TREATMENT OF ANEMIA WITH IRON-FORTIFIED RICE IN A SCHOOL LUNCH PROGRAM IN BURUNDI

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Introduction

The World Health Organization estimates one quarter of all school-age children and nearly half (48%) of developing-country school-age children are anemic (WHO 2001, WHO 2008).

Anemia can be the result of one or multiple etiologic pathways, including micronutrient-deficient diets, acute blood loss due to hookworm or malaria (Brooker et al. 2007), and other infectious agents that the body reacts to by reducing dietary iron absorption and storing blood iron as ferritin instead of forming hemoglobin (Finberg 2013).

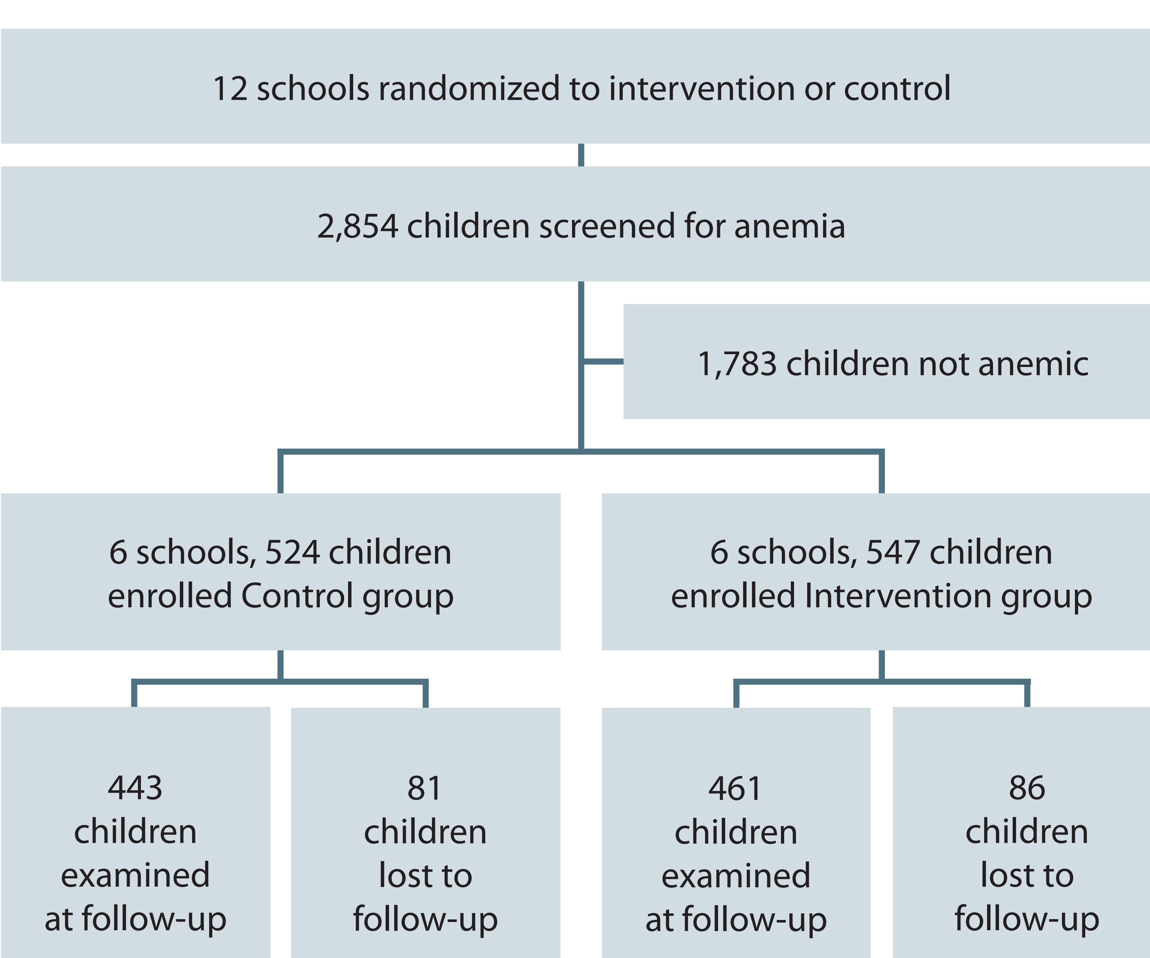
Iron-only fortified rice has previously proven to significantly improve the hemoglobin concentrations of women and children (Hotz et al. 2008, Moretti et al. 2006, Radhika et al. 2011).

Objective

To evaluate the efficacy of using multiple- micronutrient fortified rice (iron, zinc, thiamine, folic acid) to improve the hemoglobin concentration and anemia prevalence of anemic schoolchildren (7-11 years) in rural Burundi.

Methods

Figure 1. Study outline and flow of participants.



Study design

Randomized controlled trial

Eligibility criteria:

- Schoolchildren (7-11 years old)
- Anemic (Hb 7.0 g/dl-11.9 g/dl) (1500m)
- Albendazole received 2 weeks prior to enrollment

The school lunch program was supported by commodities provided by the World Food Programme (WFP).

- 5 days per week for 7 months
- Lunch ration: Rice (150 g), beans (40 g), vitamin A-fortified vegetable oil (10 g), and salt (3 g)
- Multiple-micronutrient formulation provided: iron (17.8 mg), zinc (8.5 mg), thiamine (1.8 mg), and folic acid (600 mg)

This study was approved by the PATH Research Ethics Committee and the Comite National d'Ethique du Burundi.

Data collection

Hemoglobin test (HemoCue® Hb 201+)

Questionnaires: Demographic and household information, dietary diversity (24 hours), and recent child health status

Methods continued

Data analysis

Statistical analyses were performed in Stata/SE 11.0 (StataCorp, College Station, TX).

Composite scores for wealth index and dietary diversity were calculated using principal components analysis.

The change in Hb was evaluated between the intervention and control groups using a linear mixed model; restricted maximum likelihood estimates were calculated due to a small numbers of clusters.

The change in anemia category was evaluated using a logistic mixed model. Improvement was defined as recategorization from moderate anemia at baseline to mild/no anemia at follow-up, or from mild at baseline to no anemia at follow-up.

Results

Table 1. Characteristics of study participants, by receipt of intervention.

Characteristic	Control (N = 443)	Intervention (N = 461)	Total (N = 904)
Age	8.8 (1.4)	8.9 (1.4)	8.9 (1.4)
Female	55.3%	51.1%	53.1%
Missed 2 weeks of school or more	10.7%	11.7%	11.2%
Mean socioeconomic status quintile	3.0 (1.4)	3.0 (1.5)	3.0 (1.4)
Latrine access	99.1%	98.9%	99.0%
Recent fever	48.5%	48.0%	48.3%
Dietary diversity (mean score)			
Number of recently consumed iron-rich food types (0-6)*	2.0 (0.8)	1.9 (0.8)	1.9 (0.8)
Child dietary diversity (Individual Dietary Diversity Score, 1-8)	4.1 (1.2)	3.8 (1.1)	4.0 (1.2)

Note: Continuous variables presented as mean (SD). Binary variables presented as %. * Iron-rich foods: Leafy greens, liver, meats, poultry, fish, eggs, legumes.

Figure 2. Changes in hemoglobin between baseline and follow-up.

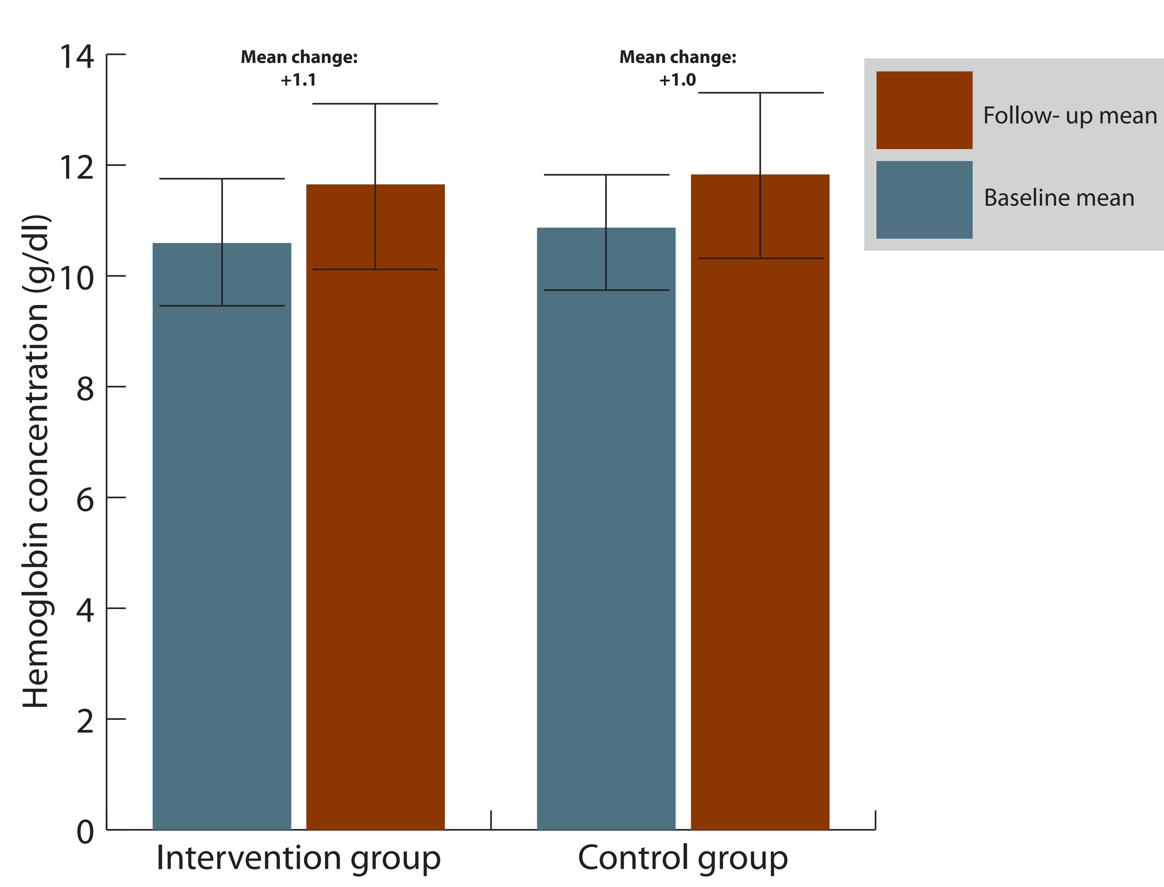
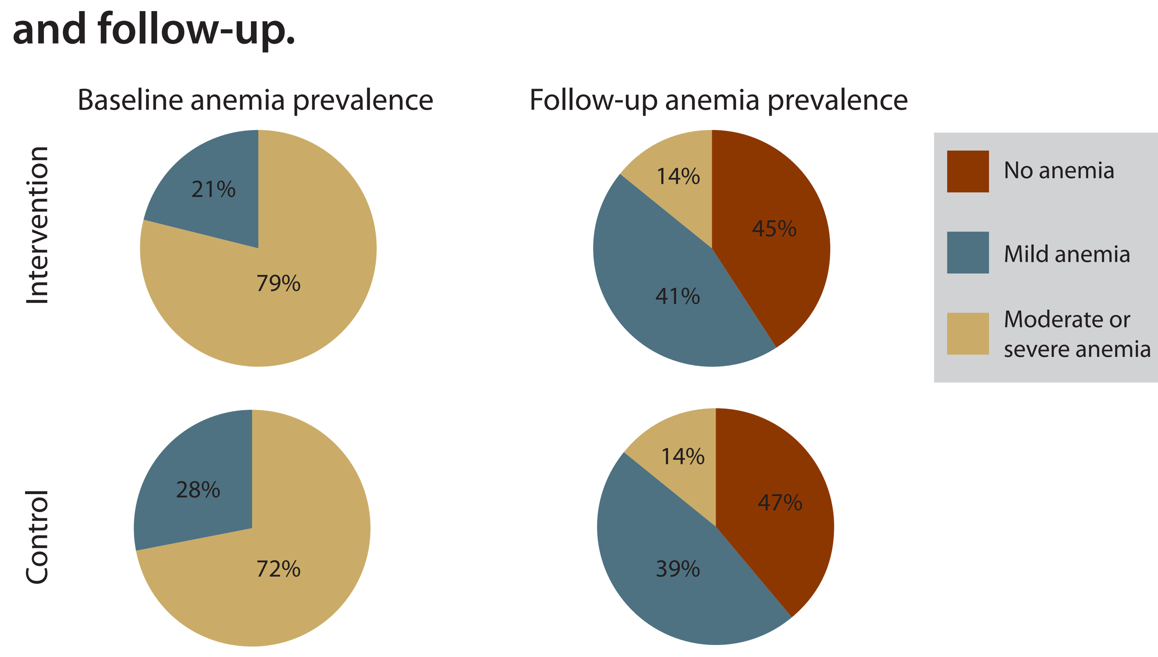


Figure 3. Changes in anemia prevalence between baseline and follow-up.



No significant differences at p = 0.05, accounting for school clusters in a logistic mixed model.

Results continued

Anemia was highly prevalent within the control schools (35.1%) and intervention schools (43.8%).

The mean change in hemoglobin concentration did not significantly differ between the intervention and control samples (β = 0.09 g/dl, 95% CI: -0.21-0.38).

The intervention and control samples were similarly as likely to improve in anemia status (Odds ratio = 0.85, 95% CI: 0.51-1.43).

50% of all children reported that they had been sick with a fever within 2 weeks before follow-up data collection. Children with a recent fever were:

- Twice as likely to not improve in anemia status.
- Twice as likely to have moderate anemia.

Limitations

Laboratory analyses of ferritin and C-reactive protein were not conducted and may have provided greater insight.

Fortified rice uses ferric pyrophosphate (FePP) as a white iron source. Current evidence suggestions that the bioutilization of iron from FePP may be inhibited by the presence of zinc.

Conclusions

Multiple-micronutrient fortified rice containing iron, zinc, thiamine, and folic acid did not significantly improve hemoglobin concentration or anemia prevalence among schoolchildren in rural Burundi.

The high prevalence of infection, as evidenced by fever, among the children may have contributed to the nonsignificant change.

Anemia interventions should implement multiple strategies (i.e., water, sanitation, and health [WASH]; malaria prevention; diet quality improvement) to eliminate both iron deficiency and infectious causes of anemia.

Acknowledgments

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