Scientific Research Publishing

Open Journal of Pediatrics, 2024, 14, 391-400
https://www.scirp.org/journal/ojped
ISSN Online: 2160-8776
ISSN Print: 2160-8741

# Risk Factors for Geo-Helminthiasis in Children Aged 6 - 36 Months in a Rural Health District in Cameroon

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**How to cite this paper:** Mekone Nkwele, I., Naiza, M., Talla Kamga, G., Nana Djeunga, H., Epée Ngoue, J., Epée Eboumbou, P., Ngo Um Sap, S., Mah Mungeh, E. and Kamgno, J. (2024) Risk Factors for Geo-Helminthiasis in Children Aged 6 - 36 Months in a Rural Health District in Cameroon. *Open Journal of Pediatrics*, **14**, 391-400.
https://doi.org/10.4236/ojped.2024.142038

**Received:** January 10, 2024
**Accepted:** March 24, 2024
**Published:** March 27, 2024



## Abstract

**Introduction and Objectives:** Soil-Transmitted-Helminthiasis (STH) is a public health problem in Cameroon. The control strategies currently in place, particularly chemoprevention, has shortcomings linked to the target population, which are school-age children. The objective was to determine the prevalence and the risk factors associated with geo-helminthiasis in children aged 0 to 3 years in a rural health district. **Method:** From December 2020 to May 2021, a descriptive and analytical cross-sectional study of 376 children between 6 and 36 months was carried out in the Akonolinga health district. This was a cluster sampling in 4 health areas. Stool samples were collected and analysed using the mini-FLOTAC method. The results expressed as the number of eggs per gram of stool. A questionnaire on socio-demographic and lifestyle data was administered to the parents. The Chi-squared test was used to measure the association between geo-helminth infection and the data collected. A multivariate analysis using logistic regression was performed ($p < 0.05$). **Results:** The prevalence of STH was 19.4% (*Ascaris lumbricoides*: 16% and *Trichuris trichiura*: 8%). Risk factors were: consumption of contaminated water (AOR = 1.93 [1.03 - 3.6]; $p = 0.040$), early contact of the child with the ground (before age of 4 months) (AOR = 4.9 [2.1 - 11.37]; $p < 0.001$), habit of walking barefoot (AOR = 2.91 [1.1 - 7.97]; $p = 0.038$), and living in a habitat with unpaved ground (AOR = 7.4 [1.55 - 35.7]; $p = 0.012$). **Conclusion:** The prevalence of STHs in infants was high. Preventive chemotherapy should be extended to this age-group, and other measures intensified.

**Keywords**

Akonolinga, Soil-Transmitted-Helminths, Children Aged 0 - 3 Years, Risk Factors

## 1. Introduction

Geo-helminthiasis is an infection of the digestive tract caused by a class of intestinal parasites called geo-helminthes [1]. The main species responsible for this disease are: *Ascaris lumbricoides*), the whipworm (*Trichuris trichiura*), hookworms (*Necator americanus* and *Ancylostoma duodenale*) and *Strongyloides stercoralis* (anguillula) [1] [2] [3] [4]. They affect around 1.5 billion people worldwide, almost 24% of the world's population [1]. Due to climatic conditions and underdevelopment, tropical and subtropical regions, including sub-Saharan Africa, which have the highest number of cases, and children are the most affected [1] [2] [3]. Indeed, the World Health Organisation (WHO) estimates that more than 568 million school-age children (≥5 years) live in areas where transmission of these parasites is high [1]. Over the long term, and depending on the intensity of the infection, geo-helminthiasis can cause children to have problems absorbing the nutrients they need for growth, with the risk of malnutrition and anaemia [5]-[11]. This weakening of their immune system will contribute to a decline in their physical and intellectual capacities, with a drop in school performance [12] [13]. To combat these diseases, the WHO recommends sanitation and raising awareness of good hygiene, combined with systematic preventive chemotherapy for people at risk (including children aged 2 to 15 years) living in endemic areas (prevalence ≥ 20%) [1] [11] [14] [15]. In Cameroon, massive infestations have been reported in young infants, with the difficulties of anthelmintic treatment in this age group. Preventive chemotherapy is administered once a year in nursery and primary schools [16] [17]. Akonolinga is a municipality in the Centre region in Cameroon, with a predominantly rural population. It lies on the Nyong River. This health district belongs to a forested environment and covers an area of about 4300 km$^2$ with equatorial type climate divided into four seasons [18]. The Akonolinga health district is a highly endemic area, favourable to the spread of geo-helminths [19]. Recent studies in the Akonolinga Health District have highlighted the persistence of the disease in children targeted by chemoprevention and a high prevalence in adults excluded from treatment [19] [20]. It was then suggested that children could be reinfected by parasites from parents and young children who had not been targeted, which limits the strategy implemented by the control programme. Most children aged between 0 and 3 who are excluded from these treatments are not attending school and are growing up in the same conditions as their elders. The objective of this study was to determine the prevalence and identify risk factors of geo-helminth infection in children aged between 6 and 36 months living in the Akonolinga Health District, with an aim to enforce better management protocols in this group age.

## 2. Material and Method

From December 2020 to May 2021, a descriptive and analytical cross-sectional study of 376 children aged 6 - 36 months was conducted in the Akonolinga health district. Children who did not provide enough stool for analysis were excluded from the study. Cluster sampling was carried out in 4 randomly selected health areas: Ekoudou, Edjom, Akonolinga-Urban and Mengang. The minimum sample size was estimated at 301, and the prevalence of geo-helminthiasis in children aged 2 to 5 excluded from mass treatment was 26.8%, according to a study conducted in the Akonolinga Health District in 2018 [21]. Before starting research, we have obtained ethical clearance No. 0218/CRERSHC/2021 from the Central Regional Research Ethics Committee for Human Health and research authorisation from the Akonolinga Health District. At the start of the procedure, we first gathered together the community health workers and the study was explained to them. They were then tasked with identifying all the target children in their selected communities (clusters). The data were then collected in the households of the target children with parental consent. A questionnaire on socio-demographic data and lifestyle was administered to the parents, and the data was collected anonymously and confidentially. For Stool samples collection, one sample pot per child, filled with 6 ml of 10% formalin, was labelled with a unique identifier and given to the parent/caregivers, with clear instructions on how to collect the faeces. If the child was able to tell when it was time to defecate, the parent asked him to defecate in his potty and then collected 4 spoonfuls of the faeces (the equivalent of 2 grams) using the spoon inside the sample pot. Finally, he sealed the jar and shook it to obtain a homogeneous mixture with the formalin, before storing it in a safe place. If the child was still wearing nappies, the parent filled the jar using the same procedure, taking the faeces from the child's nappy. The next day, all the pots containing the faeces were collected. When the jars were collected, the sample was checked and the macroscopy performed by questioning the parent. The jars were then stored in a bin bag and transported in cardboard boxes.

The stools collected were analysed using the Mini-FLOTAC method in the laboratory of the research centre on filariasis and other tropical diseases in Yaoundé. The Mini-FLOTAC flotation concentration method is a technique that utilizes a double-chambered disc allowing for a volume of 2 ml to be examined, with a high analytical sensitivity; it has been reported to have higher accuracy, precision and egg recovery compared to others technique [22]. The principle consists of diluting faeces with a sodium chloride solution that is 50% denser than the parasite elements (eggs), which will then float. Their concentration in a superficial film depends on their density being lower than that of the reagent, and on their predominant lipophilicity [23].

The results were expressed as the number of eggs per gram of stool. Geo-helminth infestation was defined by the presence of at least one egg of at least one geo-helminth per gram of stool. The chi-square test was used to compare proportions; to measure the association between geo-helminth infection and the data collected, a multivariate analysis using logistic regression was performed with an Odd Ratio with a 95% confidence interval. The significance threshold was set at $p < 0.05$.

## 3. Results

A total of 431 patients were included and 55 were excluded for failure to produce enough stools. The sample included 376 children, 190 of whom were male, for a sex ratio of 1.02. The median age was 23.6 months, with an interquartile range of [15 - 31] months. The most common age group was [13 - 24] months (42%), and 21 children (5.6%) were attending school. The most common housing type was dirt (56.4%), with an unpaved floor (69.4%). The average number of children per household was 4.64 ± 2.75, with a minimum of 01 and a maximum of 13. 14.9% of parents said that their child had already had geo-helminthiasis, and 71% said that they had already dewormed their child at least once. The average number of deworming was 2.33 ± 1.36 (**Table 1**).

In all, 73 of the 376 children recruited were infected with at least one geo-helminth, giving an overall prevalence of geo-helminthiasis of 19.4% in this study population. Comparison of this overall prevalence in the study population showed a significant difference between health areas ($p = 0.001$), with the Ekoudou health area being the most infected. A. lumbricoides and T. trichiura were the only two species found. The prevalence of co-infections was 4.3%. Among mono-infections, ascariasis was the most common at 16%, compared with 8% for trichocephalosis.

The median intensity of A. lumbricoides infection was 34.5 (interquartile range [4 - 119]) eggs per gram of stool, with a minimum of 1 and a maximum of 1520. The median intensity of T. trichiura infection was 5 ([2 - 11.25]) eggs per gram, with a minimum of 1 and a maximum of 73.

Comparison of this overall prevalence in the study population showed a significant difference between health areas ($p = 0.001$), with the Ekoudou health area being the most infected (**Table 2**).

There were 9 factors with a significant association with geo-helminth infection in this study, at the end of the bivariate analysis. After logistic regression, the risk factors for geo-helminthiasis in this study were: age of first contact with soil < 4 months (OR = 4.9 [2.1 - 11.37], $p < 0.001$); living on an unpaved floor (OR = 7.4 [1.55 - 35.7]; $p = 0.012$); drinking dirty water (OR = 1.93 [1.03 - 3.6]; $p = 0.040$) and walking barefoot (OR = 2.91 [1.1 - 7.97]; $p = 0.038$). Age ≤ 12 months (OR = 0.29 [0.08 - 1.02]; $p = 0.053$) was a protective factor. **Table 3** summarises these analyses.

**Table 1.** Breakdown of children by age and gender.

| Variables | Numbers (N = 376) | Percentages |
|---|---|---|
| **Age (in months)** | | |
| **[6 - 12]** | 79 | 21 |
| **[13 - 24]** | 158 | 42 |
| **[25 - 36]** | 139 | 37 |
| **Sexe** | | |
| **Male** | 190 | 50.5 |
| **Female** | 186 | 49.5 |

N = total number.

**Table 2.** Prevalence of STH by age group, sex, and health area.

| Variables | A. *lumbricoides* N (%) | T. *trichiura* N (%) |
|---|---|---|
| **Age (in months)** | | |
| **[6 - 12]** | 4 (5.1%) | 2 (2.5%) |
| **[13 - 24]** | 34 (21.5%) | 19 (12%) |
| **[25 - 36]** | 22 (15.8%) | 9 (6.5%) |
| **Sexe** | | |
| **Male** | 35 (18.4%) | 2 (2.5%) |
| **Female** | 25 (13.4%) | 19 (12%) |
| **Health area** | | |
| **Edjom** | 25 (25.9%) | 13 (11.9%) |
| **Ekoudou** | 18 (24.7%) | 12 (16.4%) |
| **Akonolinga-urbain** | 10 (9.8%) | 2 (2%) |
| **Mengang** | 7 (7.6%) | 3 (3.3%) |
| **Total N (%)** | 60 (16%) | 30 (8%) |

**Table 3.** Multivariate analysis of risk factors for geo-helminthiasis.

| Variables | Adjusted OR | 95% IC | *p*-value |
|---|---|---|---|
| **Early contact with soil** | 4.9 | 2.1 - 11.37 | <0.001 |
| **Uncoated floor** | 7.4 | 1.55 - 35.7 | 0.012 |
| **Walk barefoot** | 2.91 | 1.1 - 7.97 | 0.038 |
| **Consumption of contaminated water** | 1.93 | 1.03 - 3.6 | 0.040 |
| **Age ≤ 12 month** | 0.29 | 0.08 - 1.02 | 0.053 |
| **Place of defecation** | 0.69 | 0.39 - 1.21 | 0.19 |
| **Exclusive breastfeeding up to 6 months** | 1.47 | 0.83 - 2.59 | 0.19 |
| **Previous deworming of children within the last 3 - 6 months** | 1.82 | 0.9 - 3.7 | 0.095 |
| **Sucking the finger** | 0.44 | 0.15 - 1.31 | 0.131 |

## 4. Discussion

The aim of this study, carried out in the Akonolinga Health District, was to determine the prevalence of geo-helminth infection in children aged 0 - 3 years, and to identify risk factors. The study had a few limitations that needed to be considered when interpreting the results. The first was the number of stool samples taken per child. Instead of just one, there should ideally be three, taken on different days and at different times, to ensure that there is no infection. For the same reason, it is recommended that three different analysis techniques be used, given that each has a different sensitivity for detecting each geo-helminth. However, we used only one method, and took only one stool sample, due to limited material, human and financial resources. This being the case, the number of infected children in our sample could be higher. In addition, some of the children included in the study had been dewormed a few days before the stool samples were taken. In addition, the samples were taken by the parents, without the supervision of medical staff. However, the sampling technique was clearly explained to them before and the Mini-FLOTAC technique we used to examine the stool have a high analytical sensitivity. This leads to the conclusion.

The overall prevalence of geo-helminthiasis was 19.4%. These results are significantly higher than those found in Bandjoun in Cameroon in 2020. The latter conducted a study on a sample of children aged between 1 and 14 years, including 196 children aged between 1 and 5 years, among whom the prevalence of geo-helminthiasis was 8.7% [24]. Kuete *et al.* found a prevalence of 6.4% in a sample of 47 children aged 0 - 4 years, during a study of the general population in Douala in 2014 [25]. This difference can be justified on the one hand by the difference in sampling, and on the other hand by the climatic conditions in these regions of the country (West, Centre, Littoral). Indeed, Tchuem Tchuenté *et al.*, in 2012, showed that climatic conditions in the West region were favourable to a low prevalence of geo-helminthiasis compared with other regions of Cameroon [26]. The urban context of the city of Douala, as opposed to the rural and semi-urban context of our study population, could also explain this difference. Moreover, this prevalence is lower than that found in a study carried out in 2018 in the Akonolinga Health District, on 204 children aged between 2 and 5 years. The prevalence found was 26.8%, with a predominance among children aged 3 (31.3%) and 5 (32.6%) [21]. This difference may be explained by the fact that the children were older than those included in the present study, and therefore at greater risk of infection, according to the WHO [1]. In the same district a study enrolled 334 adults, Five species of soil transmitted helminthes (A. lumbricoides, T. trichiura, N. americanus, S. stercoralis and Hymenolepis nana) were found in stool samples collected as part of this study; the prevalence recorded shows that the surveyed areas are at moderate to high-risk (≥20%) [19]. This might lead to the establishment of an important refuge which may constitute a potential source of dissemination of the parasites in the general population and specially in children aged 6 to 36 months who live entirely under adult conditions. Considering that the prevalence of A. lumbricoides infection was 16% in this study similar of the adults' prevalence (18%) found in the same area, it can suggest the re-infestation of children treated by adults as the source of the persistence of this disease [19]. The present results, make it possible to extend the reservoir hypothesis to the other section of the population excluded from mass treatment, namely children aged 0 - 3 years, who are vulnerable. The prevalence of T. trichiura infection was 8%, a far cry from the 18.9% found by Tchuem Tchuenté *et al.* in 2012 in a population of school-age children in West Cameroon [26]. However, the same study found a prevalence of ascariasis of 19.5%, close to our own. However, these children receive mass treatment every year, as they are in endemic areas. A comparison of these results would therefore show that the prevalence of geo-helminthiasis in our study population is high. The question of the need for a similar preventive measure in the age group targeted by this study can therefore legitimately be raised.

In terms of the determinants of this infection, children under one-year-old were less likely to be infected than their elders aged 25 - 36 months (OR = 0.29 [0.08 - 1.02]; $p = 0.053$). This could be justified by the fact that parents are even more vigilant about their children's hygiene when they are younger. Nevertheless, a study of a larger sample in this age group would be more meaningful.

Regular consumption of non-potable water (OR = 2.5 [1.42 - 4.41] $p = 0.001$) was a risk factor. The ingestion of eggs through the consumption of contaminated water is a means of transmission of geo-helminthiasis [1] [10] [11]. A study carried out in Douala found no significant association between the source of drinking water and ascariasis [25]. This may be explained by the fact that the water was treated before consumption and stored properly after treatment.

The child's early contact with the floor (before 4 months) (OR = 4.9, $p < 0.001$), living in a house with an unpaved floor (OR = 7.4, $p = 0.012$), and walking barefoot (OR = 2.91, $p = 0.038$) were also risk factors. These results may be explained by the fact that unpaved floors, like the ground in nature, are favourable to the development of parasite eggs released in the faeces. Skin contacts with such soil, either when a growing infant is sitting up or when walking barefoot, therefore exposes the child to contamination [9] [10]. This habit of walking barefoot was found to be a risk factor (OR = 1.51 [1.28 - 1.78]; $p < 0.001$) in Ethiopia in 2019, in a study of children living in the homes of patients with intestinal parasitosis [27].

## 5. Conclusion

The prevalence of geo-helminthiasis in children aged 0 - 3 years in the Akonolinga Health District was relatively high. The comparison between the sexes was not significant. Age ≤ 12 months was a protective factor, while early contact with the ground (before the age of 4 months), drinking dirty water, living on an unpaved floor, and walking barefoot were risk factors. These results will help to improve the national strategy for combating this disease in endemic areas.

## Acknowledgements

We thank the Centre for Research on Filariasis and other Tropical Diseases (CRFilMT) for carrying out stool analyses in this study.


## Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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