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Editorial

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Iron in Groundwater: A Source for Anemia Prevention

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Anemia is common the world over among many demographics affecting more than 40% of the world's population and disproportionately affecting nearly half of all women, adolescent girls, and children [1,2]. This highly prevalent condition marked by low hemoglobin concentration increases the risk of negative health outcomes, including mortality, for a pregnant woman and her fetus and has been shown to negatively impact cognitive development and growth in children and adolescents. Because of the multitude of health impacts associated with anemia and its ubiquity in a variety of settings, the prevention and treatment of this condition receives growing attention, especially by maternal and child public health programs.

While anemia can result from many conditions including infectious diseases such as hook worm and malaria, micronutrient deficiencies of folate, vitamin A and vitamin B_{12}, to name a few, and inherited blood disorders such as thalassemia, the consensus is that half of all anemia cases, world-wide, can be attributed to iron deficiency [3]. This assumption is based on evidence from surveys providing iron status information in addition to hemoglobin concentration and an understanding that conventional, staple-based diets, namely in resource poor settings, are low in bioavailable iron. Policy makers responded by encouraging iron supplementation to populations among whom anemia rates are known or expected to be elevated [4]. These programs have been very successful at reducing the burden of anemia and continue to provide a relatively inexpensive, valuable treatment and prevention strategy to vulnerable groups.

In the same resource-limited environments were diets are poor, populations often experience increased exposure to infectious diseases that exacerbate the risk of blood loss and reduced hemoglobin. To complicate the public health response to anemia further, increasing evidence, most notably among children, suggests that there may be negative health consequences associated with providing untargeted iron supplementation to those who are regularly exposed to certain infectious diseases such as malaria [5] or enteric pathogens [6,7]. The disparate response to iron supplementation is thought to occur as a result of two mechanisms: 1) decreased epithelial integrity among those who are iron sufficient as a result of unabsorbed iron remaining in the gut and 2) increased enteric pathogen growth rates and virulence as a result of having a large supply of iron.

Results from a recent study investigating the impact of consuming iron from drinking groundwater add complexity to the challenge of defining how to address anemia prevention through iron supplementation efficiently while adapting to unique environmental characteristics. One of the first studies exploring the association between consumption of naturally iron rich water and health outcomes showed that children in Bangladesh living in households with a tubewell iron concentration >1 mg/L of iron were significantly taller than those with groundwater iron <1 mg/L [8]. Subsequently, Spatone Iron-Plus, a marketed naturally occurring mineral water with an iron concentration of roughly 200 mg/L of ferrous sulphate, was found to provide a highly bioavailable iron source for pregnant women [9]. With an interest to explore water as a source of iron, many studies have been conducted in Brazil showing that water fortified with iron (and ascorbic acid) improves hemoglobin, iron status and growth [10].

A community-based study in rural Bangladesh, a country where nearly 90% of the population uses groundwater as a source for domestic water needs and where groundwater is known to be rich in minerals [11], was conducted recently to estimate daily iron intake through groundwater and the association of that exposure to women's iron status in response to a surprising finding that iron deficiency and associated anemia rates were unexpectedly low among a population of pregnant and lactating women. The results showed a strong, consistent positive association of groundwater iron consumption, which was found to be as high as roughly 150 mg/day, with iron status of women of reproductive age in a setting where risk of iron deficiency and consequent anemia is assumed to be high [12].

Additional research is needed to explore how groundwater iron, a chronic, low-cost iron 'supplement', the concentration of which can be assessed easily using relatively cheap, field-based techniques, impacts maternal health beyond iron status, child development and growth, as well as the health of men who are often not considered at risk of iron deficiency. Also important is to understand how to mitigate exposure to other minerals found in groundwater known to be harmful, such as arsenic, while allowing the tubewell user to continue consuming iron if the typical diet does not provide an adequate source.

Research-based evidence suggests that groundwater can provide an inexpensive, sustainable, source of bioavailable iron commonly not considered in traditional dietary assessments or intervention planning phases to define target audiences. As we continue to understand more about how intake of dissolved minerals in water impacts health, it is important to remember that this environmental exposure adds another layer to the systems-wide approach to addressing nutrition issues, in this case anemia, to ensure those most vulnerable participate while others experience limited risk. Additionally, the examples described add to the growing body of evidence suggesting that while it is most likely still true that iron deficiency is the most prominent cause of anemia, treating or preventing anemia with blanket iron supplementation may improve hemoglobin concentration for many but may simultaneously increase discomfort or health risks among others.

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