Scientific Research Publishing

Advances in Infectious Diseases, 2022, 12, 847-860
https://www.scirp.org/journal/aid
ISSN Online: 2164-2656
ISSN Print: 2164-2648

Prevalence of Intestinal Parasitic Infection among Pre-School and School-Aged Children Attending to Fann University Hospital, Dakar: Results from Retrospective Analysis

Khadime Sylla[1,2*], Doudou Sow[2,3], Souleye Lelo[1,2], Cheikh B. Fall[1,4], Isaac Akhenaton Manga[1], Magatte Ndiaye[1], Babacar Faye[1,4], Thérèse Dieng[1,2], Roger Clement Tine[1,2]

[1]Département de Parasitologie-Mycologie, Faculté de Médecine, Pharmacie et Odontologie, Université Cheikh Anta Diop, Dakar, Sénégal
[2]Laboratoire de Parasitologie-Mycologie, Centre National Hospitalier Universitaire Fann, Dakar, Sénégal
[3]Service de Parasitologie-Mycologie, UFR Sciences de la Santé, Université Gaston Berger, Saint-Louis, Sénégal
[4]Laboratoire de Parasitologie-Mycologie, Centre National Hospitalier d'enfant Albert Royer, Dakar, Sénégal
Email: *khadimesylla@yahoo.fr, lelosouleye82@hotmail.com, chek2810@yahoo.fr, akhenmanga@yahoo.fr, magou22000@yahoo.fr, bfaye67@yahoo.fr, thdieng@refer.sn, rogertine@hotmail.com, doudsow@yahoo.fr

How to cite this paper: Sylla, K., Sow, D., Lelo, S., Fall, C.B., Manga, I.A., Ndiaye, M., Faye, B., Dieng, T. and Tine, R.C. (2022) Prevalence of Intestinal Parasitic Infection among Pre-School and School-Aged Children Attending to Fann University Hospital, Dakar: Results from Retrospective Analysis. *Advances in Infectious Diseases*, **12**, 847-860.
https://doi.org/10.4236/aid.2022.124061

Received: November 13, 2022
Accepted: December 24, 2022
Published: December 27, 2022

Abstract

Background: Intestinal parasitic infections represent a major public health problem worldwide. Pre-school and school children have a high risk of infection. The study aimed to determine the epidemiological aspects of intestinal parasitic infections in preschool and school-aged children in Dakar, Senegal. **Methods:** A retrospective analysis of laboratory records from preschool and school-aged children referred to the Laboratory of Parasitology at the Fann University Hospital in Dakar, Senegal, was carried out. The analysis of the period from 2016 to 2020. Stool samples were examined for the presence of parasites using direct, formal-ether concentration method and the Modified Ziehl Neelsen staining technique. Descriptive and analytic analysis was performed with Stata MP 16.1 software. **Results:** The overall prevalence of intestinal parasitic infection was 26.8% (429/1603). *Blastocystis sp.* (34%), *Entamaeba coli* (28%), *Giardia intestinalis* (9.6%), *Endolimax nana* (4.9%) and *Ascaris lumbricoides* (3.5%) were the common parasites found. Out of the 429 children positive for intestinal parasites, protozoa parasites represent 93.9%. Single infection and mixed infection represent 83.7% and 16.3%. The most prevalent associations were *E. coli* + *Blastocystis sp.* (6.3%), *E. coli* + *E. nana* (3.3%), and *G. intestinalis* + *Blastocystis sp.* (1.9%). Children between the ages of 5 - 10 years and those over 10 years had the most parasitic infections with 28.1% [aOR = 1.91; 95% CI (1.25 - 2.89)] and 27.4% [aOR = 11.92

(1.07 - 3.07)]. According to the year of sample collection, the prevalence was higher in 2017, 32.6% [aOR = 1.49 (1.11 - 2.01]. The prevalence of intestinal parasitic infection was not significantly related to gender (p = 0.87), season (p = 0.85) and symptomatology (p = 0.19). The main clinical symptoms were dysenteric syndrome, dyspeptic disorders, constipation and abdominal pain. Intestinal parasite carriage in patients with acute diarrhea was 20.4%. In HIV positive with chronic diarrhea, the prevalence was 28.6%. **Conclusion:** The results showed the frequency of intestinal parasites in preschool and school-aged children with a high proportion of protozoa parasites. Children aged over 5 years were more affected. Preventive measures such as health education, improved socio-economic conditions and environmental sanitation are required for reducing their frequency.

Keywords

Intestinal Parasites, Children, Epidemiology, Senegal

1. Introduction

Morbidity related to intestinal parasitic infection caused by pathogenic protozoa and helminths is important worldwide, particularly in developing countries where children are most affected. It is estimated that 3.5 billion patients are affected and that 450 million of them are ill [1]. According to World Health Organization (WHO), children living in endemic are most affected with an estimated number of 270 million preschool children and over 600 million school children [2]. Among intestinal protozoan parasites, *Giardia lamblia* and *Entameoba histolytica* are the most common parasites and are considered to be responsible for acute diarrhea in children [3] [4]. *G. lamblia* is responsible for about 280 million human cases of diarrhea every year annually [5]. *E. histolytica* is one of the most important intestinal protozoa in terms of morbidity and mortality, annually infecting about 500 million cases, causing clinical disease of amoebic dysentery and invasive amebiasis in about 50 million and killing about 100,000 individuals [6].

Intestinal worms and soils transmitted helminths reached up to 12% of the total disease burden in children aged 5 - 14 years in low-income countries [7]. Soil-transmitted helminth (STH) infections, caused by *A. lumbricoides*, *T. trichiura* and hookworms, are the most predominant and have been recently estimated to affect more than two billion people [8].

The risk factors that maintain the persistence of the prevalence of intestinal parasite infection are poor hygiene conditions, environmental fecal contamination and the lack of sanitary infrastructure, and low access to improved water sources [3] [9].

To reduce morbidity and mortality related to intestinal parasitic infections, several strategies are proposed. WHO recommends integrated approaches 1) preventive chemotherapy (PC), consisting of periodic administration of anthel-

mintic medicines, 2) improvement of water, sanitation and hygiene (WASH) and 3) behavior change.

In Senegal, intestinal parasitic infection is endemic and children are most affected. Previous studies showed a high prevalence of these diseases [10] [11] [12]. The Ministry of Health has adopted the WHO recommendation which is the implementation of preventive chemotherapy campaigns with Mebendazole or Albendazole [13]. This strategy has significantly reduced the morbidity related to intestinal parasitic infection.

Several years after implementation of mass preventive chemotherapy, an update on the epidemiology of intestinal parasitic infection is important. It was in this context this study was performed with the objective of the prevalence of intestinal parasitic infection in children attending the laboratory of Parasitology-Mycology of Fann Teaching Hospital.

2. Materials and Methods

2.1. Study Design and Population

We carried out a retrospective analysis from January 2016 to December 2020 in the Laboratory of Parasitology-Mycology of Fann University Hospital, which is a public referral hospital, located in the capital city of Dakar. Preschool and school-aged children attending to the laboratory during study period for a parasitological examination of stool samples were included in this study. To be included in the analysis, only children with complete data were considered.

2.2. Data Collection

Sociodemographic, clinical, and biological data from patients were collected using the laboratory records. The following variables were collected: age, sex, year of sample collection, season, clinical indication, parasitological results. Age was defined in 3 categories: less than 5 years, 5 - 10 years, and more than 10 years. The season was defined in both the dry season (October to June) and rainy season (July to September).

2.3. Parasitological Examination

For each child, stool samples were collected using clean wide mouth. After collection, samples were examined macroscopically for color, consistency, presence of blood, mucus, pus, and large worms. Microscopic examination was performed using a proportion of stool samples. Direct examination was processed using light microscopy and the formol-ether concentration technique was used to detect the presence cysts, trophozoite, eggs and larva. The preparation was examined microscopically using the 10× and/or 40 × objectives. The remaining part of stool samples was examined using a modified Zielh Neelsen technique.

2.4. Data Analysis

After data collection, data were entered in Excel software and the analysis was

performed using Stata software version MP 16 software. Quantitative variables were described in terms of means, standard deviation. 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.

2.5. Ethical Considerations

Data are routinely collected from patients who attended to hospital for biomedical testing. Before analysis the data, a permission was requested from the administration of the Hospital. This study was conducted according to the Declaration of Helsinki and existing national legal and regulatory requirements. To respect the confidentiality, an identification code was given to each participant.

3. Results

3.1. Socio-Demographic Characteristics of Preschool and School Aged Children

Au total of 1603 preschool and school-aged children were included in the analysis. Age ranged from 0.5 to 15 years. The mean age of study participant was 6.9 ± 2.4 years. Study population was mainly represented by children age from 5 to 10 years old (78.6%). Children under 5 years old represented 11.2%. Most of study populations are male (54.6%). The sex ratio was 1.2. According to the season, 76.4% of the sample was collected during the dry season against 23.6% during the wet season (Table 1).

3.2. Prevalence of Intestinal Parasitic Infection among Preschool and School-Aged Children

Out of the 1603 children, 429 (26.7%) were found infected with at least one intestinal parasite species. Single infection was noted with a frequency of 83.7% against 16.3% for mixed infections. Protozoa parasites represent 93.9%. Helminth parasites represented 4%. Association between protozoan and helminth was observed in 2.1% (Figure 1).

The most prevalent parasites were *Blastocystis sp.* (34%), *Entamoeba Coli* (28%), *Giardia intestinalis* (9.6%), *Endolimax nana* (4.9%) and *Ascaris lumbricoides* (3.5%). *Entamoeba histolytica* was observed with 1.9%. The other parasites identified were: *Pseudolimax butschili* (0.5%), *Oocyste Isospora belli* (0.5%). *Trichomonas intestinalis*, *Chilomastix meslini*, *Trichuris trichura and Teania* were found with 0.2% respectively.

The most common associations were: *E Coli* + *Blastocystis sp.* (6.3%), *E Coli* + *E nana* (3.3%), *G intestinalis* + *Blastocystis sp.* (1.9%), *Blastocystis sp* + *A. lumbricoides* (0.5%), *G. intestinalis* + *A. lumbricoides* (0.5%). Polyparasitism was noted: *A lumbricoides* + *G intestinalis* + *Blastocystis sp.*, *A lumbricoides* + *E Coli* + *E Nana*, *G intestinalis* + *A lumbricoides* + *Trichuris trichura*, *G intestinalis*

Table 1. Socio-demographic characteristics of study participant (N = 1603).

Variable	Number (n)	Percentage (%)	95% CI
Age group			
<5 years	180	11.2	9.6 - 12.9
[5 – 10]	1259	78.6	74.3 - 83
≥10 years	164	10.2	8.7 - 11.9
Gender			
Female	727	45.4	42.1 - 48.7
Male	876	54.6	51.1 - 58.4
Season			
Dry	1225	76.4	72.2 - 80.8
Rainy	378	23.6	21.3 - 26.1
Total	**1603**	**100**	

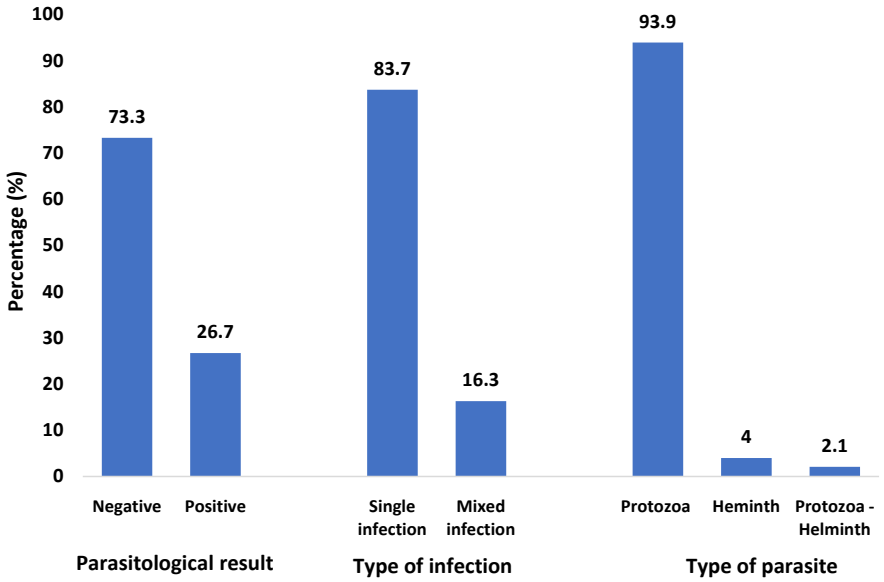

Figure 1. Prevalence of intestinal parasitic infection (IPI) among study population.

+ *Blastocystis sp* + *E Coli* and *Blastocystis sp* + *E. coli* + *E. histolytica.* One case of each was noted (Table 2).

Blastocystis sp. was more frequent in children aged over 10 years 24 (15.8%) while *E. coli* was higher in children aged from 5 to 10 years 146 (11.6%). The frequency of *G. intestinalis* was more important in children under 5 years 12 (6.7%) than in other age groups. *A. lumbricoides* was more observed in children aged over 10 years (1.8%) but the difference was not significative between other age groups. Regarding the gender, *Blastocystis sp* and *A. lumbricoides* carriage were more important in male subjects. *E. coli*, *G. intestinalis* and *E. nana* were more frequent in female. According to the season, *Blastocystis sp.* frequency was higher in rainy season (12.9%) than in dry season (11.7%) without any difference

Table 2. Intestinal parasites species identified among preschool and school-aged children (N = 429).

Parasite species	Number (n)	Percentage (%)
Single infection		
Blastocystis sp.	146	34
Entamaeba coli	120	28
Endolimax nana	21	4.9
Giardia intestinalis	41	9.6
Entamoeba histolytica	8	1.9
Pseudolimax butschili	2	0,5
Oocyste Isospora belli	2	0.5
Trichomonas intestinalis	1	0.2
Chilomastix meslini	1	0.2
Ascaris lumbricoides	15	3.5
Trichocephale	1	0.2
Teania	1	0.2
Mixed infection		
E coli + *Blastocystis sp*	26	6.1
E. coli + *E nana*	14	3.3
Blastocystis sp + *G. intestinalis*	8	1.9
Blastocystis sp + *E. nana*	4	0.9
E. coli + *E. hsitolytica*	2	0.5
Blastocystis sp + *C. meslini*	1	0.2
Blastocystis sp + *Teania*	1	0.2
Blastocystis sp + *E. histolytica*	1	0.2
E. coli + *E. nana*	1	0.2
E. nana + *G. intestinalis*	1	0,2
A. lumbricoides + *Blastocystis sp*	2	0.5
A. lumbricoides + *G. intestinalis*	2	0.5
A. lumbricoides + *E. coli*	1	0.2
Blastocystis sp + *E. coli* + *G. intestinalis*	1	0.2
Blastocystis sp + *E. coli* + *E. histolytica*	1	0.2
E. coli + *G. intestinalis* + *P. butschili*	1	0.2
Blastocystis sp + *G. intestinalis* + *A. lumbricoides*	1	0.2
T. trichura G. intestinalis + *A. lumbricoides*	1	0.2
E. coli + *E. nana* + *A. lumbricoides*	1	0,2
Total	**429**	**100**

(p value = 0.5). *E. coli* and *E. Nana* were also more observed in rainy season. The frequency of *G. intestinalis* and *A. lumbricoides* was more important in dry

compared to dry season. When looking the distribution of parasite species according to the presence of symptoms or not, the results of our study showed that *Blastocystis sp*, *E. coli*, *G. intestinalis*, *E. nana* and *A. lumbricoides* are more frequent in asymptomatic children (Table 3).

Figure 2 describes the evolution of the prevalence according to the month. Overall, an increase of intestinal parasite prevalence was observed from January to December. Low prevalence rate was noted in January, march and July with 14.9%, 22.7% and 20.6% respectively. High prevalence rate was observed in August (36.9%), October (39.4%) and November (33.3%).

According to the symptomatology 49.2% of study population was symptomatic. Among them, the positivity was 25.1%. The main clinical symptoms were diarrhea, abdominal pain, fever, dyspeptic disorder, and cough. In patients with

Table 3. Prevalence of different intestinal parasites (Single infection + Mixed infection) according to age groups, gender, season, and symptomatology among preschool and school-aged.

	Age group				Gender			Season			Symptomatic		
	<5 years (N = 180)	[5 – 10] years (N = 1259)	≥10 years (N = 164)	P value	Female (N = 727)	Male (N = 876)	P value	Dry (N = 1225)	Rainy (N = 378)	P value	No (N = 815)	Yes (N = 788)	P value
Blastocystis sp. **(n = 192)**	13 (7.2%)	153 (12.2%)	26 (15.8%)	0.04	81 (11.1%)	111 (12.3%)	0.35	143 (11.7%)	49 (12.9%)	0.5	102 (12.5%)	90 (11.4%)	0.5
E. coli **(n = 168)**	4 (2.2%)	146 (11.6%)	18 (10.9%)	0.001	81 (11.1%)	87 (9.9%)	0.43	127 (10.4%)	41 (10.8%)	0.79	90 (11%)	78 (9.9%)	0.45
G. intestinalis **(n = 57)**	12 (6.7%)	41 (3.3%)	4 (2.4%)	0.5	29 (3.9%)	28 (2.2%)	0.39	46 (3.7%)	11 (2.9%)	0.44	32 (3.9%)	25 (3.2%)	0.42
E. nana **(n = 41)**	2 (1.1%)	33 (2.6%)	6 (3.6%)	0.31	20 (2.7%)	21 (2.4%)	0.65	28 (2.3%)	13 (3.4%)	0.21	24 (2.9%)	17 (2.2%)	0.32
A. lumbricoides **(n = 23)**	2 (1.1%)	18 (1.4%)	3 (1.8%)	0.85	8 (1.1%)	15 (1.7%)	0.31	19 (1.5%)	4 (1.1%)	0.48	14 ((1.7%)	9 (1.2%)	0.33

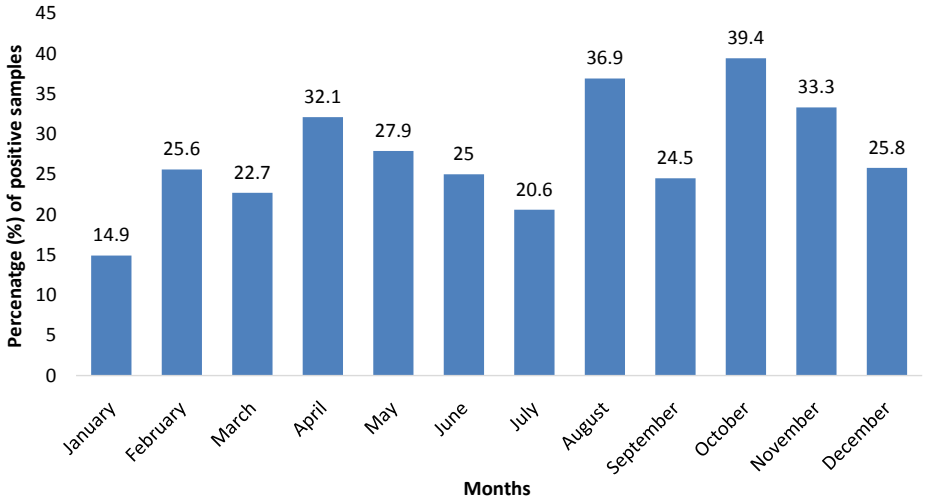

Figure 2. Monthly evolution prevalence of intestinal parasitic infestations from January 2016 to December 2020.

diarrhea, the prevalence of intestinal parasite was 28.6% (HIV positive with chronic diarrhea), 29% (patients with acute diarrhea, and 16.4% (HIV negative with chronic diarrhea). In patients presenting constipation, fever and dyspeptic disorders, the positivity rate was 33.3%, 32.1% and 32.2% respectively (Table 4).

3.3. Risk Factors Associated with Intestinal Parasitic Infection among Preschool and School-Aged Children

An association between intestinal parasite carriage and age group was noted in this study. Children in age group 5 - 10 years and those aged over 10 years old had high risk of developing intestinal parasite infection with prevalence of 28.1% (aOR = 1.91, 95% CI [1.25 - 2.89] p = 0.002) and 27.4% (aOR = 1.92, 95% CI [1.07 - 3.07] p = 0.002) compared to children under 5 years where the prevalence was 16.7%. According to the year of sample collection, sample collected in 2017, 2019, and 2020 had higher risk for being positive. Prevalence in 2017 was 32.6% (aOR = 1.49, 95% CI [1.11 - 2.01], p = 0.007). In 2019 and 2020, intestinal parasite prevalence was 28.2% (aOR = 1.27, 95% CI [0.88 - 1.84], p = 0.19) and 28.8% (aOR = 1.31, 95% CI [0.83 - 2.08], p = 0.24) respectively.

Table 4. Prevalence of different intestinal parasites according to clinical symptoms of study participant.

Variable	Total samples (N)	Positive samples (n)	Percentage (%)	95% CI
Symptomatic				
No	815	231	28.3	24.8 - 32.2
Yes	788	198	25.1	21.7 - 28.8
Clinical symptom				
Constipation	12	4	33.3	9.1 - 85.3
Acute diarrhea	142	29	20.4	13.6 - 29.3
Chronic diarrhea (*HIV positive*)	28	8	28.6	12.3 - 56.3
Chronic diarrhea (*HIV negative*)	104	17	16.4	9.5 - 26.2
Abdominal pain	251	67	26.7	20.7 - 33.9
Underweight	20	7	35	14.1 - 72.1
Clinical anemia	19	5	26.3	8.5 - 61.4
Cough	14	4	26.5	7.7 - 73.2
Anal pruritus	10	3	30	6.2 - 87.6
Dysenteric syndrome	28	5	17.8	5.8 - 41.7
Fever	78	25	32.1	20.7 - 47.3
Dyspeptic disorders	59	19	32.2	19.4 - 52.3
Urticaria	5	00	----	------
Vomiting	11	3	27.3	5.6 - 79.7
Rectorragia	7	2	28.6	3.4 - 99.9

The results from the analysis showed that gender, season and symptom were not correlated with intestinal parasite carriage. Female participants (27.4%) were more affected than male (26.3%) (p = 0.87). Parasite carriage was higher in dry season (26.8%) compared to rainy season (26.5%) without significant difference (p = 0.85). Intestinal parasite prevalence was more important in asymptomatic children (28.3%) (Table 5).

4. Discussion

Intestinal parasitic infections are one of the leading causes of morbidity and mortality in children, especially in those living developing countries. Updating the epidemiology of IPIs is an important epidemiological tool in better guiding existing or new intervention interventions. This study was conducted with the objective of evaluating the prevalence of intestinal parasitic infection in children attending to the laboratory of Parasitology-Mycology of Fann teaching hospital. In this study, the overall prevalence of intestinal parasitic infection was 26.7%% (429/1603). Protozoa were predominant (93.9%) than helminths (4%). Mixed infections represented 2.1%. The most prevalent parasites were *Blastocystis sp.* (34%), *E. coli* (28%), *G. intestinalis* (9.6%), *E. nana* (4.9%) and *A. lumbricoides*

Table 5. Risk factors associated with intestinal parasitic infection among preschool and school-aged children.

Parameters	Positive samples	(95% CI)	OR (95% CI)	aOR (95% CI)	P value
Study year					
2016	118	25 (20.9 - 29.9)	1	1	
2017	135	32.6 (27.3 - 38.6)	1.5 (1.1 - 1.9)	1.49 (1.11 - 2.01	0.007
2018	80	21.1 (13.2 - 20.8)	0.8 (0.58 - 1.1)	0.84 (0.61 - 1.17)	0.31
2019	62	28.2 (20.6 - 36.1)	1.2 (0.82 - 1.68)	1.27 (0.88 - 1.84)	0.19
2020	34	28.8 (19.9 - 42.3)	1.2 (0.77 - 1.9)	1.31 (0.83 - 2.08)	0.24
Age group					
<5 years	30	16.7 (11.2 - 23.8	1	1	
[5 - 10[	354	28.1 (25.3 - 31.2)	1.95 (1.29 - 2.94)	1.91 (1.25 - 2.89)	*0.002*
≥10 years	45	27.4 (20 - 6.7)	1.89 (1.12 - 3.18)	1.92 (1.07 - 3.07)	*0.026*
Gender					
Female	199	27.4 (27.3 - 31.5)	1	1	
Male	230	26.3 (22.9 - 29.8)	0.94 (0.75 - 1.18)	0.98 (0.78 - 0.23)	*0.87*
Season					
Dry	329	26.8 (24 - 29.9)	1	1	
Rainy	100	26.5 (21.5 - 32.2)	0.98 (0.75 - 1.27)	0.97 (0.75 - 1.27)	*0.85*
Symptomatic					
No	231	28.3 (24.8 - 32.2)	1		
Yes	198	25.1 (21.7 - 28.8)	0.85 (0.68 - 1.06)	0.85 (0.68 - 1.08)	*0.19*

(3.5%). *E. histolytica* was observed with 1.9%. These results confirm the frequency of intestinal parasitic infection in children living in Senegal with a high proportion of protozoa. Since mass preventive campaign with Mebendazole or Albendazole, a significant decrease of helminths wad noted. Similar results were described in Senegal by other authors. *Sylla et al.* when studying the epidemiological aspects of intestinal parasitic infection in the same hospital between, have found a prevalence of 26.8% with a predominance of protozoa (83%). Parasite species isolated were *E. coli* (58.9%), *E. nana* (10%), *G. intestinalis* (7.1%), *A. lumbricoides* (9.4%) [11]. *Tine et al.* in 2013 have reported 26.2% of prevalence for intestinal parasites with a predominance of protozoa in children under five years. Parasites species were represented by *G. intestinalis* (15.6%), *E coli* (10.9%), *Hymenolepis nana* (1.9%), *A. lumbricoides* (9.4%) and *Enterobius vermicularis* 0.4% [12]. *Sylla et al.* during a study evaluating the epidemiological profile of intestinal parasitic infection among children living in a rural community have found 35% prevalence. Protozoa were mainly represented (93.4%) than helminths (2.2%). Association between protozoan and helminth was observed in 4.4%. Parasites observed were *G. intestinalis* (72.48%), *E. coli* (13.76%), *Blastocystis sp* (3.67%) and *H. nana* (1.83%) [14]. *Diouf et al.* have demonstrated high prevalence of intestinal parasites (31.3%) with high proportion of protozoa. *G. intestinalis* (45.3%), *E. coli* (13.9%) and *A. lumbricoides* (31.4%) were the most prevalent parasites [15]. Low prevalence (15.8%) was noted by *Diongue et al.* when assessing the distribution of parasites detected in stool samples in Dakar. Monoparasitism represented 85.7% and mixed infection 14.3%. The most common parasites detected were *E. coli* (38.9%), *E. histolytica*/*dispar* (12.7%), *G. intestinalis* (8%), and *A. lumbricoides* (7.3%) [16]. Other studies carried out in the sub-region have shown that intestinal parasitic infections are frequent in the populations. This was demonstrated in Guinea by *Beavogui et al.* who showed 19.1% prevalence of intestinal parasite children. The main parasites identified were *Entamoeba coli* (5.4%) and *Giardia intestinalis* (5.1%) [17]. High prevalence was observed in Burkina Faso with important proportion of intestinal protozoa (84.7%), while helminths represented 10.7%. The predominant species were *E. histolytica*/*E. dispar* (66.5%), by *Entamoeba coli* (37.4%), *G. intestinalis* (28.1%), and *Trichomonas intestinalis* (23.4%). The most predominant helminth was H. nana (6.5%) [18]. In Gabon, *M' bondoukwé et al.* have noted 61.1% prevalence of intestinal parasites including intestinal protozoa (56.7%) and soil-transmitted helminths (22.2%). The most common IPI was *Blastocystis. sp* (48.6%), *A. lumbricoides* (13.7%), *T. trichura* (11.8%), *E. histolytica* (9.3%), *G. intestinalis* (4.8%), and *Strongyloides strercolaris* (3.7%) [19].

Similar result was found in Madagascar with high prevalence (93.6%) of intestinal parasites. The most prevalent parasites were *Giardia intestinalis* (79.5%), *Ascaris lumbricoides* (68.3%) and *Trichuris tri- chiura* (68.0%) [20]. In Ethiopia, Telanesh *et al.* when assessing the prevalence of intestinal parasitic infection in children under 5 years have noted that 17.4% were infected. Protozoa parasite

represent 14.2% (*G. intestinalis* 8.5%, *E. histolytica* 5.7%) [21]. Low frequency of helminths parasites was noted (3.2%): tree *A. lumbricoides*, four *T. trichura* and one *Taenia* [22]. The endemicity of intestinal parasitic infection in children was previously described in India where Deka *et al.* have found 36.6% prevalence. In this study helminths were more common than protozoa [23]. Our study showed that the prevalence of intestinal parasitosis increases significantly with age. In children under 5 years old, the prevalence was 16.7%. This prevalence was higher in children aged 5 to 10 years (28.1%) and those aged over 10 years of age (27.4%). These results are in line with what previously described by *Sylla et al.* in and Diouf *et al.* in Kaolack [14] [15]. Regarding the gender, high prevalence IPIs was noted in female subjects (27.4% compared to male subjects (26.3%), but no significant difference. Similar results were noted by *Sylla et al.* in Senegal (36.8% in female against 33.2% in male) and *Telanesh et al.* in Ethiopia (23 case in female against 20 in male) [14] [18]. In others studies intestinal parasitic infection prevalence was more important in male than female. This was demonstrated in Burkina Faso and in Kenya [18] [23]. Intestinal parasitic infection was more frequent during the dry season (26.8%) compared to rainy season (26.9%) ($p = 0.85$). This situation is related to fact that dry season is longer than rainy season. In another study conducted by Sylla *et al.* in 2013, intestinal parasite prevalence was higher frequency in rainy season (27.27%) than in the dry season 26.5% [11]. The results of our study showed that intestinal parasite prevalence was more frequent in asymptomatic subjects (28.3%) compared to symptomatic ones (25.1%). Most common symptoms in symptomatic children were diarrhea, abdominal pain, fever, dyspeptic disorder, and cough. Similar results were found in Guinea where main symptoms noted in children included abdominal bloating (35%), fever (30.4%), and cough (16.8%), and abdominal pain (4.1%) [17].

Study Limitations

In Senegal, health facilities are not regularly frequented by communities because of financial and geographic accessibility. Laboratory testing of intestinal parasite confirmation are not often prescribed. People are often use systematic deworming instead of going to hospital. In addition, the source of data (laboratory records) and study design (retrospective study in a hospital setting) are some limitations of our study. All these factors probably led to underestimate the prevalence of intestinal parasitic infections.

5. Conclusion

Intestinal parasitic infection is frequent in preschool and school-aged children with a high proportion of protozoa parasites. Low prevalence of helminth parasites could be explained by the effect of mass preventive treatment with Mebendazole or Albendazole. Additional preventive measures such as improved hygiene conditions and health education for the children could reduce transmission and re-infection of children.

Funding

This study was not funded. Funding for data collection was covered by the Laboratory of Parasitology-Mycology, of Fann Teaching Hospital.

Acknowledgements

We would like to acknowledge the entire study participant and the staff of the laboratory of parasitology at Fann Teaching Hospital.

Authors' Contributions

Khadime Sylla conceived and designed the study. Khadime Sylla supervised the data collection. Khadime Sylla analyzed the data and wrote the first draft of the manuscript. All authors read and approved the final manuscript.

Availability of Data and Material

The data used for this research article are available from the corresponding author upon request.

Conflicts of Interest

The authors declare that they have no competing interest.

References

[1] Al-Mekhlafi, A.M., Abdul-Ghani, R., Al-Eryani, S.M., Saif-Ali, R. and Mahdy, M.A. (2016) School-Based Prevalence of Intestinal Parasitic Infections and Associated Risk Factors in Rural Communities of Sana'a, Yemen. *Acta Tropica*, **163**, 135-141. https://doi.org/10.1016/j.actatropica.2016.08.009

[2] Dib, H.H., Lu, S.Q. and Wen, S.F. (2008) Prevalence of *Giardia lamblia* with or without Diarrhea in South-East, South-East Asia and the Far East. *Parasitology Research*, **103**, 239-251. https://doi.org/10.1007/s00436-008-0968-6

[3] Ayeh-Kumi, P.F., Quarcoo, S., Kwakye-Nuako, G., Kretchy, J.P. and Mortu, S. (2009) Prevalence of Intestinal Parasitic Infections among Food Vendors in Accra, Ghana. *Journal of Tropical Medicine & Parasitology*, **32**, 1-8.

[4] Baxt, L.A. and Singh, U. (2008) New Insights into Entamoeba Histolytica Pathogenesis. *Current Opinion in Infectious Diseases*, **21**, 489-494. https://doi.org/10.1097/QCO.0b013e32830ce75f

[5] Einarsson, E., Ma'ayeh, S. and Svärd, S.G. (2016) An Up-Date on *Giardia* and Giardiasis. *Current Opinion in Microbiology*, **34**, 47-52. https://doi.org/10.1016/j.mib.2016.07.019

[6] World Health Organization (1997) Entamoeba Taxonomy. *Bulletin of the World Health Organization*, **75**, 291-294. https://apps.who.int/iris/handle/10665/264239

[7] Reji, P., Belay, G., Erko, B., Legesse, M. and Belay, M. (2011) Intestinal Parasitic Infections and Malnutrition amongst First-Cycle Primary Schoolchildren in Adama, Ethiopia: Original Research. *African Journal of Primary Health Care and Family Medicine*, **3**, 198-202. https://hdl.handle.net/10520/EJC134148 https://doi.org/10.4102/phcfm.v4i1.198

[8] World Health Organization (2012) Soil-Transmitted Helminthiases: Eliminating as

a Public Health Problem Soil-Transmitted Helminthiases in Children: Progress Report 2001-2010 and Strategic Plan 2011-2020. WHO, Geneva. https://apps.who.int/iris/handle/10665/44804

[9] Alum, A., Rubino, J.R. and Ijaz, M.K. (2010) The Global War against Intestinal Parasites-Should We Use a Holistic Approach? *International Journal of Infectious Diseases*, **14**, 732-738. https://doi.org/10.1016/j.ijid.2009.11.036

[10] Faye, B., Ndiaye, J.L., Tine, R.C., Lo, A.C. and Gaye, O. (2008) Interaction paludisme et helminthiases intestinales au Sénégal: Influence du portage de parasites intestinaux sur l'intensité de l'infection plasmodiale. *Bulletin de la Société de Pathologie Exotique*, **101**, 391-394.

[11] Sylla, K., Tine, R.C., Sow, D., Dieng, T., Faye, B., *et al.* (2013) Epidemiological Aspects of Intestinal Parasitic Infection Diagnosed in Parasitology and Mycology Laboratory of Fann Hospital, Dakar. *Médecine d'Afrique Noire*, **60**, 339-346.

[12] Tine, R.C.K., Faye, B., Ndour, C.T., Sylla, K., Sow, D., Ndiaye, M., Ndiaye, J.L., Magnussen, P., Alifrangis, M., Bygbjerg, I.C. and Gaye, O. (2013) Parasitic Infections among Children under Five Years in Senegal: Prevalence and Effect on Anaemia and Nutritional Status. *Clinical Study*, **2013**, Article ID: 272701. https://doi.org/10.5402/2013/272701

[13] World Health Organization (2004) Schistosomiase et géo-helminthiases: Prévention et lutte: Rapport d'un comité d'experts de l'OMS. Série de rapports techniques. https://apps.who.int/iris/handle/10665/42880

[14] Sylla, K., Tine, R.C., Sow, D., Lelo, S., Ndiaye, L.A., Faye, B.T., Ndiaye, M., Faye, B. and Gaye, O. (2018) Epidemiological Profile of Intestinal Parasitic Infection among Preschool and School Children Living in a Rural Community in Senegal: A Cross Sectional Survey. *Journal of Bacteriology & Parasitology*, **9**, Article ID: 1000343. https://doi.org/10.4172/2155-9597.1000343

[15] Diouf, S., Diallo, A., Camara, B., Diagne, I., Signate, A., Sarr, M. and Fall, M. (2000) Parasitoses intestinales de l'enfant en zone rurale sénégalaise (khombole). *Médecine d'Afrique Noire*, **6**, 903. https://doi.org/10.1016/S0929-693X(00)88494-8

[16] Diongue, K., Ndiaye, M., Seck, M.C., Diallo, M.A., Ndiaye, Y.D., Badiane, A.S. and Ndiaye, D. (2017) Diseases Due to Intestinale Protozoa Diagnosed at Le Dantec University Hospital in Dakar, Senegal, from 2011 to 2015. *Médecine et Santé Tropicales*, **27**, 431-434. https://doi.org/10.1684/mst.2017.0741

[17] Beavogui, A.H., Cherif, M.S., Camara, B.S., Delamou, A., Kolie, D., Cissé, A., Camara, D., Sow, A., Camara, G., Yattara, M., Goumou, N., Doumbouya, A., Kourouma, K., Diarra, B. and Djimde, A. (2021) Prevalence of Parasitic Infections in Children of Boke, Guinea. *Journal of Parasitology*, **107**, 783-789. https://doi.org/10.1645/19-198

[18] Erismann, S., Diagbouga, S., Odermatt, P., Gerold, J., Shrestha, A., Tarnagda, G., Sawadogo, B., Schindler, C., Utzinger, J. and Cisse, G. (2016) Prevalence of Intestinal Parasitic Infections and Associated Risk Factors among Schoolchildren in the Plateau Central and Centre-Ouest Regions of Burkina Faso. *Parasites & Vectors*, **9**, Article No. 554. https://doi.org/10.1186/s13071-016-1835-4

[19] M'bondoukwé, N.P., Kendjo, E., Mawili-Mboumba, D.P., *et al.* (2018) Prevalence of and Risk Factors for Malaria, Filariasis, and Intestinal Parasites as Single Infections or Co-Infections in Different Settlements of Gabon, Central Africa. *Infectious Diseases of Poverty*, **7**, Article No. 6. https://doi.org/10.1186/s40249-017-0381-4

[20] Habib, A., Andrianonimiadana, L., Rakotondrainipiana, M., Andriantsalama, P., Randriamparany, R., Randremanana, R.V., Rakotoarison, R., Vigan-Womas, I., Ra-

falimanantsoa, A., Vonaesch, P., Sansonetti, P.J. and Collard, J.-M. (2021) High Prevalence of Intestinal Parasite Infestations among Stunted and Control Children Aged 2 to 5 Years Old in Two Neighborhoods of Antananarivo, Madagascar. *PLOS Neglected Tropical Diseases*, **15**, e0009333. https://doi.org/10.1371/journal.pntd.0009333

[21] Zemene, T. and Shiferaw, M.B. (2018) Prevalence of Intestinal Parasitic Infections in Children under the Age of 5 Years Attending the Debre Birhan Referral Hospital, North Shoa, Ethiopia. *BMC Research Notes*, **11**, Article No. 58. https://doi.org/10.1186/s13104-018-3166-3

[22] Deka, S., Kalita, D. and Kumar, H.N. (2022) Prevalence and Risk Factors of Intestinal Parasitic Infection in Under-Five Children with Malnutrition: A Hospital Based Cross-Sectional Study. *Journal of Family Medicine and Primary Care*, **11**, 2794-2801. https://doi.org/10.4103/jfmpc.jfmpc_1742_21

[23] Mbae, C.K., Nokes, D.J., Mulinge, E., Nyambura, J., Waruru, A. and Kariuku, S. (2013) Intestinal Parasitic Infections in Children Presenting with Diarrhoea in Outpatient and Inpatient Settings in an Informal Settlement of Nairobi, Kenya. *BMC Infectious Diseases*, **13**, Article No. 243. https://doi.org/10.1186/1471-2334-13-243