Impact of Wheat Flour Fortification on Anemia

Food Fortification Initiative
Enhancing Grains for Healthier Lives

Opportunity

Anemia is a public health problem that can decrease physical and mental productivity of populations in industrialized and developing nations.

Fortification of wheat flour with nutrients may reduce the prevalence of anemia caused by nutritional deficiencies.

Anemia and Public Health

An estimated 30% of the world's population is anemic [1]. Anemia can be caused by nutritional deficiency (e.g., iron, folate, vitamin B12, vitamin A) and non-nutritional factors (e.g., malaria, hookworm, hemoglobinopathies, infection) [2, 3].

Anemia is defined by low hemoglobin concentration in the blood [4]. Hemoglobin is needed to transport oxygen throughout the body. Anemia during pregnancy increases maternal and infant mortality [3]. It impairs children's physical and cognitive development, and results in fatigue, reduced work performance and reduced immune status. Reductions in cognitive and work performance of substantial portions of the population can have detrimental economic consequences for entire nations [4].

Why Fortify?

Food fortification can be a cost-effective way to reduce anemia prevalence. By fortifying with multiple nutrients such as folic acid, vitamin B12 and iron, it is possible to combat more than one dietary cause of anemia at the same time.

Effectiveness of Flour Fortification Programs around the World

Studies were reviewed that reported hemoglobin levels before and after the initiation of fortification of wheat flour (alone or in combination with maize flour) with multiple nutrients (Figure). The nutrients added to wheat and maize flour in these studies included iron, zinc, folic acid (B9), thiamin (B1), riboflavin (B2), niacin (B3), pyridoxine (B6), and vitamin A.

A total of 23 sub-group analyses were reported; they represented children up to 15 years of age, women of childbearing age, pregnant women, men 40-65 years of age, and all males and females 0-55 years of age. Eleven of the sub-groups analyzed reported an increase in hemoglobin levels after flour fortification began. The increase ranged from 1 g/L in Brazilian pregnant women [5] to 21 g/L in Tajikistani children [6]. Twelve of the sub-group analyses showed a decrease in hemoglobin after fortification began, or no change in relation to a control group (9 analyses in [7]). All of these studies had several limitations, including no information on the coverage or intake of fortified flour by the study population.

The inconsistent impact of fortification on anemia status may be due to several reasons. One possibility is that anemia is not principally due to a deficiency in the nutrients that are added to flour. Another is that the population at risk does not consume adequate amounts of fortified flour to improve nutrient status or prevent deficiency which in turn leads to anemia. A third is that the least effective (and most inexpensive) iron compounds are added to the flour. In summary, the evidence from effectiveness trials is equivocal on whether fortification of flour with one or several nutrients improves hemoglobin.

References

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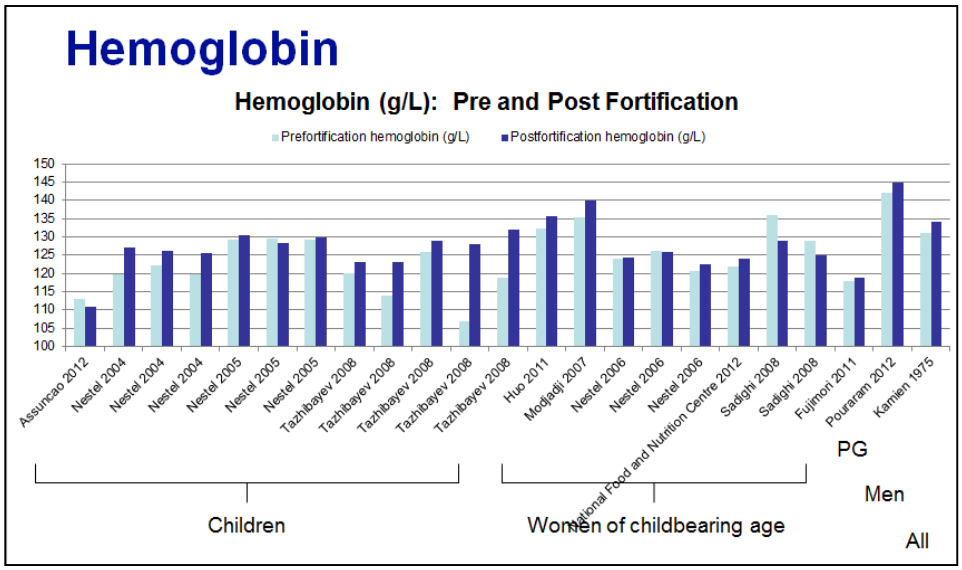
Figure. Hemoglobin levels (grams/liter) reported in studies that examined children up to 15 years of age, women of childbearing age, pregnant women (PG), men 40-65 years of age, and all males and females 0-55 years of age (ALL) before and after implementation of fortification of wheat flour (alone or in combination with maize flour) with multiple nutrients.



From left, the data were collected in the following countries:

Assuncao 2012 [8]: Brazil
Nestel 2004 [7]: Sri Lanka
Tazhibayev 2008 [6]: Azerbaijan, Kazakhstan, Mongolia, Tajikistan, Uzbekistan
Huo 2011 [9]: China
Modjadji 2007 [10]: South Africa
National Food and Nutrition Centre [11]: Fiji
Sadighi 2008 [12]: Iran
Fujimori 2011 [5]: Brazil
Pouraram 2012 [13]: Iran
Kamien 1975 [14]: Australia

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