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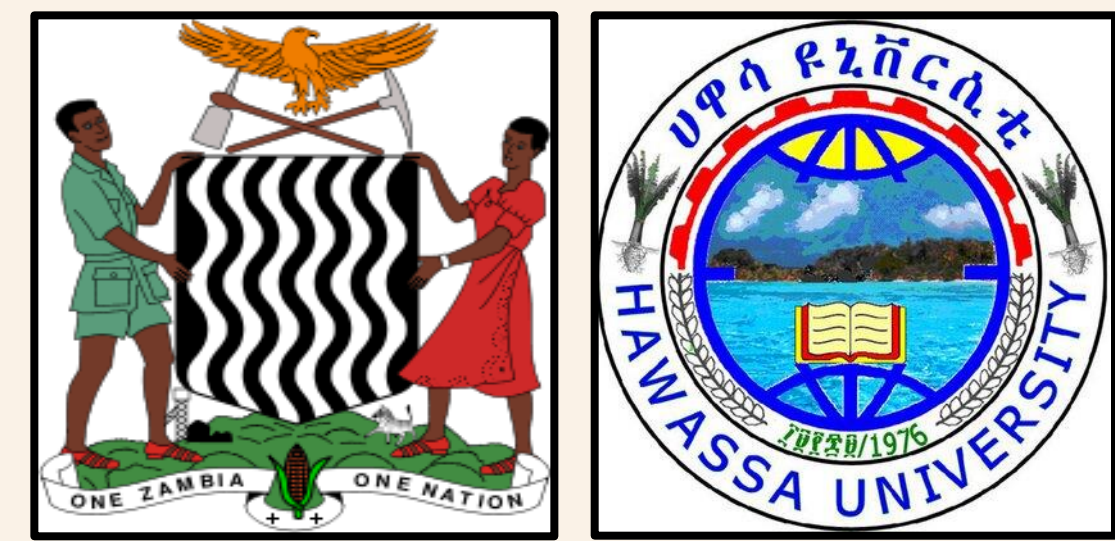
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Iron-Rich Foods, Anemia, and Malaria in Primary School Children in Southern Ethiopia and Zambia

By: Julianne Fay



Abstract

PURPOSE: To examine the relationship between iron-deficient anemia and malaria in primary school children in Southern Ethiopia and Zambia and assess the correlation between diet and health status.

METHODS: Market inventories, observations at health outposts, and interviews and anthropometric assessments of 6th and 7th grade students.

RESULTS: Both Ethiopia and Zambia had 20 iron-rich foods available in local markets. Only liver consumption was associated with malaria experience; those who consumed liver were significantly less likely to have had the disease ($p < .05$). More Ethiopian than Zambian primary students experienced malaria; 67.38% to 32.62%, respectively. Both Zambia and Ethiopia had similar percentages of children who are short for their age, 10% versus 8%, respectively. Zambian children were significantly more likely to be stunted ($HAZ < -2$ SD) than Ethiopian children and this difference was significant ($p < .05$).

DISCUSSION: Given the high prevalence of malaria in Southern Ethiopia and Zambia, and the correlation between liver consumption and malaria experience, nutrition education concerning iron-rich foods is essential.

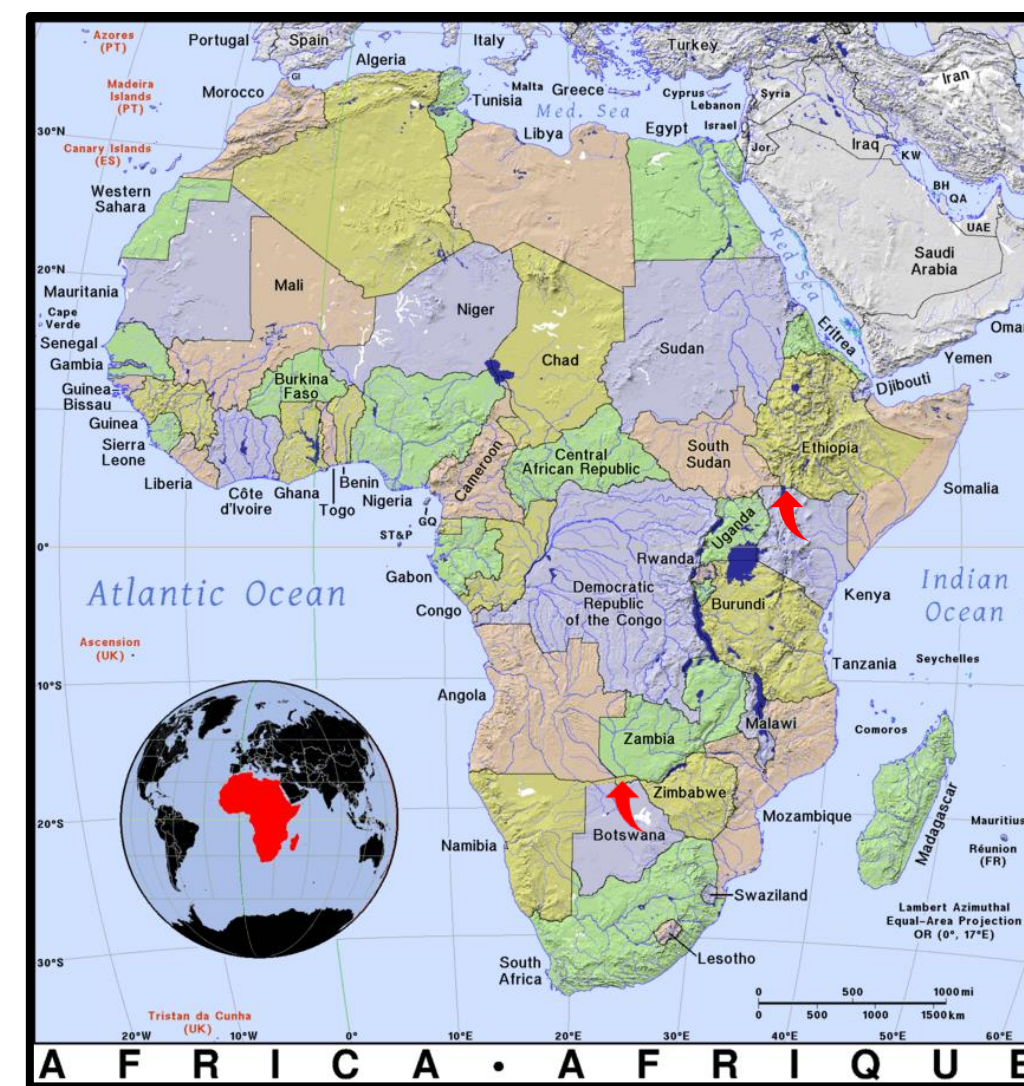


Figure 1: Map of Africa with Sites Designated by a Red Arrow
Source: <https://ian.mackay.net/pat/map/afri/afriblu2.gif>

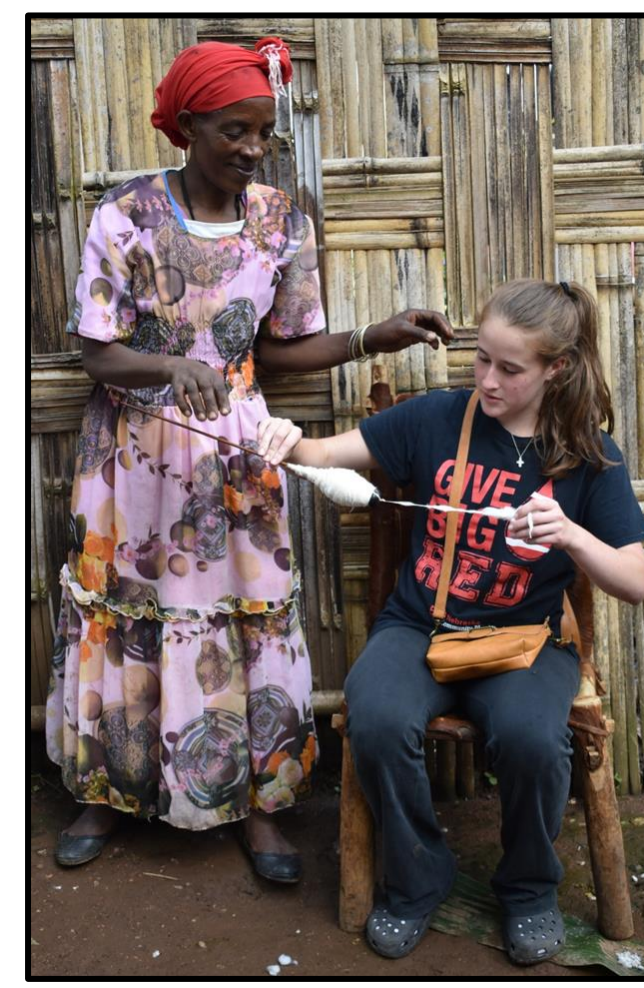


Figure 2: Ethiopian Health Outpost in Hawassa and Zambian Market in Livingstone

Subjects: 6th - 7th graders from 4 schools in Ethiopia and 5 schools in Zambia

Environment: (Figure 1)

- Ethiopia's Sidama Region (formerly SNNPR), within 1 hour of Hawassa
- Zambia's Southern Province, within 1 hour of Livingstone

Experimental Design:

- Data were collected in May-June 2019
- Inventories were made of available market food and observations/interviews were made at health outposts (Figure 2)
- Students were measured for height using a stadiometer and interviewed about their basic diet and experience with malaria (Figure 3)
- Project was conducted under IRB 20150515251 EP and permissions were granted by schools, parents, and participants before data were collected

Statistical Analyses:

- Data were entered into Excel and uploaded to *Statistica*
- Descriptive and correlational analyses, and t-test of independent variables, were conducted



Figure 3: Interviewing and Interacting with Zambian and Ethiopian Primary School Students

Results

- There were 20 iron-rich foods available in each of the sampled markets, Zambia's Livingstone Market and Ethiopia's Hawassa City Market (Figure 5a-5b).
- Children who reported diets higher in iron, e.g., those with more meat and leafy green vegetables, reported fewer iron-deficiency related illnesses. Also children who consumed liver reported fewer malaria experiences ($p < .05$) (Figure 4).
- Approximately equal percentages of children from both countries reported consuming 11 iron-rich foods including eggs, beef, beans, peanuts, milk, yogurt, fish, goat, leafy green vegetables, chicken and cheese (Figure 5a-b).
- Zambian students reported eating more soybeans, pork, mice, and caterpillars compared to their Ethiopian counterparts (Figure 5a).

Results (Continued)

- Ethiopian students reported consuming chickpeas, lentils, and lamb more often than did Zambian students.
- There were more cases of self-reported malaria among Ethiopian students, although this varied by school. Malaria was reportedly experienced by ~ 67.38% of Ethiopian students, compared to just 32.62% of Zambian children (Table 1).
- Children reported eating leafy greens, beans, and chicken, as the most frequently consumed high iron foods in Zambia (Figure 5a) and lentils, chicken, and beef for Ethiopia (Figure 5b).
- Typically, students who were below average height for age were more likely to report having experienced malaria.
- Health workers often treat pneumonia, tuberculosis, typhoid, malaria (mostly in rainy season), and anemia (usually in mothers). Both malaria and nutrition education and treatment are provided at health outposts and clinics.

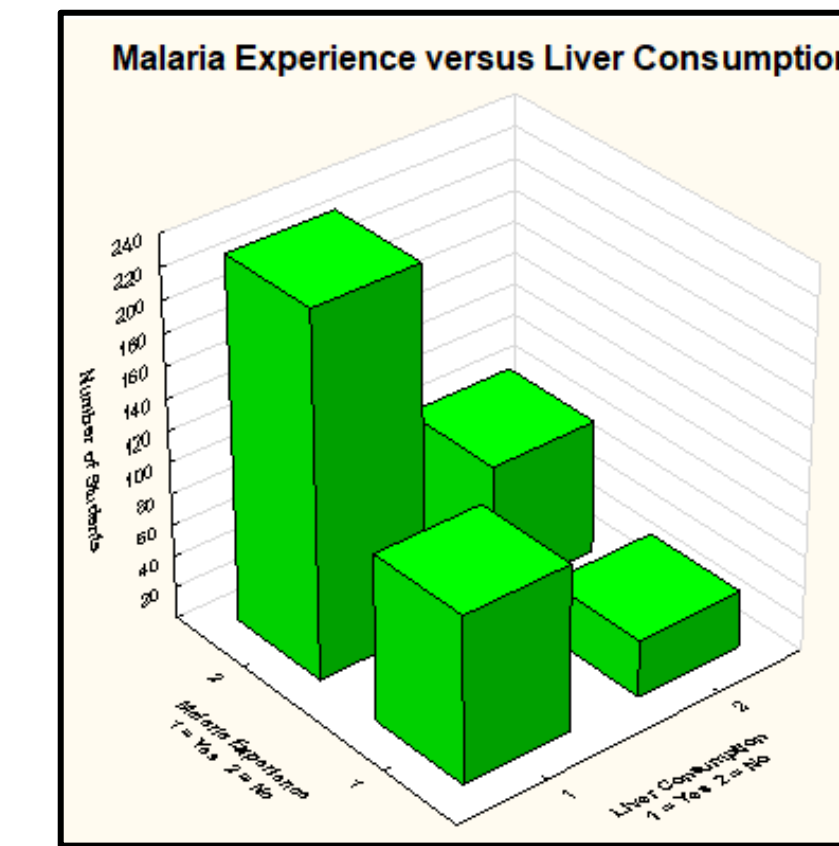


Figure 4: Liver Consumption and Malaria Rates in Ethiopia and Zambia

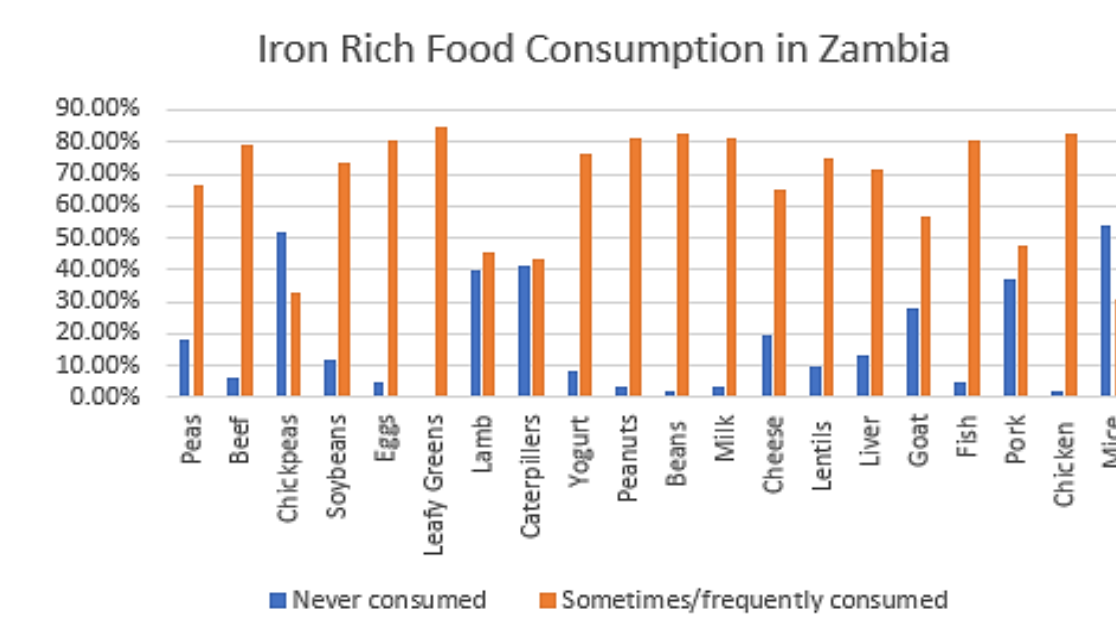


Figure 5a: Percentage of Iron-Rich Foods Consumed in Zambia

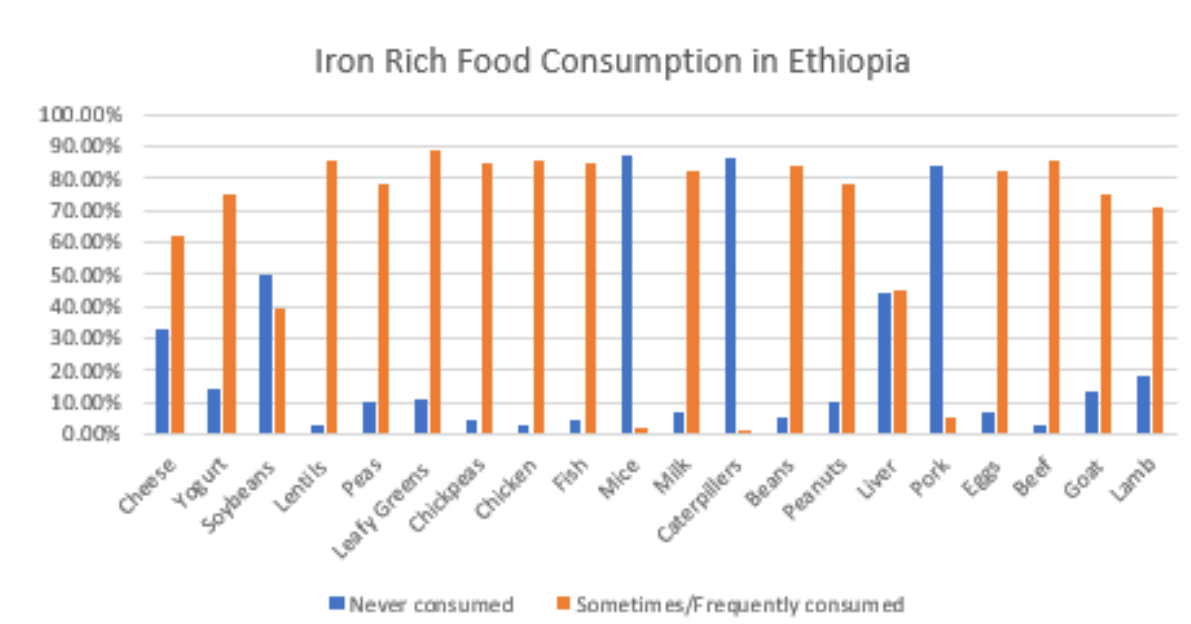


Figure 5b: Percentage of Iron-Rich Foods Consumed in Ethiopia

Table 1: Student Malaria Experience by Country

Country	% Malaria
Ethiopia (n=347)	67.38%
Zambia (n=168)	32.62%



Discussion

- Malaria is one of the major causes of iron deficient anemia and both illnesses remain major global health threats.
- Based on interviews with primary school children and staff at health clinics, both anemia and malaria remain common in the southern regions of Zambia and Ethiopia. In this study of primary school children, malaria was the most common disease experienced and given high rates of morbidity, iron deficiency is also likely to be common. This result aligns with results of other research studies (Kateera, et al. 2015).
- Of the 20 iron-rich foods consumed by participants, only liver was associated with reduced malaria experience. Because the interaction between iron and malaria is a complex one, this correlation may be due to other things, e.g., better overall diet, greater use of malaria prophylaxis, and/or easier access to health care. In other words, liver consumption may be a proxy for something else.
- Goat meat/liver are extremely iron dense (higher than beef, pork, chicken, etc.) and nearly equal percentages of primary school children in both countries reportedly consume goat meat. The same cannot be said for all other available iron-rich foods. Ethiopians consume more pulses, while Zambians consume more unique iron-rich foods, e.g., caterpillars and mice.
- There are limitations to this study. The sample is not a random one, dietary data represent seasonal snapshots rather than a complete picture of what is available and consumed, and actual dietary intake was not measured.
- Further research on how culture and monetary resources affect dietary intake, malnutrition rates, and illness prevention and/or treatment should be undertaken.



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Acknowledgements

This project was made possible by the UNL MAPS Scholarship program, as well as the UNL Honors Program. I would also like to thank Dr. Mary Willis, Professor Alazar Kirubel, and the Hawassa University graduate students, along with the dentists, drivers, and other individuals who made this experience possible. Finally, I would like to thank my fellow students for their help and support.

Background

- Anemia and malaria are deleterious health conditions causing high rates of infant and child mortality, and are frequently coexisting with undernutrition and macronutrient deficiencies, in Sub-Saharan Africa (Kateera et al., 2015).
- Inadequate access to health care, food shortages, lack of malaria prophylaxis, and a nutrient-poor diet keep anemia rates high (Spottiswoode, et al., 2014).
- Anemia is associated with iron deficiencies which cause headaches, weakness, fatigue, and shortness of breath (Osazuwa and Ayo, 2010).
- This is detrimental and could cause children to miss extended periods of school (Spottiswoode and Drakesmith, 2012).

Purpose

To examine the relationship between anemia and malaria in primary school children in Southern Ethiopia and Zambia and assess the correlation with diet and growth status.