1), in India, salt has advantages over wheat flour as a vehicle for fortification because of its more universal consumption and relative low variability in daily intake. Thus, the double fortification of salt with iron and iodine seems an attractive approach. A recent review (5) indicated that double-fortified salt (DFS) may provide an effective contribution to national food fortification efforts, but also noted challenges in terms of cost, production, and organoleptic properties in comparison to fortification with iodine alone.

The report by Makkar et al. (1) therefore provides useful additional information for the current use of DFS in India, as well as for other countries where the use of DFS is under review or consideration. The study used an existing consumer expenditure survey and linked it to an existing employment survey. Combined survey data were used to assess nutrient intakes, intakes of iron absorption inhibitors and enhancers, iron-deficiency anemia prevalences, and the impact of DFS on anemia, as well as the impact on income due to improved iron status. All these indicators were obtained through modelling approaches.

Results show that estimated prevalence of iron deficiency anemia in men dropped from 10.6% to 0.7% due to consumption of DFS alone, while in women the prevalence dropped from 23.9% to 20.9%. Interestingly, when improved sanitation, in addition to DFS consumption, was included into the modeling, the prevalence in women was predicted to drop from 23.9% to 3.6%. This difference in the impact of DFS on the anemia prevalence between men and women is striking, and other limiting nutrient intakes could play a role. The significant difference in the impact of sanitation, while highlighting its importance, is not really explained and could benefit from further investigation. Over a 5-year period, the benefit of increased income compared with the additional cost of adding iron premix to iodized salt led to a benefit-to-cost ratio of 4.2:1 when calculated for men and women jointly. The benefit-to-cost ratio was predicted to be higher in men, both because of the greater reduction in anemia and because men are more frequently employed, with higher renumeration.

The authors point out several weaknesses and limitations of their study and the modelling approach that was used. The following additional considerations can be offered.

The study focused on economic impact and income earning to assess the benefits of DFS. Several other benefits, including the impacts on health, are mentioned. However, important social factors that were not mentioned include the impact of iron deficiency on school performance in children and adolescents (especially girls) (6) and the impacts of related fatigue and lack of energy on social interactions and the capacity of mothers to provide care (7). The benefit of anemia reduction goes far beyond wage earning by adults, and in that sense the benefit-to-cost ratio is higher than the calculated 4.2:1.

The study argues that the benefit-to-cost ratio indicates that use of DFS is promising. However, a major driver of benefit was the reduction in anemia among men, a population group with a relatively low prevalence of anemia. The modeled impact of DFS on women, one of the most vulnerable population groups, was disappointing and limited compared to other studies, including a study that reported an anemia reduction rate of about 34% in women of reproductive age due to food fortification (8). Among the Indian population studied (1), the provision of sanitation seemed a much more effective strategy to reduce the anemia prevalence in women than intake of extra iron through DFS. This may illustrate the complex etiology of anemia and the need for increased intakes of several nutrients, in combination with efforts to reduce infection and intestinal parasites, to achieve a significant improvement in hemoglobin concentrations. However, the possible reason for this major difference between men and women in terms of the impacts of access to sanitation is unclear.

The study (1) used the assumption of virtual complete coverage of population use of DFS. This is quite optimistic from a public health and marketing perspective, and the assumption leads to an overly optimistic estimate of impact. Current use of DFS in India is, to a large extent, based on large-scale, government-funded food distribution schemes. It is much less widely purchased by individual households, and a rapid

Address correspondence to JWS (e-mail: jwschultink@ign.org).
Author disclosures: The author reports no conflicts of interest.

First published online January 20, 2022; doi: https://doi.org/10.1093/jn/nxab422.

expansion in use seems uncertain. A benefit-to-cost analysis of use of DFS among populations targeted by food distribution schemes might be helpful in informing the government of India and for food distribution schemes in other countries.

India seems to still be the only country where DFS is used at large scale, mainly linked to government-funded public food distribution and school-feeding schemes. Because of the variation in causes of anemia, and the factors that may influence the decision to produce (e.g., the higher cost) and consume DFS (e.g., organoleptics), the results of this study may not be easily transferable to other countries.

References

1. Makkar S, Minocha S, Bhat KG, John AT, Swaminathan S, Thomas T, Mannar MGV, Kurpad AV. Iron fortification through universal distribution of double fortified salt can increase wages and be cost-effective. An ante-ex modelling study in India. J Nutr 2022;152(2):597–611.
2. Heidkamp RA, Piwoz E, Gillespie S, Keats EC, D'Alimante MR, Menon P, Das JK, Flory A, Clift JW, Ruel MT, et al. Mobilising evidence, data, and resources to achieve global maternal and child undernutrition targets and the Sustainable Development Goals: an agenda for action. Lancet North Am Ed 2021;397(10282):1400–18.
3. Zimmermann MB, Andersson M. Global perspectives in endocrinology: coverage of iodized salt programs and iodine status in 2020. Eur J Endocrinol. 2021;185(1):R13–R21.
4. Horton S, Mannar V, Wesley A. Best practice paper. Food fortification with iron and iodine. Copenhagen (Denmark): Copenhagen Consensus Center, Copenhagen Business School; 2008.
5. Houston R, Tsang BL, Gorstein J. The double fortified salt (iodized salt with iron) consultation: a process for developing evidence-based considerations for countries. J Nutr 2021;151(Suppl 1): 1S–2S.
6. Soemantri AG, Pollitt E, Kim I. Iron deficiency anemia and educational achievement. Am J Clin Nutr 1985;42(6):1221–8.
7. Scholz BD, Gross R, Schultink W, Sastroamidjojo S. Anemia is associated with reduced productivity of women workers even in less-physically-strenuous tasks. Br J Nutr 1997;77(1):47–57.
8. Keats EC, Neufield LM, Garrett GS, Mbuya MNN, Bhutta ZA. Improved micronutrient status and health outcomes in low- and middle-income countries following large-scale fortification: evidence from a systematic review and meta-analysis. Am J Clin Nutr 2019;109(6): 1696–708.