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Malaria and helminth co-infection and nutritional status of febrile patients in Southern Ethiopia

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KEYWORDS

Plasmodium;
Helminth;
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Summary

Background: Because the mechanisms by which *Plasmodium* and helminth parasites affect nutritional status are different, these parasites likely have additive effects when they co-exist in a host. This study aimed to compare the prevalence of undernutrition in patients infected with either *Plasmodium* or helminths and those co-infected with the two types of parasites.

Methods: Acute febrile patients suspected of having malaria who attended the outpatient clinic at Dore Bafeno Health Center between December 2010 and February 2011 were examined for *Plasmodium* parasites using Giemsa-stained thick and thin blood smears and for helminths using the thick Kato-Katz method. Nutritional status was determined using anthropometric indices generated from height and weight measurements.

Results: Of the 702 patients examined, 34.5% were infected with helminths alone, 12.3% were infected with *Plasmodium* alone, and 19.4% co-infected with *Plasmodium* and intestinal helminths. Out of the patients examined, 44.9% were undernourished. The prevalence of undernutrition was not significantly different between those patients not infected with *Plasmodium* or helminth species and those infected with *Plasmodium* or helminth species. The differences in the odds of undernutrition were also not significant between patients who were co-infected with different *Plasmodium* and helminth species and those with single infections with *Plasmodium* or helminth species in our multivariable logistic regression model adjusted for the confounding effects of age and sex.

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Conclusion: The prevalence of undernutrition was comparable in patients infected with *Plasmodium* or helminths alone and those co-infected with *Plasmodium* and helminths in Dore Bafeno Health Center, Southern Ethiopia. However, further studies are needed in areas of intense transmission where both parasites are endemic to elucidate whether the impact of *Plasmodium* and helminth co-infection on undernutrition is additive or multiplicative.

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Introduction

Plasmodium and helminth infections are common public health problems in sub-Saharan Africa [1]. Each parasite may cause undernutrition, anemia, cognitive impairment and organ dysfunction [2]. In regions where these parasites are co-endemic, co-infections are common and can result in severe morbidity [1,2]. However, the difference in severity of individual infections and co-infections is unclear [1]. Thus, it is necessary to determine the public health impact of *Plasmodium* and helminth co-infections to design effective control measures [1].

The mechanisms by which helminths and *Plasmodium* parasites affect the nutritional status of individuals are not the same [3–5]. Helminths affect the physiopathology of the human gastrointestinal wall, leading to intestinal inflammation, reduced appetite, malabsorption and chronic blood loss [3,4]. *Plasmodium* infection induces the secretion of inflammatory cytokines, which may in turn result in anorexia and catabolic responses, causing undernutrition in infected individuals [5]. Therefore, the effects of these parasites could be additive when they co-exist in a host. However, supporting evidence is limited [6].

Because *Plasmodium* and helminth co-infections are common in most parts of Ethiopia [6–8], the evaluation of the implication of these infections on undernutrition is vital for designing an appropriate intervention strategy. Therefore, we compared the prevalence of undernutrition between patients infected with *Plasmodium* or helminths alone and those co-infected with *Plasmodium* and helminths.

Materials and methods

Study area and participants

We conducted a cross-sectional study in acute febrile patients suspected of malaria who attended the outpatient department of Dore Bafeno Health Center, Sidama Zone, Southern Ethiopia, from

December 2010 to February 2011 [7]. Participants were patients suspected to have malaria who had not taken anti-malarial drugs within the two weeks prior to the examination date. Almost all of the study participants belonged to the Sidama ethnic group and lived in a rural area with a similar lifestyle. Malaria transmission is unstable in the area and occurs mainly from October to December, following the heavy rainy season, and from April to May, following the light rainy season. The daily register of the health center showed the occurrence of *Plasmodium falciparum*, *Plasmodium vivax* and mixed *P. falciparum* and *P. vivax*-infected cases, indicating that the area is endemic for malaria. A previous study in this health center also documented *P. falciparum* (54.3%, 146/269) and *P. vivax* (10.4%, 28/269) infections among febrile patients seeking treatment [9]. Clear data regarding prevalence of undernutrition among communities in the study area were not available. Administration of micronutrient supplementation to children under five and lactating mothers was underway in the area during the study period.

Nutritional status

The heights (to the nearest 0.1 cm) and weights (to the nearest 0.1 kg) of each participant were recorded while the patients were barefoot and in light clothing. A portable digital balance with a wooden board attached with plastic tape was used to measure height and weight. Z-scores were determined using Anthro (for children age < 5) and AnthroPlus (for children age between 5 and 19 years) software (WHO, Geneva, Switzerland) [10,11]. Based on individual Z-scores, children were grouped as being undernourished or well-nourished [12]. Children were grouped as undernourished when either they were underweight (weight-for-age Z score or body mass index-for-age Z score < -2), displayed stunted growth (height-for-age Z score < -2) or displayed wasting (weight-for-height Z score < -2). Adults aged 19 and

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