International Journal of Parasitology Research
ISSN: 0975-3702&E-ISSN: 0975-9182, Volume 9, Issue 1, 2017, pp.-201-204.
Available online at http://bioinfopublication.org/jouarchive.php?opt=&jouid=BPJ0000241

Research Article

HIGH PREVALENCE OF INTESTINAL HELMINTHIASIS AMONG SCHOOL CHILDREN IN URBAN AREAS IN MAN, WESTERN CÔTE D'IVOIRE

KIKI-BARRO PCM[1,2]*, KASSI FK[1,3], BEDIA-TANOH AV[1], VANGA-BOSSON H[1], KONATÉ A[1], ANGORA EK[1], DJOHAN V[1], MIEZAN S[1], YAVO W[1,2] AND MENAN EIH[1,3]

[1]Parasitology and Mycology Department, Faculty of Pharmacy, 01 BP-V 34, Abidjan, Côte d'Ivoire.
[2]Parasitology and Mycology Laboratory of National Institute of Public Health, Abidjan BPV 47, Côte d'Ivoire.
[3]Center for the Diagnosis and Research on AIDS and Others Infectious Diseases, BP-V 3, Abidjan, Côte d'Ivoire
*Corresponding Author: Email-kikipcm@yahoo.fr

Received: June 20, 2017; Revised: August 07, 2017; Accepted: August 08, 2017; Published: August 28, 2017

Abstract- Since the Ministry of Health implemented deworming programs in schools in 2012, there have been limited studies on the prevalence of helminth-related infections in Côte d'Ivoire, particularly in Man. Hence, determining the magnitude of intestinal helminth infections and identifying factors that can increase the risk of infection are important for establishing the effectiveness of government programs and monitoring the health and disease risk of the population. This cross-sectional study was conducted among 400 children aged 4–15 years in urban areas in Man, western Côte d'Ivoire. Single stool samples were, and analyzed using the Kato-Katz, simplified Ritchie, and Baermann techniques. Overall,23.3% (95% CI = 19.3–27.6) of children were found to be infected with one or more species of intestinal helminths, including *Ascaris lumbricoides* (32.3%), hookworms (33.3%), *Schistoso mamansoni* (18.3%),*Trichuris trichiura* (10.8%), *Strongyloides stercoralis* (4.3%), and *Taenia* sp (3.23%). Biparasitism was observed among 2.2% of the pupils. Deworming during the last 6 months was associated with a decline in the incidence of parasitism (p=0.02).Age and drinking water supply (p=0.03) were linked to cases of intestinal parasitism. The use of rivers was associated with the occurrence of *S.mansoni* infection (p=0.002*)*. However, gender and fecal matter disposal mode were not significantly associated with parasitism (p>0.05). Overall, these results demonstrate that the prevalence of intestinal helminthiasis in Man is high, posing a substantial threat to the health of children. This situation could be improved by mass treatments and appropriate hygiene measures.

Keywords- prevalence, intestinal helminthiasis, school children, western Côte d'Ivoire.

Citation: Kiki-Barro PCM, *et al.,* (2017) High Prevalence of Intestinal Helminthiasis among School Children in Urban Areas in Man, Western Côte D'ivoire. International Journal of Parasitology Research, ISSN: 0975-3702 & E-ISSN: 0975-9182, Volume 9, Issue 1, pp.-201-204.

Introduction

Intestinal helminth infections, mainly soil-transmitted helminth infections and schistosomiasis, are important neglected tropical diseases, which are closely linked to poverty. These infections primarily affect individuals living in the poor regions of America, Asia, and sub-Saharan Africa, characterized by inadequacy of a clean water supply, sanitation, and hygiene [1–3]. The prevalence of these pathologies is substantially greater for school-aged children. The World Health Organization estimates that approximately 1.5 billion people worldwide are affected by soil-transmitted helminths, and at least 218 million people required preventive treatment against schistosomiasis in 2015 [1]. These intestinal parasites, mainly *Ascaris lumbricoides*, *Trichuris trichiura,* species of hookworms such as *Necator americanus* and *Ancylostoma duodenale*, and *Schistosoma* spp. constitute one of the primary causes of global morbidity [4–12].

Intestinal helminths represent a serious public health problem in Côte d'Ivoire. Among the 83 sanitary districts in Côte d'Ivoire, all 83 are endemic for soil-transmitted helminthiasis and 81 are endemic for schistosomiasis. With increasing awareness of the negative impact of these intestinal parasite infections on the health of the population, mainly the children who constitute a vulnerable group, a national program for the fight against soil-transmitted helminthiasis, schistosomiasis, and lymphatic filariasis was established in 2007 [13]. The objective targeted by this program was reduction of the morbidity rate linked to the main helminthiasis by regularly carrying out mass treatments among the population or high-risk individuals, with a focus on children [1]. These interventions began in 2012 with the support of different development partners. Therefore, an epidemiological evaluation of the present situation of intestinal helminth infections in the different sanitary districts is necessary to determine the outcome of this intervention. The results of this study will serve as an indicator of the status of intestinal helminth infections among children in the urban center of Man, in western Côte d'Ivoire.

Materials and Methods

Study design and area

This cross-sectional study was carried out from May to July 2014 in primary public schools in urban areas in the city of Man. The city of Man is located in the west of Côte d'Ivoire, 580 km from Abidjan. Man is characterized by a mountain chain ending in the south on a peneplain, consisting of a rugged terrain over one third of its area with heights over 1000 m in its northern and central regions. The communal perimeter covers an area of 64 km^2. The city is divided into 33 neighborhoods to which 18 surrounding villages are added. The temperatures vary from 27.9°C to 34.4°C with an average temperature of 31.05°C. The vegetation consists mainly of humid forest in its southern and central-western regions, and there is a wooded savannah in the north. The hydrographic network is marked by two major rivers: the Sassandra river in the east with many tributaries, and the Cavally river in the west with important tributaries. There are

also other some less important rivers that can dry up during the main dry season. In addition, there are lowlands that generate swampy areas, which have been turned into rice fields. The rainfall and average annual temperature are 13.5 mm and 24.32°C, respectively, with an average humidity rate of 80.31%. The city of Man has a humid tropical savannah climate characterized by four seasons: a major dry season from November to March, a short dry season from July to August, a major rainy season from June to October, and a short rainy season from March to May [14].

Sample size determination and sampling technique

Our study focused on pupils among six forms in primary schools (forms1–6) that were present during the study period. The number of pupils to be included in the sample was determined for detecting an expected prevalence rate of 55.2% [15] with 5% precision and an α-type error equal to 5%. The minimum number of pupils to be examined based on these criteria was estimated using Epi Info version 7 software. All pupils who agreed to participate in the study and whose parents or legal guardians approved beforehand were included in this study, regardless of gender or age. Pupils that had received a deworming treatment less than three week before the study were not included. The list of schoolchildren in each classroom was obtained, which enabled simple random selection.

Sample collection and laboratory procedure

The day before the collection of stool samples, a questionnaire was submitted to the pupils in order to collect socio-demographic data (the name of the pupil, gender, age, period of the last deworming, lifestyle, type of sanitary equipment installed in the pupil's household, and mode of drinking water supply).The following day, the Graham anal Scotch tape test was conducted to search for pinworm eggs, and then the stools were collected in clean pots. The samples were immediately sent to the laboratory to conduct the examination for parasites. The following examinations were carried out on each sample: fresh-state direct microscopic examination, the qualitative Kato-Katz technique to search for helminth eggs [16], and the simplified Ritchie technique. The specific search for roundworm eggs was conducted using the Baermann extraction concentration method [17]. For the Kato-Katz technique, some portion of the specimen was used to prepare fecal thick smears; 30 to 60 min after preparation, slides were read under a microscope at 40 x magnification. The number of eggs for *A. lumbricoides*, hookworm, *T. trichiura* and *S. mansoni* was not counted. For the Baermann technique, about 10 g of stool was placed on medical gause in a glass funnel fitted with a rubber tube clamped with a Morh claw and filled with twenty ml of warm tap water (30 – 45 °C). After 1 to 3 hours, the extraction water (10 ml) was collected in a centrifuge tube. After centrifugation for 3 to 5 minutes at 3000 RPM the sediment was collected and examined by light microscopy. The larvae were spotted thanks to their mobility after magnification x 10 and x 40.

A subject was considered to be parasitized when the direct stool examination or one of the supplementary techniques revealed the presence of one or many parasites in any form (eggs and/or larvae).

Statistical analysis

After data collection and entry, statistical analysis was conducted with Epi-info 7 software adapted for epidemiological analysis. The frequencies of the variables were determined, and the significance with a risk of type one error was determined at an alpha level of 5% along with the95% confidence interval (CI); significance was determined at $p<0.05$.

Ethical considerations

Before beginning the investigation, we obtained official agreement from all of the primary education inspectors. The objectives of the study as well as the procedures of the investigation were explained to the pupils in the presence of their teachers.

The children that tested positive were given an anti-helminth treatment with a 400mg albendazol tablet for cases of soil-transmitted helminth infections and with praziquantel for cases of schistosomiasis.

Results

Characteristics of the study population

A total of 400 subjects were examined. The average age of the subjects was 9.5± 3.1 years, ranging from 4 to 15 years. The sex ratio was 50% male and 50% female. According to the socio-economic status, approximately 50% of the children examined came from households in which the parents had a relatively high level of education (primary and secondary). The average monthly income was around 188.294 ± 140.853 USD. Overall, 70.3% of the children did not have access to improved drinking water systems, and nearly 99.3% and 0.7% used water from wells and rivers, respectively. Approximately 21.4% of the children defecated outdoors.

Prevalence of intestinal helminth infections

Among the children tested, 93 were found to be infected by parasites, indicating an overall prevalence of 23.6%. According to age groups, the parasite infection rate was significantly higher among children less than 10 years old (28.6%; p=0.02). Parasite infection was most prevalent in the younger children, and decreased after the age of 10 (18.8%; [Table-1]. We diagnosed intestinal helminth infections in 53 female pupils and in 40 male pupils, without a significant gender difference (p=0.06).

Table-1 *Relationship between socio-demographic characteristics and the prevalence of intestinal helminth infections (%) among primary school children in Man, western Côte d'Ivoire, in 2014.*

Variable	No examined	Nopositive	Percentage (95% CI)	P-value
Gender				
Male	201	40	19.9 (14.8–25.9)	0.06
Female	199	53	26.6 (20.8–33.1)	
Age group (years)				0.02
<10	217	59	27.2 (21.6–33.4)	
≥10	183	34	18.6 (13.4–24.7)	
Date of last deworming				0.02
<6 months	298	65	21.8 (17.4–26.8)	
>6 months	102	33	32.4 (23.8–41.9)	
Visits to rivers and sites of *S. mansoni* infection				0.002
Yes	139	11	7.9 (4.2–13.3)	
No	261	5	1.9 (0.7–4.2)	
Fecal matter disposal system at home				0.4
Outdoors	28	6	21.4 (9.2–39.3)	
Toilets	372	87	23.4 (19.3–27.9)	
Drinking water supply				0.03
Wells	281	72	25.6 (20.8–31.0)	
Distributed water (fountains and faucets)	119	20	16.8 (10.9–24.3)	

Helminth proportion and distribution

Among the 93 subjects that tested positive for a parasitic infection, 52 (55.9%) were infected by a skin-transmitted helminth and 43 (46.2%) were infected by feco/oral-transmitted helminths. Among the helminths found [Table-2], there were four species of nematodes, one cestode, and one trematode. The helminths were found alone (monoparasitism) in 97.6% of cases and in double association (poly-parasitism) in 2.2% of cases. There were two cases of bi-parasitism, which both involved hookworms (one case of hookworms /*Ascaris lumbricoides* and one case of hookworms /*Schistosoma mansoni* double-infection).

Table-2 *Frequencies of intestinal helminth infections among school children in Man, western Côte d'Ivoire in 2014.*

Intestinal helminth species	Frequency	Percentage
Necator americanus	31	33.3
Ascaris lumbricoides	30	32.3
Schistoso mamansoni	17	18.3
Trichuris trichiura	10	10.8
Strongyloides stercoralis	4	4.3
Taenia sp.	3	3.2

Discussion

The overall prevalence of intestinal helminth infections detected among primary public school children in urban areas of Man in the present study was lower than those reported previously among schoolchildren in other cities of Côte d'Ivoire. A prevalence of 55.2%, 36.5%, 37.9% and 47.5%, was observed in Biankouma en 2007, among 1001 children examined in the city of Abidjan in 1994, in 2220 pupils examined in six cities in the southwest of Côte d'Ivoire in 2001, and inDivo in 2005, respectively [15, 18, 19,20]. Although the prevalence in Man is lower, which could be attributed to the deworming program in schools initiated by the Ministry of Health, it is still relatively high, which could be attributed to a low treatment coverage. However, the parasite infection rate could also be related to the specific geographic location of the city of Man, which is located in a mountainous humid forest area with an average temperature that is more or less tropical, and thus favorable to the development of helminths. The prevalence rate detected in this study is also substantially lower than those observed among pupils and students (8–18 years old) in the province of Ghazi in eastern Afghanistan (60.6%) from November 2013 to April 2014 [21], in Kibera in Nairobi among preschool and primary school pupils in 2012 (40.8% and 40.0%, respectively) [22], and in Chuahit, a district of Dembia located in the northwest of Ethiopia, in 2015 (32.5%) [23]. Two previous studies found prevalence rates similar to that of the present investigation. The first study was carried out in Rivers State in Nigeria in 2011, which recorded an infection rate of 27.6% [24]. The second was carried out in schools in Myanmar, and reported an infection rate of 21.0%, which could be the consequence of a 7-year-long deworming campaign [25]. However, a lower prevalence (13.8%) was reported among primary school pupils in the city of Babilein the east of Ethiopia in 2012, which could be linked to greater implementation of the teaching of hygiene rules through collaboration with a health sciences university coupled with active deworming campaigns [26].

Age is considered to be the best predictive factor of intestinal parasite infections. The prevalence of intestinal helminth infections according to age varies substantially among studies but is also related to whether the study was conducted in urban or rural areas. Our results on the prevalence of these infections in children over 7 years old are in line with the findings of the study conducted in Divo in the south of Côte d'Ivoireare different for urban areas (30–50%), and for rural areas (50–60%) [20]. A study carried out in Tiassalé, another city in the south of Côte d'Ivoire, recorded a prevalence of around 50% for children under 7 years old, whereas the infection rate was only 10–14%for children over 7 years of age [27].Two studies conducted in Ethiopia showed that pupils with a lower educational level, and therefore younger, tended to be at greater risk of infection than those with higher educational levels (p=0.001 [26] and p=0.031 [28]).

In our study, there was no significant influence of gender on the prevalence of intestinal helminth infections. This could be explained by the fact that pupils of both genders were subjected to the same environmental and hygiene conditions, and thus exposed to the same infection risk [29]. This result is in accordance with studies conducted in schools in Thailand [30] and in Ethiopia [26].

Our results demonstrate that deworming can effectively reduce the intestinal helminth infection prevalence, as reported for Kibera in Nairobi [31]. Even though a deworming program cannot completely spare children from becoming re-infected [32], deworming nevertheless represents a key tool to enable reducing the transmission of intestinal helminths in school children [33]. The prevalence of hookworms and *S. mansoni,* two skin-transmitted parasites, was particularly high in our cohort. These high prevalence rates mainly that of *S.mansoni*, could be explained by the fact that many of these pupils had regular contact with rivers. This is confirmed by the fact that the rate of *S.man*soni infection was significantly higher among children that reported visiting rivers (p=0.002). The high prevalence of hookworms could be caused by this same exposure to rivers with minimum protection, which would increase their exposure to soil contaminated by hookworm larvae. However, the geographic location of the city of Man (amountainous humid forest area), rainfall, and low socio-economic level might also contribute to the high hookworm infection rate [34].These two parasites seem to predominate in Man, with a previous study carried out in urban farming communities finding 51.4% and 24.7% cases of infection by *S. mansoni* and hookworms, respectively [35]. These two parasites are also frequently detected in other cities in the west of Côte d'Ivoire, with rates ranging from 5.4% to 79% [15, 34].

The prevalence of *A.lumbricoides* was similar to that of hookworms in the present study. The high detection rate, along with that of *T. trichiura*, is a consequence of oral transmission, which confirms that intestinal helminth infections largely result from inadequate hygiene [1]. These results are confirmed by the fact that the clean water supply was significantly associated to parasite infections (p=0.03). Water contamination is very likely to occur during transportation, and more than 70% of the pupils used well water for drinking.

The low detection rate of strong yloid larvae is comparable to that (2.7%) previously reported in public schools in Abidjan [36].The scarcity of cases of infection with *Taenia* sp. in our study could be linked to the eating habits of certain pupils, which consisted of eating out, and buying beef that was likely not cooked properly from sellers around some of the schools.

Conclusion

The prevalence of intestinal helminth infections among urban area school children in Man remains high despite implementation of a deworming program since 2012.Cases of ascariasis, hookworm infections, and intestinal schistosomiasis dominated, which can seriously threaten the health of children. Well-conducted mass treatments along with improvement in hygiene measures and education could help to further reduce the infection rate and improve the health of this population.

Acknowledgments

We acknowledge the help of all of the participants included in this study. We are particularly grateful to the teachers and head teachers of the participating schools who enabled this study. We also thank all of the children who agreed to take part in this investigation.

Competing Interests

The authors declare that they have no competing interests

Author Contributions: Menan EIH has initiated the study. Kiki-Barro PCM performed analyses and drafted the manuscript. All authors read and approved the final.

References

[1] World Health Organisation (2017) Géohelminthiases, Aide mémoire, N° 366, *World Health Organization*, Geneva, Switzerland.

[2] Brooker S, Clements A.C.A., Bundy D.A.P. (2006) *Parasito*l, 62,221-261.

[3] Hotez P.J., Bundy D.A.P., Beegle K., Brooker S., Drake S.L., de Silva N., Montresor A., Engels D., Jukes M., Chitsulo L., Chow J., Laxminarayan R., Michaud C., Bethony J., Correa-Oliveira R., Xiao S.H., Fenwick A., Savioli L. (2006) *Disease Control Priorities in Developing Countries. 2nd ed. Washington, DC: World Bank*.

[4] Stoltzfus R.J, Albonico M., Tielsch J.M., Chwaya H.M., Savioli L. (1997) *J nutr,* 127,1099-105.

[5] Stephenson L.S., Latham M.C., Ottesen E.A. (2000) *Parasitology* 121 Suppl, S23-38.

[6] Moore S.R., Lima A.A., Conaway M.R., Schorling J.B., Soares A.M. and Guerrant R.L.(2001)*Int J Epidemiol,* 30,457-64.

[7] Crompton D.W. and Nesheim M.C. (2002). *Annurev.nutr,* 22, 35–59.

[8] Watkins W.E. and Pollitt E. (1997)*Psychol Bull*., 121, 171–91.

[9] Stoltzfus R.J., Kvalsvig J.D., Chwaya H.M., Montresor A., Albonico M., Tielsch J.M., Savioli L. and Pollitt E. (2001)*BMJ*, 323(7326), 1389–93.

[10] Mahalanabis D., Jalan K.N., Maitra T.K. and Agarwal S.K.(1976)*Am j clinnutr.,* 29,1372-5.

[11] Robertson L.J., Crompton D.W., Sanjur D. and Nesheim M.C. (1992)*Trans R Soc Trop Med Hyg,* 86, 654-6.

[12] Brooker S., Peshu N., Warn P.A., Mosobo M., Guyatt H.L., Marsh K. and Snow R.S.(1999)*Trans R Soc Trop Med Hyg,* 93, 240–6.

[13] Côte d'Ivoire. (2007) Ministère de la santé et de l'hygiènepublique.

Arrêtémodifiantl'arrêté n°159 MSHP/CAB du 21 juin 2007 portantcréation, organisation, attribution et fonctionnement du Programme National de luttecontre la Schistosomiase, les géoHelminthiases et la Filarioselymphatique. N° 316.
[14] pluviométriewww.levoyageur.net/climat-ville-man.htlm la moyenne de 1999-2014 (consulté le 07/11/14)
[15] Adoubryn K.D., Kouadio-Yapo C.G., Ouhon J., Aka N.A., Bintto F. and Assoumou A. (2012)*Trop MédSante*. 22, 170-6.
[16] WHO (1991World Health Organisation Geneva: pp: 25-26.
[17] Baermann G. (1917)*Geneesk. Tijschrift Ned-indie*57, 131-137.
[18] Menan E.I., Nebavi N.G., Adjetey T.A., Assavo N.N., Kiki-Barro P.C. and Kone M. (1997)*Bull SocPatholExot,* 90,51-54.
[19] Evi B., Yavo W., Barri-Kiki P.C., Menan E.H. and Kone M. (2007) *Bull socpatholexo,* 100,176-7.
[20] Kassi F.K, Menan E.I.H., Yavo W., Oga S.S.A., Djohan V., Vanga H., Barro P.C.K., Adetey T.A.K. and Kone M. (2008) *Cah. Santé Publique*; 7, 2008.
[21] Korzeniewski K., Augustynowicz A., Smoleń A. and Lass A.(2015) *Pak J Med Sci,* 31,1421-5.
[22] Worrell C.M., Wiegand R.E., Davis S.M., Odero K.O., Blackstock A., Cuéllar V.M., Njenga S.M., Montgomery J.M., Roy S.L. and Fox L.M. (2016) *PLoSOne*1,e0150744.27.
[23] Alemu A., Tegegne Y., Damte D. and Melku M. (2016) *BMC Public Health,* 16,422.
[24] Abah A.E. and Arene F.O. (2015)*J ParasitolRes,* 2015,937096.
[25] Tun A., Myat S.M., Gabrielli A.F. and Montresor A. (2013) *Trop Med Int Health*., 18, 1017-20.
[26] Tefera E., Mohammed J. and Mitiku H. (2015)*Pan Afr Med J*., 2015, 20:50.
[27] Menan E.I.H., Kassi F.K., Yavo W., Djohan V., Vanga H., Barro P.C.K., Oga S.S.A., Konate A., Gbocho F.Y., Adjetey T.A.K and Kone M. (2008)*Méd Trop,* 68, 658-9.
[28] Gelaw A., Anagaw B., Nigussie B., Silesh B., Yirga A., Alem M., Endris M., Gelaw B. (2013)*BMC Public Health*13,304.
[29] Benouis A., Bekkouche Z. and Benmansour Z. (2013)*IJIAS,* 2, 613-620.
[30] Kitvatanachai S. and Rhongbutsri P. (2013) *Asian Pac J Trop Med*., 6,699-702.
[31] Worrell C.M, Wiegand R.E, Davis S.M, Odero K.O, Blackstock A., Cuéllar V.M., Njenga S.M., Montgomery J.M., Roy S.L. and Fox L.M. (2016) *PLoS One,* 11,e0150744.27.
[32] Yap P., Du Z.W., Wu F.W., Jiang J.Y., Chen R., Zhou X.N., Hattendorf J., Utzinger J. and Steinmann P. (2013) *Am J Trop Med Hyg*., 89,23-31.
[33] Gabrie J.A., Rueda M.M., Canales M., Gyorkos T.W. and Sanchez A.L. (2014) *Parasit Vectors,* 7,354.
[34] Raso G., Vounatsou P., Gosoniu L., Tanner M., N'Goran E.K. and Utzinger J. (2006) *Int J Parasitol*, 36,201-10.
[35] Matthys B., Tschannen A.B., Tian-Bi N.T., Comoé H., Diabaté S., Traoré M., Vounatsou P., Raso G., Gosoniu L., Tanner M., Cissé G., N'Goran E.K. and Utzinger J. (2007)*Trop Med Int Health,* 12,709-23.
[36] Djohan V., Yavo W., Barro-Kiki P.C.M., Vanga A.H., Kassi K.F., Konaté A., Ouattara M., Menan E.I and Koné M. (2010)*Méd. Trop,* 70, 305.