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Epidemiological Profile of Intestinal Parasitic Infection among Preschool and School Children Living in a Rural Community in Senegal: A Cross Sectional Survey

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Abstract

Introduction: Intestinal parasitic infection (IPI) remains major public health problem in worldwide, being most prevalent in developing countries. Mass drug administration with Mebendazole is an effective strategy for the control of these diseases in pre-school and schoolchildren. The aim of this study was to assess the prevalence of intestinal parasitic infections and established associated risk factors among pre-school and schoolchildren living in rural area in Senegal.

Materials and method: A cross sectional survey was carried out between Novembers to December 2014. Children less than 10 years were randomly selected using a systematic random sampling method. Stool samples were examined by light microscopy for the detection of parasite using direct examination, Modified Ritchie Method and the modified Ziehl Neelsen staining method.

Results: Among 392 children selected in the study, 137 were found with at least one intestinal parasite representing an overall prevalence of 34.95% [CI 95% (29.3–41.3)]. *Protozoan* infection was more frequent than *helminthic* infection (93.4% versus 2.2% respectively). Association between *helminths* and *protozoa* was 4.4%. Intestinal parasites identified were *Giardia intestinales* (72.48%), *Entamoeba coli* (13.76%), *Blastocystis hominis* (3.67%) and *Hymenolepis nana* (1.83%). Prevalence was higher among children aged over 5 years old (48.4%) (aOR= 5.39; 95% IC (2.06–13.9); p=0.001). Children living in family with more than 10 individuals and those drinking unsafe water were found most infected respectively 37.5%) (aOR= 1.24; 95% CI (0.65–2.38); p=0.51) and (42.3%) (aOR=1.45; 95% CI (0.83–2.52); p=0.18). Prevalence was higher in children with underweight 36.3% [aOR= 1.53; 95% IC (0.88–2.67); p=0.13). No correlation was found between sex and intestinal parasitic infection.

Conclusion: This study showed that intestinal parasites remain prevalent in pre-school and schoolchildren with a changing of the epidemiological profile. *Protozoan* infection was more frequent than helminthic infection. Preventive measures including mass drug administration with Albendazole and water supply could reduce the prevalence of these diseases.

Keywords: Intestinal parasites; Children; Epidemiology; Senegal

Abbreviations: IPI: Intestinal Parasitic Infection; NTDs: Neglected Tropical Diseases; WHO: World Health Organization; NCHS: National Centre for Health Statistics; CNERS: Conseil National d'Ethique et de Recherché en Santé; CI: Confidence Interval; SD: Standard Deviation; OR: Odds Ratio; aOR: Adjusted Odds Ratio.

Introduction

Intestinal parasitic infection (IPI), considered as Neglected Tropical Diseases (NTDs) remain major public health problem in worldwide being most prevalent in developing countries where environmental and social factors contribute to the development of these diseases. The World Health Organization (WHO) estimates that about 3.5 billion people in worldwide are still infected by intestinal parasitic infections and 450 million are ill [1].

Pre-school, schoolchildren and pregnant woman have high risk of infection. Several studies shown that pre-school and schoolchildren are more infected [2-4]. In addition to the morbidity and mortality, infection with intestinal parasites have been associated with stunting, underweight, physical weakness and low educational performance in schoolchildren [5-7].

To reduce the burden intestinal parasitic infection, WHO recommend mass drug administration with Mebendazole or Albendazole as a preventive strategy for pre-school and school children [8].

In Senegal, intestinal parasitic infection is one of the most frequent causes of outpatient morbidity. Previous studies showed high prevalence of these diseases [9-11]. In order to control the morbidity associated to intestinal parasitic diseases in pre-school and schoolchildren the Ministry of health adopted the WHO recommendation (Mass deworming programme with Mebendazole)

[12]. This strategy has significantly reduced the morbidity related to intestinal parasitic infection. Recent studies have found protozoa to be the most prevalent parasitic infection compared to helminths infection in Senegal [10,11].

The objective of this study was to evaluate the prevalence of intestinal parasitic infections and established associated risk factors among pre-school and schoolchildren living in rural area in Senegal several years after implementation mass deworming campaign with Mebendazole.

Patients and Methods

Study area

This study was carried out in Ndoffane health district located in Kaolack region. In this district, the study was conducted Keur Soce area which is a rural area located at 217 Km from Dakar (Capital city of Senegal). This site had two health posts: Keur Soce health post and Lamarame health post. These health posts are headed by nurses and serve 71 villages for a total estimated population of 31,000 inhabitants. Several activities for child survival are carried out at in Keur Soce: nutritional monitoring, vitamin A and iron supplementation, mass deworming campaign with Mebendazole, universal coverage of long lasting net.

Study design and population

A cross-sectional study was carried out from November to December 2014 in household polarized by Keur Soce and Lamarame health posts. Children less than 10 year's old living in these areas were included in this study. Inform consent of parent or legal representative was required prior the inclusion in the study. Children were randomly selected using a two stage, cluster random sampling technique with clusters proportional to the size of the population.

A minimum sample size of 290 children less than 10 years of age was calculated using Epi Info software based on an expected prevalence of intestinal parasite of 26.2% [11], with alpha= 5% (CI: Confidence Interval at 95%), power at 90% (beta 10%), and being multiplied by 2 for a design effect.

Data collection

The socio-demographic and biological data were collected using a standard questionnaire. For each child, a physical examination was performed first. The child and theirs parents were interviewed in their home settings. After informed consent, the questionnaire was administered to collect individual (age, gender, weight, height, family size, water source). Weight and height were collected to determine nutritional status.

Laboratory methods

Fresh stool sample was collected into wide mouth for intestinal parasite detection. Stool samples were examined macroscopically for color, consistency, presence of blood, mucus, pus and large worms. A portion each of the stool samples was processed with a direct examination by light microscopy to detect cysts, *trophozoïte*, eggs and larva. The remaining parts of stool samples were examined using a modified Ritchie technique and modified Zielh Neelsen technique.

Data analysis

After data collection, data were entered in Excel software and the analysis was performed using Stata software version IC 12. Quantitative variables were described in terms of means and standard deviation. Inter group comparisons were performed using ANNOVA test or Student t test after checking the conditions of application of these tests. When these tests were not applicable, the non-parametric tests (Man Withney, Kruskall Wallis) were used. For descriptive data, percentage with confidence interval (CI) was used to assess the prevalence of each outcome.

Proportions were compared using chi-square test or the Fisher exact test (univariate analysis). Risk factors were assessed by multivariate survey logistic regression models. Significance level of the different tests was 0.05 two-sided. To assess the nutritional status, data were transferred into Epi Info 3.04 d. The -scores for weight-for-age (underweight) and height-forage (stunting) were derived using Epinut Anthropometry. Children who had -scores below−2 standard deviation (SD) of the NCHS (National Centre for Health Statistic) reference population median were considered to be malnourished. Ethics considerations

This study was conducted according to the Declaration of Helsinki and existing national legal and regulatory requirements. The protocol was reviewed and approved by the Senegalese Ethics Committee (Conseil National d'Ethique et de Recherche en Santé: CNERS). Approval number: 319MSAS/DPRS/CNERS (2014). Informed consent of parent or legal representative was required prior the participation to the study. To respect the confidentiality, an identification code was given to each participant.

Results

Socio demographic characteristics of study population

Overall, 392 children under 10 years were included in this study. The mean age of study participant was 3.6 ± 2 years. Study population was mainly represented by children under 5 years old (57.1%). The sex ratio was 1.03. Study population was mainly constituted by children living in family with less than 5 individuals and 5 to 10 individuals with 34.95% and 48.72% respectively. Concerning the water source, only 71 children (18.11%) consumed unsafe water (open source). 81.9% of children used safe water (closed source). The prevalence of underweight was 56.9%; while, stunting and wasting represented 39.8% and27.3%, respectively (Table 1).

Parameters	Number	Percentage (%)	95% IC
Age group (years)			
< 1	40	10.2	07.2 – 13.8

[1-5]	224	57.1	49.9 – 65.1
>5	128	32.7	27.2 – 38.8
Gender			
Female	193	49.2	42.5 – 56.6
Male	199	50.8	43.9 – 58.3
Family size			
<5	137	35	29.3 – 41.3
[5-10]	191	48.7	42 – 56.1
>10	64	16.3	12.5 – 20.8
Underweight			
Yes	223	56.9	49.6 – 64.8
No	169	43.1	36.8 – 50.1
Stunting			
Yes	156	39.8	33.7 – 46.5
No	236	60.2	52.7 – 68.3
Wasting			
Yes	107	27.3	22.3 – 32.9
No	285	72.7	64.5 – 81.6
Water source			
Safe source	321	81.9	77.2 – 91.3
Unsafe source	71	18.1	14.1 – 22.6

Table 1: General characteristic of study population

Prevalence of intestinal parasitic infection

Overall, 35% (137/392) of the children were found infected with at least one intestinal parasite species. Intestinal parasites were mainly represented by *protozoans* (93.4%). *Helminth* parasites represented 2.2%. Association between *protozoan* and *helminth* was observed in 4.4% as shown in Table 2.

Parameters	Number	Percentage (%)	95% IC
Results			
Negative	255	65	57.3 – 73.5
Positive	137	35	29.3 – 41.3
Parasites group			
Helminth	3	2.2	0.4 – 6.3
Protozoan	128	93.4	77.9 – 100
Helminth and protozoan	6	4.4	1.6 – 9.5
Association			
Yes	28	20.4	13.5 – 29.5

No	109	79.6	65.3 – 95.9

Table 2: Prevalence of intestinal parasitic infection among study participants

As can be observed from Table 3, the most prevalent parasites were *Giardia intestinales* (72.5%), *Entamoeba coli* (13.7%), *Blastocystis hominis* (3.7%), *trophozoïtes* and cysts of *Entamoeba coli* and *Endolimax nana* (2.7%). Only one child had t*rophozoïtes* and cysts of *Giardia intestinalis* and another had oocyst of *Cryptosporidium parvum* (0.9%). Double infection was observed in 16.7% of participants. The main associations were: *Entamoeba coli* and *Giardia intestinalis* (50%), *Blastocystis hominis* and *Giardia intestinalis* (14.3%). However triple infection represented (3.6%): (i) *Blastocystis hominis* + *Entamoeba coli* + *larva of Anguillule* (1 case), (ii) *Endolimax nana* + *Entamoeba coli* + *Hymenolepis nana* (1 case); (iii) *Giardia intestinalis* + *Endolimax nana* + *Entamoeba coli*; (iv) *Blastocystis hominis* + *Entamoeba coli* + *Endolimax nana*; (v) *Blastocystis hominis* + *Entamoeba coli* + *Hymenolepis nana*.

Type of intestinal parasites	Number	Percentage (%)	95% IC
Cyst Giardia intestinales	79	72.5	57.4 – 90.3
Cyst Entamoeba coli	15	13.8	7.7 – 22.7
Blastocystis hominis	4	3.7	0.9 – 9.4
Cyst Endolimax nana	3	2.7	0.6 – 8.1
Trophozoïtes & cyst Entamoeba coli	3	2.7	0.6 – 8.1
Trophozoïtes & cyst Giardia intestinales	1	0.9	0.01 – 5.1
Oocyst Cryptosporidium parvum	1	0.9	0.01 – 5.1
Hymenolepis nana	2	1.8	0.22 – 6.6
Enterobius verimcularis	1	0.9	0.01 – 5.1

Table 3: Type of intestinal parasites identified among study participant

Intestinal parasite and possible risk factors

The results of this study showed that intestinal parasite carriage increased with age. The prevalence of intestinal parasitic infection was significantly higher among children aged over 5 years 48.5% [aOR=5.4; 95% CI (2.1–13.9); p<10-3] compared to those aged from 1 to 5 years (30.8%) [aOR= 2.6; 95% CI (1.1–6.6); p=0.04]. The prevalence was lower in children less than 1 year old (15%). The overall prevalence of intestinal parasites was higher among female participants (36.8%) compared to male participants (33.2%) but the difference was not significant (p=0.57). Regarding the family size, intestinal parasite prevalence was higher children living in family with more 10 individuals (37.5%) [aOR= 1.2; 95% CI (0.6 – 2.4); p=0.51]. In family with less than 5 individuals and those with 5 to 10 individuals, the prevalence was 36.5% and 33% respectively. Water source was not associated with intestinal parasite infection even if the prevalence was higher in children drinking unsafe water (42.25%) compared to those drinking safe water (33.3%). Intestinal parasitic infection was not significantly related to nutritional status (p>0.05) as shown in Table 4.

Parameters	Number	% (IC 95%)	OR (IC 95%)	aOR (IC 95%)	P value
Age group					
<1	6	15 (5.5 – 32.6)	1	1	
[1-5]	69	30.8 (24 – 39)	2.52 (1–6,3)	2.6 (1.1–6.6)	0.04
>5	62	48.4 (37 – 62)	5.32 (2.1–13.5)	5.4 (2.1–13.9)	<10-3
Gender					
Female	71	36.8 (28.7-46.4)	1	1	
Male	66	33.2 (25.6–42.2)	0.88 (0.6 – 1.3)	0.8 (0.5 – 1.4)	0.57
Family size					
<5	50	36.5 (27 – 48)	1	1	

[5-10]	63	33 (25.3 – 42.2)	0.85 (0.5 – 1.4)	0.9 (0.5 – 1.5)	0.72
>10	24	37.5 (24 – 55.8)	1.04 (0.6 – 1.9)	1.2 (0.6 – 2.4)	0.51
Underweight					
No	56	33 (25 – 43)	1		
Yes	81	36.3 (28 – 45)	1.15 (0,7 – 1.7)	1.5 (0.8 – 2,6)	0.13
Stunting					
No	90	38 (30.6 – 46. 8)	1		
Yes	47	30 (22 – 40)	0.69 (0.5 – 1.1)	0.9 (0.5 – 2.1)	0.92
Wasting					
No	105	36.8 (30.1–44.6)	1		
Yes	32	30 (20.5 – 42.2)	0.73 (0.5 – 1.2)	0.6 (0.2 – 1.5)	0.26
Water source					
Safe source	107	33.3 (27.3–40.3)	1	1	
Unsafe source	30	42.3 (28.5–60.3)	1.5 (0.8 – 2.5)	1.5 (0.8 – 2.5)	0.18

Table 4: Risk factors associated with intestinal parasitic infection among study participants

Discussion

Intestinal parasitic infection remains major public health problem in worldwide particularly in developing country where children living in rural area are most infected. IPIs are often associated with stunting, underweight, physical weakness and low educational performance. To fight intestinal parasitic infection, WHO recommended Mass Drug Administration with Mebendazole or Albendazole to pre-school and school children. To reduce morbidity related to IPI, the Senegalese Ministry of Health adopted WHO recommendation. This study assessed the prevalence of IPI and its associated risk factors among preschool and school children living in rural area in Senegal. The study showed an overall prevalence of 3<5% of intestinal parasites. *Protozoan* parasites were more frequent (93.4%) than *helminth* parasites (2.2%). Association between *protozoan* and *helminth* was found in 4.4%. These results are in line with an earlier study carried out in the same area (Keur Soce) in 2013 by Tine et al who showed 26.2% of prevalence for intestinal parasites with a predominance of *protozoan* parasites [11]. Same tendency was also observed by Tine et al. in 2017 when assessing the prevalence of intestinal parasitic infection in children younger than 10 year's old living in the South part of Senegal (Velingara) [13].

These findings showed an increase of intestinal parasitic infection from 26.2% in Keur Soce to 30.35% Velingara and 35% in Keur Soce.

Our results are in line with what was found by Diouf et al. in 1998 with a prevalence of 30.6% for intestinal parasites. *Protozoans* were more frequent compared to *helminth* parasites [14].

Comparing to urban area, several previous studies showed similar results. NDiaye et al. in 2013 reported 20.3% of prevalence for intestinal parasitic infection [15]. Sylla et al. in 2013, when assessing the epidemiology of intestinal parasitic infection in Dakar showed a prevalence of 26.8% with predominance of *protozoan* compared to *helminth* [10]. In contrast, Dieng et al. showed a high prevalence of intestinal parasitic infection (42.26%) [16].

Our study showed a low prevalence of intestinal parasitic infection compared to the 68.2% reported in Ivory Coast and the 75.8% reported in Burkina Faso [17-18] while it was higher than the 15% reported by Forson et al. au Ghana [19]. In Uganda, Buzigi et al. reported 54.4% of prevalence for intestinal parasitic infection. The main species were *Giardia intestinalis* and *Entamoeba hystolytica* [20].

The finding of the present study is in line with what found in Kenya (25.6%) [21] And in Ethiopia (26.2%) [22]. In Algeria, Benouis et al. reported 19.6% prevalence of intestinal parasites with a high rate of *protozoan* (95.7%) compared to *helminth* (4.7%) [23].

In Perou, Bailey el al. showed 66.3% of overall prevalence of intestinal parasite with a high proportion of *protozoan* 62.8% [24].

The results of this study showed that intestinal parasitic infection increased significantly with age. In children less than 1 year and those aged from 1 to 5 years, the prevalence was 15% and 30.8% respectively. However, in children aged over 5 years old, the prevalence was higher 48.4%. Previous studies showed similar results [11,13-14]. The prevalence of intestinal parasitic infection observed in this study was higher among female participants compared to male participants but the difference was not statistically significant. This is in line with previous study conducted in Kenya where the prevalence of intestinal parasitic infection was higher in female participant (42.5%) compared to male participants (41.6%) [25]. However, other studies reported that intestinal parasitic infection was more important in male participant [26]. In our study, family size was not associated with intestinal parasite carriage. These findings are in line with what was found in Turkey and Pakistan [27,28]. Previous studies showed a predictive effect of family size with intestinal parasitic infection [29,30].

Intestinal parasite carriage was more important in children with underweight (36.3%). While it was lower in children with stunting and

wasting (30%). Similar findings were noted by Kidane et al. in Ethiopia with a 34.6% prevalence of intestinal parasitic infection in children with underweight. Generally, intestinal parasitic infection is more frequent in malnourished children. This was showed in Nigeria and Marocco [7,31].

In our study, children drinking unsafe water were infected compared to those drinking safe water. This was demonstrated by Alver et al. and Benzalim et al. who found 66% and 27.3% for intestinal parasite carriage in children drinking unsafe water compared to those drinking safe water [29,32]. Other studies showed no association between intestinal parasite infection and water source [30,33-34].

Conclusion

This study showed that intestinal parasites remain prevalent in pre-school and schoolchildren with a changing of the epidemiological profile indeed the use of Mebendazole in mass deworming campaign. There is a need to readapt the national strategy against intestinal parasites by using Albendazole. However, sustainable school-based deworming and safe water supply should be important strategies for the control of intestinal parasitic infection in Senegal.

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Ethical Approval and Consent for Participation

This study was conducted according to the Declaration of Helsinki and existing national legal and regulatory requirements. The protocol was reviewed and approved by the Senegalese Ethics Committee (Conseil National d'Ethique et de Recherche en Santé: CNERS). Approval number: 319MSAS/DPRS/CNERS (2014). Informed consent of parent or legal representative was required prior the participation to the study. To respect the confidentiality, an identification code was given to each participant.

Consent for Publication

Not applicable

Availability of Data and Material

All data generated or analyzed during this study are included in this manuscript and are available from the corresponding author on reasonable request.

Competing Interests

The authors declare that they have no competing interest

Author Contributions

KS conceived and designed the study. KS, RCT, LAN, BTF supervised the data collection. KS analyzed the data and wrote the first draft of the manuscript. All authors read and approved the final manuscript.

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