

Effects of intermittent iron and semestrial high-dose vitamin A supplementation on nutritional status and cognitive development of schoolchildren in Southern Ethiopia

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Introduction

Background: Anemia, the most prevalent nutritional problem worldwide, results from a poor body status in iron, folic acid, vitamin B12, and/or vitamin A, acute and chronic infections, or genetic disorders. Cognitive skills are related with school performance and long-term achievements. Poverty, low societal motivation, and poor nutritional and health conditions contribute at different levels to poor cognitive development and schooling outcomes.

Objective: To generate evaluated the effectiveness of intermittent iron supplementation and semestrial vitamin A supplementation for schoolchildren on hemoglobin (Hb) concentrations, iron and vitamin A status, and cognitive development. The project aims to explore these secondary objectives additionally: 1) To assess the association between nutritional status and cognitive development of schoolchildren. 2) To evaluate the impact of the COVID-19 pandemic and the resulting closing of school activities on the cognitive and behavior of schoolchildren.

Method

Randomized, placebo-controlled, 2x2 factorial design by recruiting 504 schoolchildren were participated to receive (1) placebo vitamin A and iron (placebo arm); (2) vitamin A supplement (VitA arm); (3) iron supplement (Fe arm); and (4) iron and vitamin A supplements (FeVitA arm). Forty-two mg of iron was supplemented weekly and 200,000IU vitamin A was supplemented two times semestrial. Digit span, Tower of London (ToL), Raven's Coloured Progressive Matrices (RCPM), and visual search using cancellation task were used to assess the cognitive development of the

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children. Behavioural difficulties of the children were assessed using the Strengths and Difficulties Questionnaire. Venous blood samples were drawn from the child, and Hb, serum ferritin (sF), soluble transferrin receptor (sTfR) and retinol-binding protein (RBP) concentration were analyzed. Additionally, a systematic review and meta-analysis was conducted to review the evidence from published randomized controlled trials to evaluate the effects of iron supplementation on cognitive development and function among school-age children.

Results

The prevalence of anemia, iron deficiency, low iron stores, Iron deficiency anemia (IDA) and vitamin A deficiency 23.6%, 20%, 2.9%, 3.9% and 12.1%, respectively.

HAZ was positively associated with digit span, RCPM and performance index of visual search tasks. BMIAZ was significantly associated with digit span while Hb concentration was not associated with the three cognitive outcomes. Post-COVID-19-lockdown participant's digit span and RCPM were significantly higher while performance index for visual search task was lower compared to participants of pre-COVID-19-lockdown. There was no significant difference in total difficulties score between pre- and post-COVID-19-lockdown.

Intermittent iron supplementation did not have any effect on cognitive development of school children, but it had a significant negative effect on the performance index of visual search tasks. Semestrial vitamin A supplementation of schoolchildren resulted in a significant improvement in

digit span. No effects on other cognitive outcomes were found.

Neither intermittent iron nor semestrial vitamin A supplementation intervention had a significant effect on Hb, sTfR and RBP concentrations. Iron supplementation resulted in a significant increase of sF and total body iron store but not vitamin A supplementation.

Conclusion

This finding confirms that chronic malnutrition is associated with cognitive development outcomes during school-age. The attention domain of the schoolchildren post-COVID-lockdown was lower compared to pre-lockdown while the working memory and non-verbal intelligence were, paradoxically, improved. There was no difference in behavioral difficulties among pre- and post-COVID-19-lockdown

Iron supplementation had a negative effect on the attention and concentration domain of schoolchildren but no effect on other domains. Semestrial vitamin A supplementation of schoolchildren improved their working memory but not their non-verbal intelligence, planning and problem solving, and attention and concentration. Intermittent iron supplementation improved the iron store while vitamin A had no effect on both iron and vitamin A status of the schoolchildren.

[The thesis is available online on Ughent website](#)

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Curriculum vitae

Befikadu Tariku Gutema attended his Bachelor degree in Nursing at the Faculty of Health Sciences, Department of Nursing, Haramaya University, Ethiopia, and Master of Science in Applied Human Nutrition at the School of Food Science and Nutrition Hawassa University, Ethiopia. He joined Doctoral Schools Training programme, Ghent University, Ghent, Belgium in 2018. Since October 2008 he works at Arba Minch University, College of Medicine and Health Science, School of Public Health. He promoted to Assistant Professor of Human Nutrition at Arba Minch University School of Public Health On April 02/2017.

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