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Geohelminth among Public School Children in Douala Metropolis: Prevalence, Perception and Associated Risk Factors

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Abstract In the current estimate, approximately two billion people are infected with soil-transmitted helminths (STHs) worldwide and more than 550 million school-age children live in areas where these parasites are extensively transmitted. Studies have indicated the prevalence of intestinal parasites in rural settings in Cameroon. However, there are paucity of information on the prevalence and risk factor associated with STHs in school going children in Douala metropolis. The objectives of the study were to determine the prevalence and assess the risk factors associated with STH infections among school children in three government primary schools in Douala. A school-based cross-sectional study was carried out from April to June 2016 to estimate the prevalence, and associated factors with regards to STH transmission using multivariate regression analysis. School children with the age range between 5 and 15 years old were randomly selected from three government primary schools from different Subdivisions in the Wouri Division. Among the 320 school children that were enrolled, the overall prevalence of STH was 41.3 % (132/320). The most dominant STH specie in the present study was *A. lumbricoides* (28.7%), followed by *N. americanus* (8.1%) and *T. trichuria* (6.8%). Of the total number of school children that participated in the study, 118 (36.8 %) had monoinfections, 12 (3.6 %) double infections and 2 (0.6 %) triple infections. Multivariate logistic regression analysis showed that nails hygiene, family of less than 3 children and children less than 9 years old were predictors of STH infection. Attending EP Newbell and being in grade 2, increased the risk of STH by 4 times. The work indicated a high prevalence of STHs among school age children. Annual mass deworming campaign might not be enough to eliminate STHs in school age children in Douala. Health education and improved sanitation and personal hygiene might hold the key for a successful control and elimination of STHs infection in this setting.

Keywords: *Soil-transmitted helminths, school age children, prevalence, Douala*

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1. Introduction

The STHs are among the most common infections in the tropic and affect rural and remote communities especially the vulnerable population that are children and pregnant women. STH are transmitted by eggs present in the human excreta which contaminate the ground where poor sanitation prevails. The major species of STH which infect the man are roundworms (*Ascaris lumbricoides*), whipworms (*Trichuris trichiura*), and hookworms (*Ancylostoma duodenale* and *Necator americanus* [1].

In 2016, there were approximately two billion people are infected with STH worldwide and more than 550 million school-age children living in areas where these parasites thrive [2]. The prevalence of intestinal parasites is particularly high in certain regions because of the prevailing poor environmental conditions, low level of sanitation, inadequate water supply, and poverty [3].

The number of people infected worldwide with hookworms (*A. duodenale* or *N. americanus*) was estimated to 460 million, with *A. lumbricoides*, 820

million and 464.6 million, with *T. trichiura* in 2010. Meanwhile the years lived with disability (YLDs) due to STH stood at 4.98 million, of which 65% were due to hookworm, 22% to *A. lumbricoides* and *T. trichiura* 13% [4]. STHs are classified as 'neglected' because they persist exclusively in the poorest segment of the populations whom often live in remote and rural areas, in urban slums or in conflict zones [5]. Several studies in Sub-Saharan African children indicated that STHs contribute to stunted growth, malnutrition and cognitive impairement [6].

Recent studies in rural Cameroon indicated the prevalence of 24.5% of STH infection in Nkondjock [7], 29.6 % in Mfou Health District [8], 18 % in Akonolinga Health District [9] and 33.76% in Munyenge [10]. The prevalence of STH in urban setting revealed a different epidemiology panorama. For instance, the prevalence of helminths infection was 5.8% in Douala [11], and 4.95% in Bazou [12]. WHO is recommending WASH (Water Sanitation and Hygiene) interventions. STHs are transmitted through contact with faeces of infected persons. Infection does occur when larvae living in the soil enter bare skin. Administration of chemotherapy is used to treat infection. However, there is a high probability of reinfection in the absence of an efficient WASH system.

Cameroon launched a nationwide mass drug administration in 2007 that lead to the treatment of 4 million school age children annually with mebendazole, donated by Johnson & Johnson. Control of STHs is primarily implemented through school-based distribution of mebendazole, co-administered with praziquantel in schistosomiasis hotspots. Children between the age of 1-5 years are treated with mebendazole administered bi-annually [14]. Approximately 7.6 million children between the age 1 to 15 years are at risk of STH infections in Cameroon. In 2012, approximately 95% of all people at risk of soil-transmitted helminth infection were reported to have received treatment [15].

Despite the Ministry of Public Health efforts through the National Program for the Control of Schistosomiasis and Soil-transmitted helminthiasis (NPCS/STH), STHs remain a major public health concern in Cameroon. The factors that contribute to the endemicity and the transmission remain diverse and complex. The use of the school infrastructure for drug administration is one the cornerstone of NPCS/STH interventions. However, challenges such as the implementation of health education and improved sanitation interventions remained.

Studies have indicated the prevalence of intestinal parasites in rural settings in Cameroon. However, there are paucity of information on the prevalence and risk factor associated with STH in school going children in Douala metropolis. The objectives of the study were to determine the prevalence and assess the risk factors associated with STH infections among school children in three government primary schools in Douala city. The information relevant to assess burden of these infections on school children and monitor the impact of interventions.

2. Materials and Methods

2.1. Study Area

This study was carried out in Douala city, in the Wouri Division, the Regional Capital of Littoral Region. Douala is located in the coast of Atlantic Ocean, at the bottom of Guinea Gulf region of Cameroon with a land area of 20 248 square kilometers and a total population of 3,623,770 inhabitants [16]. Douala lies within the equatorial region and has a humid equatorial climate with high annual rainfall ranging from 2400 to 4000mm with a high relative humidity especially in raining season of 85 %. The temperature varies between 23.89°C et 28.89°C with a maximum of 30°C in January and a minimum of 23.33 in August. The Wouri Division is divided into 06 (six) administrative units called subdivisions which include Douala 1, Douala 2, Douala 3, Douala 4, Douala 5, and Douala 6. The water and electricity supplies are insufficient, inadequate and erratic.

2.2. Selection of Schools

This study was carried out in three randomly selected government public primary schools in Douala, namely Ecole Publique (EP) de Ndogpassi ZR, EP d'application Petit Joss and EP de New Bell Bamileké. The schools were randomly selected from the six subdivisions that make up the Region. Private primary schools could not be assessed in this study because authorizations were not given.

2.3. Study Design and Period

A school-based cross-sectional study was carried out to estimate the prevalence, and associated factors with regards to STH transmission. School children with the age range between 5 and 15 years old were selected from three government primary schools from different subdivision in the Wouri Division. The study was conducted from April to June 2016.

SAMPLE SIZE

The sample size was determined using the formula [17]:

$$n = \frac{Z^2 \times p(1-p)}{e^2}$$

Sample size calculation was based on the prevalence of 29.6% of helminthiasis infection recorded in Mfou Health District [18] where n is the sample size required, z = 1.96 is confidence level test statistic at the desired level of significance, p = 95% confidence level and considering a 5% marginal error. The required sample size was 320.

2.4. Sampling Technique

Simple random technique was used to select the three primary schools. Sample size was proportionally allocated to each school and each class of participating schools. Using the attendance registries of the participating schools, each child was given a number and selection of the children to participate in the study was achieved based on their ages.

2.5. Data Collection

2.5.1. Questionnaire Administration

Structured questionnaires were prepared in French, pre-tested and administered through face to face interview by the research team with the assistance of the teachers. Data on sociodemographic characteristics and risk factors of STH infection were collected.

2.5.2. Stool Collection and Processing

School children whose parents and/or guardians agreed to participate in the study were given a clean labelled capped plastic stool cups with a code and their full names. They were instructed to bring approximately 5 grams of their own stool. Prior to this, children were educated to collect fresh stool samples. Samples were processed and analyzed at the Laboratoire Yondja Analyse (Douala 3 Subdivision) within 04 hours of collection for parasitological examination stool were examined using Kato Katz technique following standard protocol [19].

2.5.3. Data Analysis

The data obtained were analyzed using SPSS 20.0 statistical package. The analysis of variance (ANOVA), and Fisher exact tests were used to compare group means. Proportions of infection rate were compared using the chi-square test. Logistic regression analysis was used to measure the association between hygiene conditions, sanitation and the prevalence of STH among school going children. The differences were considered to be statistically significant when the *P*-value obtained was less than 0.05.

2.5.4. Ethical Consideration

The study was approved by the University of Douala Institutional Review Board. Study subjects were provided information about the purposes and objectives of the study and the possible discomforts that their participation in the study might cause to them. Emphasis was laid on the voluntary nature of participation and that they could withdraw at any time without any explanation. Infected participants received a 400 mg single-dose of albendazole as recommended by the Cameroon Ministry of Public Health.

Table 1. Characteristics of the study subjects

Characteristcs	Number(n)	Percentage (%)
Sex		
Male	145	45.3
Female	175	54.7
Age group (years)		
<9	77	23.9
9 - 11	115	35.7
12 - 15	128	39.8
Grades		
SIL	28	8.8
CP	41	12.8
CE1	47	14.7
CE2	98	30.6
CM1	86	26.9
CM2	20	6.3
Type of toilets		
Traditional	172	53.8
Modern(Water Closet)	76	23.8
Pit Latrine	68	21.3
Open defaecation	4	1.3
Water supply		
Bore hole	245	76.5
CDE(Water Utility Company)	40	12.5
River	13	4.4
Bottle water	21	6.6
Nail hygiene		
Clean nail	130	40.6
Dirty nail	190	59.4
Hand washing before eating		
Yes	136	42.5
No	184	57.5
Hand washing after defaecation		
Yes	204	63.7
No	116	36.3
Hand washing after animal contact		
Yes	28	8.8
No	292	91.3
Using soap for hand washing		
Yes	128	40
No	192	60
Family size		
1-3 children	83	25.9
4-6 children	94	29.4
> 6 children	143	44.7

3. Results

3.1. Characteristics of the Study Population

A total of 360 pupils from three primary schools were approached for the study but only 320 positively responded, while 40 pupils did not return the concerned forms. The mean age was 10.0 with standard division 2.8. The age group 12-15 old consist of 38.9% of the pupils, the female account for 54.7%, the traditional type of toilet used by 53.8 %, only 12.5 % using the water supply by the CDE (Water Utility company) and most of the families have more than 6 children (44.7%) to cater for (Table 1).

3.2. Prevalence of STH

The overall prevalence of STH was 41.3 % (132/320). The prevalence of infection between male and female (20.4% vs 20.7%) showed no significant difference (P=0.212). Children in the age groups less than 11 years old were the most affected with 14.7 % (Table 2). The most abundant species was *A. lumbricoides*. Of the total number of school children that participated in the study, 118 (36.8 %) had monoinfections, 12 (3.6 %) double infections and 2 (0.6 %) triple infections. Triple infection were made up of *A. lumbricoides*, *N. americanus* and *A. duedonale* while double infections were dominated by the combination of *A. lumbricoides* and *T. trichuria* (3.4%).

Table 2. Prevalence and polyparasitism of STHs in school children, proportion

Variables	Number Positive	Prevalence(%)
Overall prevalence of STH	132	41.3
Sex		
Male	65	20.4
Female	67	20.7
Age Groups		
<9	47	14.7
9 to 11	47	14.7
12 to 15	38	11.9
STH Species		
Necator americanus	26	8.1
Ascaris lumbricoides	92	28.7
Ancylostoma Duodenale	8	2.5
Trichiura. trichuria	22	6.8
Infection Types		
Mono	118	36.8
Double	12	3.7
Triple	2	0.6

The distribution of STH species among the school going children with respect to age groups, sex and schools

The distribution of STH species among the school going children with respect to age groups, sex and schools is shown in Table 3. The distribution of *N. americanus* between male and female showed a significant difference (P=0.032). The prevalence of *A. lumbricoides* varied significantly with the grade (P=0.000), age group (P=0.005) and the location of the schools (P=0.000) while the prevalence of *T. trichuria* significantly differs (P=0.001) with location of the schools.

Potential risk factors for STH infection in school children

The results of the logistic regression analysis are shown in Table 4. Attending EP New-Bell and being in Grade 2 increased the risk of STH by 4, while a small family size increased the risk of STH infection 2.85 times. For infection with *A. lumbricoides*, attending EP New-Bell increased the risk of infection 5.76 times and are 4 times more likely to be infected with *A, duodenale*.

Table 3. The relashionship of sex, age groups and schools with STH species prevalence

Variables	STH species				
	Number	*Necator americanus*	*Ascaris lumbricoides*	*Ancylostoma duodenale*	*Trichuira trichuria*
Sex					
Male	145	17(11.7)	42(29.0)	4(2.8)	13(9.0)
Female	175	9(5.1)	50(28.6)	4(2.3)	9(5.1)
Level of significance	X^2=4.601		X^2=0.006	X^2=0.73	X^2=1.810
	P=0.032		P=0.938	P=0.787	P=0.179
Age group					
<9	77	5(6.5)	34(42.2)	4(5.2)	9(11.7)
9 A 11	115	14(12.2)	31(27.0)	2(1.7)	9(7.9)
12 A 15	128	7(5.5)	27(21.1)	2(1.6)	4(3.1)
Level of significance	X^2=4.010		X^2=12.765	X^2=3.029	X^2=5.760
	P=0.135		P=0.002	P=0.22	P=0.056
Grades					
Sil	28	2(7.1)	7(25.0)	2(7.1)	1(3.6)
Cp	41	2(4.9)	26(63.4)	2(4.9)	4(9.8)
Ce1	47	4(8.5)	16(34.0)	0(0.0)	7(14.9)
Ce2	98	12(12.2)	25(25.5)	4(4.1)	4(4.1)
Cm1	86	4(4.7)	10(11.6)	0(0.0)	4(4.7)
Cm2	20	2(10.0)	8(40.0)	0(0.0)	2(10.0)
Level of significance	X^2=4.337 P=0.502		X^2=38.932 P=0.000	X^2=8.356 P=0.138	X^2=7.893 P=0.162
Schools					
EP Joss	134	10(7.5)	34(25.4)	0(0.0)	6(4.5)
EP Ndogpassi	103	12(11.7)	11(10.7)	0(0.0)	3(2.9)
EP Newbell	83	4(4.8)	47(56.6)	8(9.6)	13(15.7)
Level of significance		X^2=3.009 P=0.222	X^2=48.652 P=0.000	X^2=23.429 P=0.000	X^2=13.740 P=0.001

4. Discussion

WHO is recommending scaling up mass drug administration (MDA) targeting STH, so that by 2030, STH morbidity in school-age children is eliminated and elimination sustained [20]. The study aimed at determining the prevalence of geohelminths in three different schools located in different socio-geographical areas in the Douala city. The overall prevalence of STH was 41.3 % (132/320), higher than the 4.95% recorded in Mbazou [12]) and 29.6% in Mfou Health District [8] elsewhere in Cameroon. However, in a study carried out in the general population of Douala, Kuete [11] found a lower prevalence of intestinal helminth (5.8%). The prevalence of geohelminths in the present study is comparable to that of most rural settings [8,21]. The findings of high prevalence rate in the urban population may refect the deterioration of living conditions, lack of social amenities and the poor sanitation infrastructures. WHO is recommending a school-based control programme consisting of deworming, improvement of water and sanitation, and health education to control STH [22] in order to control the transmission of STH.

The magnitude of the burden of geohelminthiasis in Douala seems to be obviously underestimated, and deserves to be given more attention due to its adverse effects on children's cognitive development, immune system and the economic development of the communities.

The prevalence of geohelminths between male and female showed no significant difference. However, males were significantly more infected with *N. americanus* than females (P=0.032). *Necator americanus* and *Ancylostoma duodenale* (Hookworms) are transmitted through contact with contaminated soil. This difference might reflect the poor handwashing of boys compared to girls.

The prevalence of intestinal helminth was higher in the age bracket of 5-11 years compared to the older age groups. This is consistent with studies in Nigeria by Owaka [23]. During field work, we observed that the pupils in the lower age groups have more contact with soil and sand during school break periods. Furthermore, these pupils scarcely engage in handwashing before eating during these periods. Most of time, they only rubbed their dirty hands over their uniforms, collect and shared the food among their peers, consequently, spreading the parasite from one person to another. The WHO target N^{o} 1 is to achieve and maintain elimination of STH morbidity in pre-school age children and school age children by 2030 [24]. Several studies have documented that STH spread through contaminated finger nails and poor handwashing practices [25]. In the present study, children with untrimmed and dirty nails were predictor of STH, thus underscoring the importance of personal hygiene. Shockingly, a household having less than three children were 3 times more likely to be infected with STH. Studies elsewhere have indicated that the prevalence of STH increase with increasing number of persons in the household [26]. Wash hands before food, wash hands after defaecation, and washing hands after contact with animals were not associated with a risk of STHs, contrary to several other studies [11,12].

Despite the provision of tap water in the primary schools, most parents usually provide their pupils with water-bottles as they are going to school. During field works, the toilet facilities of EP New-Bell and EP Ndogpassi were in deplorable condition and appeared messy after breaks, therefore increasing the risk of intestinal parasitic infections. However, EP Joss gave a different socio-geographic scenery. EP Joss is located at the Douala Central Business District. The Joss Plateau where the school is situated is the host of all administrative head offices, banks, insurance companies, judiciary and port authorities. The most dominant STH species in the present study were *A. lumbricoides* (28.7%), followed by *N. americanus* (8.1%) and *T. trichuria* (6.8%). This finding is consistent with report of Petter [8] in the Mfou rural area (Cameroon), but in contrast with the report from Kenya, by Pullan [4].

Table 4. Factors associated with soil-transmitted helminth infection in school children in Njombé

Risk factors	Total examined n=320		Bivariate analysis		Multivariates analysis	
	Positive	Negative	OR 95%CI	P -value	OR 95%CI	P -value
Sex						
Male	65	80	1.330(0.849 - 2.081)	0.212		
Female	67	108				
Wash Hands before Food	44	88	0.522(0.329 - 0.827)	0.006		
Wash Hands After Defaecation	92	40	1.561(0.974 - 2.502)	0.064		
Wash After Contact With Animal	14	118	1.475(0.678 - 3.206)	0.325		
Wash Hands With Soap	54	78	1.067(0.677 - 1.679)	0.781		
Nail Hygiene	65	67	2.045(1.295 - 3.228)	0.002		
Age group						
<9	47	85	2.912(1.717 - 4.940)	0.000	3.711(2.047 -6.725)	0.000
10-11	25	23	0.976(0.613 - 1.552)	0.918	1.637(0.963 - 2.784)	0.069
12-15	37	89	0.440(0.274 - 0.706)	0.001		
Schools						
EP Joss	50	84	0.755(0.479 - 1.189)	0.225		
EP Ndogpassi	25	78	0.329(0.195 - 0.556)	0.000	0.538(0.304 - 6.586)	0.033
EP Newbell	57	26	4.735(2.763 - 6.114)	0.000	3.683(2.060 - 6.585)	0.000
Grades						
Grade 1	9	19	0.651(0.285 - 1.487)	0.305	0.316(0.096 - 1.044)	0.059
Grade 2	23	9	4.921(2.921 - 13.859)	0.000	2.370(0.743 - 7.566)	0.145
Grade 3	24	23	1.594(0.857 - 2.967)	0.139	0.696(0.241 - 2.011)	0.503
Grade 4	39	59	0.917(0.565 - 1.488)	0.726	0.441(0.165 - 1.176)	0.102
Grade 5	16	70	0.233(0.128 - 0.424)	0.000	0.152(0.054 - 0.434)	0.000
Grade 6	12	8	2.250(0.893 - 5.668)	0.079		
Family Size						
Family 1	49	83	2.878(1.713 - 4.836)	0.000	3.094(1.761 - 5.439)	0.000
Family 2	35	97	0.789(0.481 - 1.293)	0.347	1.199(0.697 - 2.063)	0 .513
Family 3	48	84	0.536(0.340 - 0.882)	0.007		
Types Of Toilets						
Traditional	68	104	0.858(0.549 - 1.341)	0.502	0.654(0.090 - 4.753)	0.675
Latrine	25	43	0.788(0.453 - 1.369)	0.397	0.581(0.077 - 4.387)	0.599
Modern	37	39	1.488(0.886 - 2.498)	0.132	0.949(0.127 - 7.087)	0.959
Open Air	2	2	1.431(0.199 - 10.288)	0.721		
Water supplied						
CDE	14	118	0.739(0.370 - 1.476)	0.391	0.373(0.128 -1.087)	0.071
Borehold	101	32	0.996(0.589 - 1.683)	0.987	0.486(0.200 - 1.179)	0.110
River	4	128	0.622(0.187 - 2.062)	0.433	0.308(0.072 - 1.375)	0.112

The presence of a large number of *A. lumbricoides* may damage the lungs during migration which is potentially fatal and larvae reach blood circulation, they wander to brain, eye or retina causing granulomas [27]. Symptoms of the Trichuris dysentery syndrome is associated with abdominal distention, anaemia, diarrhea and dysentery, growth impairment, pallor and rectal prolapse. [28,29]. Sustainable Development Goal target 6.2 calls for adequate and equitable sanitation for all. However, poor sanitation is believed to be the main cause of some 432 000 deaths worldwide [30]. The present data indicated the presence of multiple infection among the school going children. This finding is consistent with other studies in Cameroon [31] and elsewhere [32]. Most of the dual infections observed were due to *A. lumbricoides* and *T. trichuria* (3.4%) which are similar to the report by Pasaribu [33] but higher than 0.4% found in another study Douala [11]. The high annual rainfall coupled with a high relative humidity especially in raining season could provide optimum growth conditions for the parasites growth. The prevalence of triple infection was comparable to that of Pasaribu [33]. All cases of triple infection and most cases of double infection occurred in EP NewBell. These findings indicated an association between the low socio-economic status of pupils attending EP NewBell the occurrence of multiple STH species.

Logistic regression was used to assess the association between potential risk factors and the occurrence of STH infection. Nails hygiene, family of less than 3 children and children less than 9 years old were predictors of STH infection. Attending EP Newbell and being in grade 2 increased the risk of STH by 4 times. EP Newbell is located at the heart of the metropolis, an old settlement with open drainage, no sewage system, made up of numerous street markets where garbage is disposed of bi-weekly by Hysacam (Company in charge of municipal waste disposal) and where toilet wastes are most of time channels to the gutters lining the streets. The general sanitary infrastructures in New-Bell l is despicable and call for concerns. The multivariate analysis did not find an association between the types of toilets and the risk of STH infection. However, revealed the association between open defaecation and the risk of STH [34]. Identification of infection hotspots such as these schools and contextual risk factors could provide critical information for the transmission of intestinal helminths and help design a focal preventive approach.

5. Conclusion

The work indicated a high prevalence of STH among school going children. Annual mass deworming campaign might not be enough to eliminate STH in school going children. Health education, improved sanitation and personal hygiene might hold the key for a successful control and eradication of STH infection in these schools.

Limitations.

The study had a few limitations. Kato Katz was performed only once on stools samples which would have given a low sensitivity. Private schools could not be included to the study due to lack of permission granted by the owners. Ours findings could not be generalized due to the small numbers of selected schools out of numerous primary schools in Doula city.

Competing Interests

The authors declare no competing interest.

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