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Intestinal helminths and protozoa in children in pre-schools in Kafue district, Zambia

Joyce Siwila[a,*], Isaac G.K. Phiri[a], Heidi Larsen Enemark[b], Mbiko Nchito[c], Annette Olsen[d]

[a] Department of Clinical Studies, School of Veterinary Medicine, University of Zambia, P.O. Box 32379, Lusaka, Zambia
[b] Section for Adaptive Immunology and Parasitology, National Veterinary Institute, Bülowsvej 27, DK-1790 Copenhagen V, Denmark
[c] EQUIP 2 Programme, Ministry of Education, P.O. Box 32330, Lusaka, Zambia
[d] DBL-Centre for Health Research and Development, Faculty of Life Sciences, University of Copenhagen, Thorvaldsensvej 57, DK-1871 Frederiksberg C, Denmark

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ABSTRACT

Intestinal parasitic infections are among the most widespread of human infections in developing countries, and children are the most vulnerable. The aim of this study was to determine the prevalence of the protozoa *Cryptosporidium* and *Giardia*, as well as prevalence and intensity of intestinal helminths in children attending pre-school or day-care centres in Kafue District, Zambia. Single stool samples were collected from 403 children from 10 pre-schools and were subjected to duplicate Kato–Katz thick smears to identify and quantify helminths. A commercial immunofluorescence kit was used to identify *Cryptosporidium*- and *Giardia*-positive samples. The overall prevalence of helminth infection was 17.9%. *Ascaris lumbricoides* was found in 12.0%, hookworm in 8.3%, *Taenia* spp. in 0.9%, *Hymenolepis nana* in 0.6% and *Schistosoma mansoni* in 0.3%. The overall prevalence of *Cryptosporidium* and *Giardia* was 28.0 and 29.0%, respectively, with more girls infected with *Giardia* (33.8%) than boys (22.7%) ($P = 0.02$). Significant differences in infections with *A. lumbricoides* and *Cryptosporidium* were observed between the various pre-schools ($P < 0.001$). These findings indicate that intestinal parasites are prevalent in children enrolled in pre-schools in Zambia. Future studies should explore local factors associated with transmission of these infections, and consequently provide the necessary health education to parents and teachers.

1. Introduction

Intestinal parasites, including helminths and protozoa, are common among children in developing countries, and the frequency of these parasites can be extremely high, affecting nearly everyone at some point during their lives.[1]

Among the intestinal helminths, the soil-transmitted helminths (STHs), also referred to as geohelminths, are important parasites of humans.[2] STH infections are particularly common in tropical and subtropical regions of developing countries,[3] and more than one billion of the world's population are infected with at least one of the STH species.[4] It is further estimated that children of pre-school age account for 10–20% of those infected with STHs.[5] The most common of the STH infections are *Ascaris lumbricoides*, *Trichuris trichiura* and the hookworms (*Necator americanus* and *Ancylostoma duodenale*), and in less-developed countries it is common that children are parasitized with more than one species at the same time, 'with resultant impairments in physical, intellectual, and cognitive development'.[4] In addition, the parasites tend to affect the immune response of infected children.[5] The

* Corresponding author. Tel.: +260 977 319 826; fax: +260 211 293 727.
E-mail address: siwilaj@yahoo.co.uk (J. Siwila).

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transmission is enhanced by poor socioeconomic conditions, poor personal hygiene and poor disposal of human excreta.[6,7]

Protozoan parasites belonging to the genera *Cryptosporidium* and *Giardia* are major causes of gastroenteritis in humans and animals globally. Clinical manifestations vary from absence of symptoms to acute or chronic diarrhoea, dehydration, abdominal pain, nausea, vomiting and weight loss,[8,9] depending on factors such as age and health of the infected host as well as infective dose and genetic background of the parasite. In developing countries, *Cryptosporidium* infections occur mostly in children younger than 5 years of age.[10,11]

Giardia duodenalis is the most common intestinal parasite of humans in developed countries,[12] and in Asia, Africa and Latin America about 200 million people have symptomatic giardiasis, with about 500 000 new cases reported each year, especially among children.[6] It is reported to be a significant cause of protozoal diarrhoea, morbidity and mortality in both developing and developed countries.[13] Because of its association with outbreaks of diarrhoea in day-care centres, *G. duodenalis* has been recognized as a re-emerging infection.[14]

In most parts of the world, there is an increase in the number of women combining child rearing and employment outside the home,[15] and this has resulted in an expansion in the provision of day-care centres. The trend has been observed in Zambia, with a notable increase in the number of day-care centres or pre-schools catering for young children. These pre-schools operating in peri-urban or semi-rural areas are often housed in an environment characterized by overcrowding and insufficient sanitary facilities. So far there have been no epidemiological data on the occurrence of intestinal parasites in children attending these pre-schools. On this basis, the present study was undertaken in order to determine the prevalence and intensity of STH infections, the prevalence of intestinal protozoa (*Cryptosporidium* and *Giardia*) and the presence of multiple infections in children attending pre-school centres in Zambia.

2. Materials and methods

2.1. Study area and population

The study was done in Kafue District in Zambia from June to August 2007. The district is located 45 km south of Lusaka, the capital of Zambia, and has a population of more than 150 000 people. The main ethnic groups are Nyanja, Bemba and Tonga, with Nyanja being used as the main language of communication. More than 13% of the population are unemployed, but most of these people are involved in small-scale farming. The main crop grown is maize.[16] The district has 21 registered pre-schools distributed in different townships, and each school has an average of 50 enrolled children. Ten of these pre-schools were randomly selected to participate in the study. Of the ten selected schools, two are privately owned, three are community schools managed by the community in which they are located, and five are managed by non-governmental organizations (NGOs).

2.2. Data collection and laboratory methods

Faecal samples were collected over a 3-month period. With the help of the parents, a single stool specimen was obtained from each child and transported to the University of Zambia laboratory in cool boxes packed with ice. The specimens were then separated into two parts. One part was processed directly with duplicate 41.7 mg Kato–Katz thick smears[17] for quantitative diagnosis of intestinal helminth infections. To detect hookworm eggs, slides were read within 1 h of preparation. The other half of the specimen was processed by mixing one portion of stool with three portions of 10% buffered formalin and further analysed by immunofluorescence microscopy using a commercial kit (Meridian Diagnostics Inc., Cincinnati, OH, USA) to identify *Cryptosporidium* oocysts and *Giardia* cysts. Demographic data for the pre-school and the children were collected through questionnaires.

2.3. Treatment

Children harbouring helminths were treated with single-dose oral mebendazole 500 mg (five tablets of 100 mg, Fourrts, India) with the help of community health workers from the local clinics. One week before sample collection, children from Lifebridge and Hillside community schools were dewormed by the Ministry of Health during national immunization week, and therefore these children were not treated by the project.

2.4. Data analysis

The information from Lifebridge and Hillside community schools was excluded in the analyses of STH infections because of the above-mentioned Ministry of Health deworming, so $n = 324$. By contrast, all schools were included in the analyses of protozoan infections ($n = 403$). Statistical analyses were carried out using STATA version 10.1 (Stata Corp., College Station, TX, USA) and SPSS version 11 (SPSS Inc., Chicago, IL, USA). STH egg counts per child were converted to eggs per gram (epg) faeces by multiplying the average count of the duplicate Kato–Katz slides by a factor of 24.[17] Intensities of infection for each STH were expressed as epg and were compared with non-parametric tests as normal distributions of egg counts even after log-transformations were not obtained. Confidence intervals were taken from the STATA output if proportions were between 0.1 and 0.9. When proportions were outside this range, confidence intervals were found using statistical tables.[18] Proportions were compared with χ^2 tests, and all results were considered significant if $P < 0.05$.

2.5. Ethical considerations

Permission to conduct the study in the schools was sought from the pre-school headteachers. Meetings explaining the purpose of the study were held with the parents, and the children were enrolled in the study after obtaining written informed consent from their parents.