



Epidemiology of intestinal parasite infections in three departments of south-central Côte d'Ivoire before the implementation of a cluster-randomised trial



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ABSTRACT

Hundreds of millions of people are infected with helminths and intestinal protozoa, particularly children in low- and middle-income countries. Preventive chemotherapy is the main strategy to control helminthiasis. However, rapid re-infection occurs in settings where there is a lack of clean water, sanitation and hygiene. In August and September 2014, we conducted a cross-sectional epidemiological survey in 56 communities of three departments of south-central Côte d'Ivoire. Study participants were invited to provide stool and urine samples. Stool samples were examined for helminth and intestinal protozoa infections using the Kato-Katz technique and a formalin-ether concentration method. Urine samples were subjected to a filtration method for the diagnosis of *Schistosoma haematobium*. Information on sociodemographic characteristics, knowledge, attitude, practices and beliefs with regard to hygiene, sanitation and intestinal parasitic diseases were collected using a questionnaire administered to household heads. Multivariable logistic regression models were employed to analyse associations between parasite infections and risk factors. Overall, 4,305 participants had complete parasitological and questionnaire data. Hookworm was the predominant helminth species (21.2%), while *Ascaris lumbricoides*, *Trichuris trichiura*, *Schistosoma mansoni* and *S. haematobium* showed prevalences below 10%. Infections with pathogenic intestinal protozoa (e.g. *Entamoeba histolytica*/*E. dispar* and *Giardia intestinalis*) were similarly prevalent in the three departments. Hookworm infection was associated with open defecation and participants' age and sex. *Entamoeba coli* infection was negatively associated with the use of tap water at home (odds ratio (OR) = 0.66; $p = 0.032$). Disposal of garbage in close proximity to people's home was positively associated with *G. intestinalis* (OR = 1.30; $p = 0.015$). Taken together, helminth and intestinal protozoa infections affected a considerable proportion of rural dwellers in south-central Côte d'Ivoire at the onset of a

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cluster-randomised intervention trial. Our results will serve as baseline to monitor the effect of a package of interventions, including preventive chemotherapy, sanitation and health education on re-infection with helminths and intestinal protozoa.

Trial registration: ISRCTN53102033 (date assigned: 26 March 2014)

1. Introduction

Intestinal parasitic diseases due to infections with helminths (e.g. soil-transmitted helminthiasis (STH) and schistosomiasis) and intestinal protozoa (e.g. amoebiasis and giardiasis) are widespread in tropical and subtropical regions, where climatic, ecological, socioeconomic and hygienic conditions favour their transmission (Hotez et al., 2014; Utzinger et al., 2012). More than a billion people are affected by STH, schistosomiasis and intestinal protozoa infections, causing an estimated 26.1 million disability-adjusted life years (GBD 2015 DALYs and HALE Collaborators, 2015; Pullan et al., 2014). School-aged children in low- and middle-income countries are at highest risk of infection, and hence, developing morbidity (Nematian et al., 2004; Ostan et al., 2007).

For the control of STH and schistosomiasis, the World Health Organization (WHO) recommends preventive chemotherapy, which is the periodic treatment with albendazole or mebendazole against STH and praziquantel against schistosomiasis, mainly targeting school-aged children (WHO, 2006). Preventive chemotherapy primarily aims at reducing worm loads, and hence, reducing associated morbidity (WHO, 2011). However, preventive chemotherapy does not protect from re-infection (Hotez et al., 2008; Jia et al., 2012). To sustain control and move towards elimination, it is necessary to complement preventive chemotherapy with other measures, such as interventions improving water, sanitation and hygiene (WASH) and information, education and communication (IEC) (Grimes et al., 2014; Jia et al., 2012; McManus et al., 2014; Strunz et al., 2014; Ziegelbauer et al., 2012).

In Côte d'Ivoire, STH, schistosomiasis, giardiasis and amoebiasis are of considerable public health relevance (Ouattara et al., 2010; Yapi et al., 2016). Coverage of improved water and sanitation is low among rural populations. In turn, open defecation is common (Schmidlin et al., 2013). In 2011 and 2012, a pilot study was implemented to evaluate the effect of an intervention package to reduce re-infection with helminths and intestinal protozoa and to initiate changes in hygiene and defecation behaviour (Hürliemann et al., 2018). Results were promising, and hence, a research project was launched in August 2013, designed as a cluster-randomised trial to be conducted in 56 communities of three departments in south-central Côte d'Ivoire. The aim was to document the effect of an integrated control approach, consisting of preventive chemotherapy, community-led total sanitation (CLTS) and health education, on re-infection with helminths and intestinal protozoa and diarrhoeal incidence. Here, we focus on the baseline situation before implementing the aforementioned cluster-randomised trial and describe the epidemiology of helminthiasis and intestinal protozoa infections.

2. Material and methods

2.1. Ethics approval and consent to participate

Institutional approval of the study protocol was granted by the research commission of the Centre Suisse de Recherches Scientifiques en Côte d'Ivoire (CSRS). Ethical clearance was granted by the ethics committees of Basel (EKBB, reference no. 300/13) and Côte d'Ivoire (reference no. 76-MSLS-CNER-dkn). Local authorities (village chiefs) and community members were informed on the objectives, procedures, and potential risks and benefits of the study. Written informed consent of each participant was obtained (for children aged below 18 years, consent was given by parents or legal guardians). It was emphasised that participation was voluntary and withdrawal from the study was possible anytime without further obligations.

All members of the 56 communities received a single oral dose of albendazole (400 mg for participants aged > 2 years and 200 mg for children aged 1–2 years, respectively) against STH. A single 40 mg/kg oral dose of praziquantel against schistosomiasis was administered to community members aged 5 years and above in localities where the prevalence of schistosomiasis was greater or equal to 5%, while individual case treatment was applied in localities with lower prevalences. Drug administration was implemented by the 'Programme National de Lutte contre les Maladies Tropicales Négligées à Chimiothérapie Préventive' (PNLMTN-CP) in collaboration with personnel from local health districts and our research team.

2.2. Study area and population

The study was conducted in August and September 2014 in the departments of Taabo, Djékanou and Toumodi, located in the south-central part of Côte d'Ivoire. The department of Taabo belongs to the Agnéby-Tiassa region, while Djékanou and Toumodi are part of the Bélier region (Fig. 1). The area of the three departments is drained by the tributaries of the Bandama and N'Zi rivers. The former crosses the Taabo department and is impounded by a large dam creating Lake Taabo that is used for hydroelectric power production (N'Goran et al., 1997). Additionally, there are seasonal streams that are usually dried out between November and February. The study zone is characterised by a forest savannah ecology (Koffi et al., 2013) and a tropical climate with a recent tendency to a single rainy season (March to July) (Bassa et al., 2016). The mostly rural population is engaged in subsistence farming (e.g. banana, cassava, maize and yams) and cultivation of cacao, coffee and rubber for cash. In communities living in close proximity to Lake Taabo, fishery constitutes an important livelihood activity.

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