Original Research Article

Health threats of residents living close to household refuse collection points in Mfoundi Division, Centre Region, Cameroon

ABSTRACT

Aims: Household wastes constitute favorable environment for the development of human pathogens, posing thus important public health problem in the absence of appropriate waste management. Factors influencing their dissimilation include low level of environmental sanitation, lack of potable water supply, low level of personal hygiene among others.

Study design: The prospective and cross-sectional study consisted of collecting stool samples from the populations in 12 quarters of Yaoundé around Hygiene and Sanitation in Cameroon refuse collection sites from November 2019 to February 2020.

Methodology: Stool samples collected were treated with the formol ether and Kato-Katz technics. Questionnaires were administered to volunteer participants to evaluate risk factors related to contamination.

Results: Of the 252 stool samples collected from participants aged 1 to 60 years, 209 (82.9%) individuals were infected with at least one species of parasite with 19 (7.8%) having single infestation and 209 (82.9%) multiple infestation. The parasites identified belong to Helminths (16.7%): *Ascaris lumbricoides* (12.3%), *Trichirus trichiura* (3.2%), hookworms (5.5%), to Protozoa: *Entamoeba histolytica* (11.5%), *Entamoeba coli* (13.5%), and Yeast *Candida* spp. (76.1%). Infection rate varied significantly by neighborhood (P= 0.02). The distance between residence and the collection point (P= 0.004); hand washing with soap before meals (P = 0.001); frequency of abdominal pain (P= 0.001); the date of the last deworming (P= 0.003); promiscuity (P= 0.005); source of water supply (P= 0.002) and the distance between the water source and the collection point (P = 0.006) were the main risk factors for the transmission of intestinal parasitosis.

Conclusion: The results of this study show that people living close to HYSACAM dumpsites could be exposed to high risk of contamination of pathogens which develop and are propagated

from these areas. An appropriate management house hood wastes collection point is indispensable in maintaining the neighborhood population in a healthy status. .

Keywords: Refuse dumpsites, Human pathogens, Transmission, Neighborhood population, Risk factors, Yaoundé.

INTRODUCTION

The rise in industrialization and urbanization in many developing countries worldwide and Cameroon in particular, has led to a continuous movement of people from rural to urban areas as well as massive immigration rates of citizens from nearby countries who are attracted to big cities in search of greener pastures. This rapid population increase, has greatly encouraged mushrooming of numerous urban slums which is a conducive environment for the transmission of human pathogens. Such environments are characterized as unhygienic following the indiscriminate disposal of wastes which are not hastily evacuated to safe dump sites. As a result, organic waste rots, pollutes the environment and spreads infectious agents such as eggs, larvae, cysts and yeast cells all belonging to gastrointestinal pathogens of humans, constituting a potential risk factor for the population [1]. Development, persistence and dissemination of these pathogens are directly related to specific geographic characteristics, as well as ecological, sanitary, socioeconomic and cultural factors [2]. Today, several million people with the prevalence rate ranging from 30-60% in low-income countries are still affected [3, 4]. Transmission is favored by direct and indirect contamination of soil, water and food with human or animal feces. Significant progress has been done in Cameroon regarding the control of parasitic infections, especially helminthiasis where a great number of people are administered antihelminthic drugs annually associated to other sensitization measures, yet up till 20% of the population is still affected (PNLSHI, 2020, personal communication). Some studies exist on the relationship between environmental sanitation and human contamination by intestinal parasitic infections in Cameroon [5]. However, there still exist some lapses in understanding clearly the impact of some environmental activities like the HYSACAM Company, which provides public hygiene and sanitation services in Cameroon by collecting around 1,100 tons out of 1,800 tons of

waste produced daily in the city of Yaoundé. The daily differential of 700 tons of non-evacuated waste in the various districts represents a major source of public health risk [6] as the dump sites have been showed to be a favorable medium for the development and maintenance of human pathogens [1]. Considering the morbidity and mortality of these infectious diseases in children in particular, and the impact on the economy growth of the country as a whole, studies to evaluate the level of human pathogens transmission in surrounding population, risk factors and practices done by the population during waste disposal will have a positive impact on recommending the stakeholders for better management of these dump sites in Cameroon as a whole.

The present study seeks to determine the impact of household refuse collection points on the spread of pathogens resistant forms among residents living close to theses collection points in the city of Yaoundé. It specifically aimed to:

i: identify the different intestinal pathogens in human population living closer to the different collection points,

ii: determine the occurrence rate of the different intestinal pathogens identified,

iii: determine the different risk factors and practices associated to infestation of the different intestinal pathogens diagnosed in human population.

MATERIALS AND METHODS

Study site

This study was carried out in Yaoundé, the political capital of the country. Yaoundé is located in the Mfoundi Division, Centre Region, also called the city of seven hills. It is crossed by small streams among which the Mfoundi, Biyeme and Mefou rivers. Yaoundé is subject to an equatorial type climate characterized by two dry seasons, from December to March and from June to August, alternating with two rainy seasons from March to June and from September to November. Yaoundé is subdivided into seven districts-urban communities (Yaoundé I, Yaoundé II, Yaoundé III, Yaoundé IV, Yaoundé V, Yaoundé VI and Yaoundé VII) [7] (Figure 1). According to the Central Office of Censuses and Population Studies (BUCREP), the city of Yaoundé had approximately 2,638,648 inhabitants in 2010 [8].

This study was conducted in six different quarters (Biyem-Assi, Carrière, Efoulan, Mbankolo, Nsimeyong and Quartier Général) belonging to five districts of the city of Yaoundé (Yaoundé II, III, IV, V and VI: Figure 1). The choice of the different quarters was based on the population density around the refuse dump sites. The process involved collection of stool samples from human population living closer to the garbage collection points of HYSACAM from November 2019 to February 2020.

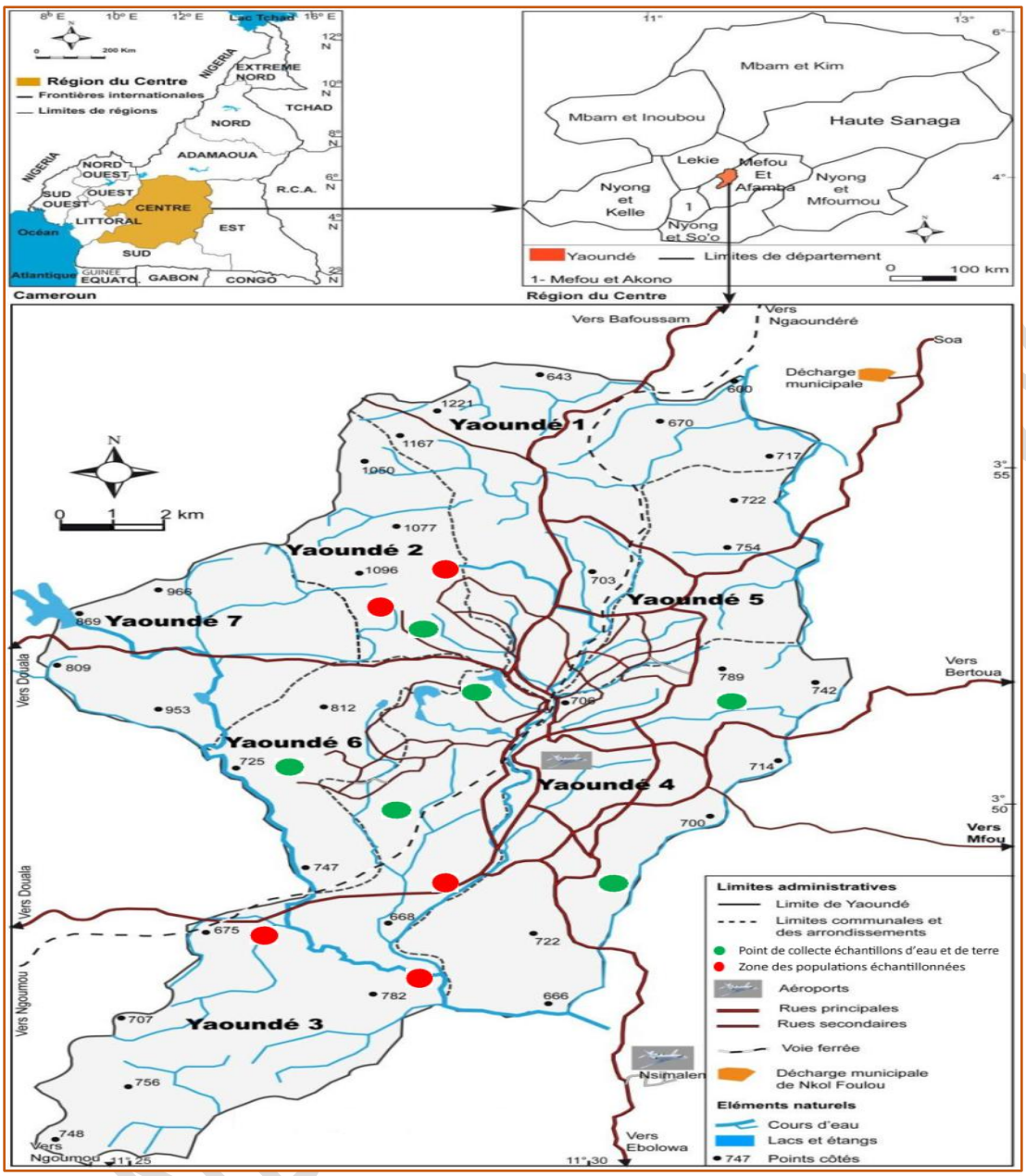

Figure 1: Geographic location of study sites ([7] modified by Taya Fokou Bosco, 2020).

Study Subjects

The study population included children and adults aged 4 to 62 years. Of the 282 persons who voluntarily accepted to participate in the study, 252 (133:52.8 % male sex and 119: 47.2 % female sex) from six different quarters provided stool samples. Three classes of age interval were deducted with respect to minimal equitability in the number of persons in each age group: 1-10 years; 11-20years; and above 20 years.

Ethical Considerations

Ethical approval was obtained from the Central Regional Ethics Committee (CREC) at the Regional Delegation of the Ministry of Public Health (MINSANTE) of the Center Region (N° 00841/CRERSHC/2019). Other research documents were obtained from the Centre Regional Delegate of Health (N° 00844/AP/MINSANTE/SG/DRSPC/2019) and from the Institute of Medical Research and Medicinal Plant Studies (IMPM) of the Ministry of Scientific Research and Innovation, Cameroon. Community leaders were duly informed on the objectives and benefits of the study before commencement. Parents/guardians were informed about the aim and the procedure of the work. Participants included in the study gave informed consent either as a parent or children parents/ guardians. Participants were recruited on a voluntary basis and their personal information was treated privately and was not divulged to a third party. People found infected following sample analysis were administered free treatment with Mebendazole 100 mg (2 tablets taking two times per day for 3 days consecutively) under the direct supervision of a clinical nurse.

Sample collection and processing

A questionnaire was administered to all participants enrolled in the study to evaluate risk factors related to contamination including information on socio-demography, the environment and health status and treatment history. Sterile plastic containers carrying participant's identification code were handed to all participants at enrollment with detailed instructions about the procedure for stool specimen collection. All stool samples were collected early in the morning, preserved in coolers containing ice blocks before transportation to the Parasitology laboratory of the Centre of Research for Health and on Priority Pathologies (CRHPP) of the Institute for Medical Research and Medicinal Plants Studies (IMPM) in Nkomo-Yaoundé. While in the laboratory, each sample was examined for the presence of intestinal pathogens resistant forms following two techniques: Kato-Katz and formalin ethyl acetate concentration techniques [9, 10].

Statistical analysis

Parasitological data were analyzed using Statistic logistic SPSS Version 21 and SX and Microsoft Excel 2007. The Chi square test was used to compare the prevalence of pathogens in relation to sex, age groups and quarters, while the one way ANOVA or Kruskal-Wallis test was used to compare egg load in relation to sex, age groups and quarters. Kruskal-Wallis test was used when the conditions for the parametric test of ANOVA were not valid [11]. Univariate and multivariate logistic regression was used to determine the correlation between different pathogens infections and risk factors. Multivariate analysis was done for all variables which showed a significance of $P < 0.2$ and other variables which did not show any significance but are known to be associated to the disease [12]. The level of statistical significance was at 95% ($P<0.05$)

RESULTS

Socio-demographic characteristics

Out of the 282 individuals who voluntarily agreed to participate in the study, 252 (89.4%) provided stool samples among which 209 (82.9%) were positive for at least one pathogen. The most represented were Yeast cells (76.1%) of the genus *Candida* spp. followed by Protozoans (25.8%) represented by *Entamoeba histolytica/E. dispar* et *E. coli* and Helminths (16.7%) represented by *Ascaris lumbricoïdes, Trichuris trichiura* and hook worms **(**Figure 2). Identical parasitic infestation trend was observed for both sexes. Nonetheless, the highest infection rate for *Candida* spp. was registered in females (80.0%) same as in participants of more than 20 years (76.9%), though with no significance observed (Table I).

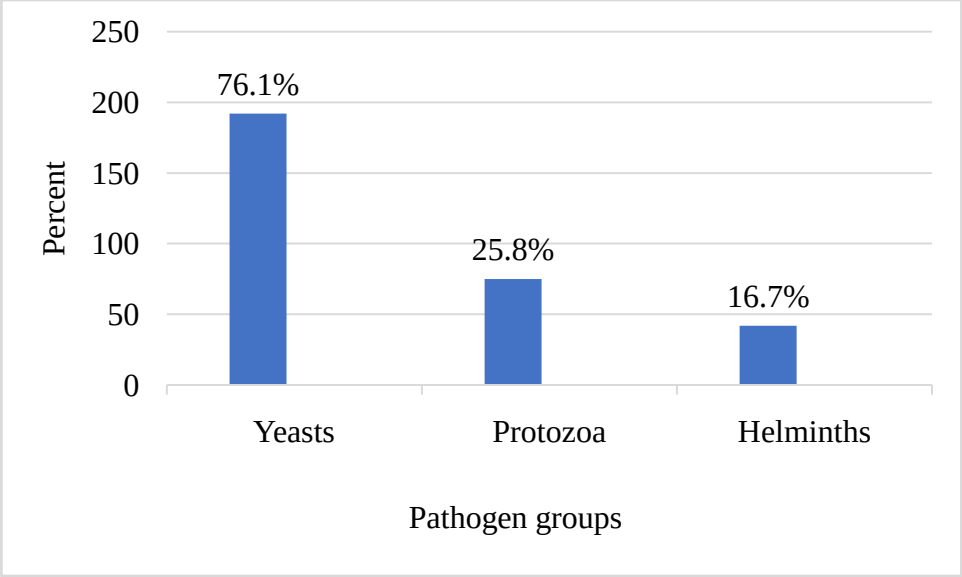

Figure 2: Occurrence rate of different pathogens

Table I: Occurrence rate of different pathogens by socio-demographic characteristics

	Parasite species (%)					
	A. lumbricoides	***T. trichiura***	**Hookworms**	***E. histolytica***	***E. coli***	***Candida* spp.**
Gender (n)						
Female (133)	18 (13.5)	4 (3.0)	8 (6.0)	13 (9.7)	15 (11.2)	107 (80.0)
Male (119)	13 (10.9)	4 (3.3)	6 (5.0)	16 (13.4)	19 (15.9)	85 (71.4)
X^2	0.395	0.025	0.113	0.828	1.559	3.317
P	**0.53**	**0.873**	**0.737**	**0.363**	**0.206**	**0.069**
Age group (n)						
[1-10[(58)	7 (12.0)	4 (6.9)	5 (8.6)	4 (6.9)	9 (15.5)	45 (77.5)
[10-20[(90)	12 (13.3)	3 (3.3)	3 (3.3)	9 (10.0)	9 (10.0)	67 (74.4)
>20 (104)	12 (11.5)	1 (1.0)	6 (5.7)	16 (15.3)	16 (15.3)	80 (76.92)
X^2	0.147	4.261	1.887	2.935	0.291	0.469
P	**0.929**	**0.119**	**0.339**	**0.23**	**0.879**	**0.791**

Distribution of pathogens by neighborhoods

Varying degree of pathogens distribution was observed at the different neighborhoods sampled with all pathogens identified in all the quarters exception made for *T. trichiura* which was not identified in two quarters *(*Efoulan and Nsimeyong). *Candida* spp. showed the highest occurrence rate in all quarters ranging from 62.5% (Quartier Général) to 94.6% (Efoulan). Similar occurrence trend was observed in Mbankolo for *A. lumbricoides* (16.6 %), *T. trichiura* (9.5 %), hookworms (16.6 %) and *E. histolytica/E. dispar* (19.0 %) same as in Carrière for *E. coli* (15.7 %) and *Candida* spp. (74.5 %). Significance was observed between different quarters for hookworms (*P*=0.02) and *Candida* spp. (*P*=0.03) (Table 2). Apart from *Candida* spp. with highest occurrence rate observed in female sex (80.0 %) and in participants above 20 years (76.9 %), other pathogens appeared to occur equally in both sex and other age groups.

Table II: Global occurrence rate of different pathogens according to neighborhood

Neighborhoods	**Parasite species (%)**					
	A. lumbricoides	***T. trichiura***	**Hookworms**	***E. histolytica***	***E. coli***	***Candida* spp.**
Biyem-Assi lac (37)	5 (13.5)	1 (2.7)	1 (2.7)	7 (18.9)	8 (21.6)	29 (78.3)
Carriere (51)	7 (11.1)	1 (2.0)	1 (2.0)	6 (11.7)	8 (15.7)	38 (74.5)
Efoulan (37)	2 (5.4)	0 (0)	1 (2.7)	4 (10.8)	4 (10.8)	35 (94.6)
Mbankolo (42)	7 (16.6)	4 (9.5)	7 (16.6)	8 (19.0)	5 (11.9)	33 (78.5)
Nsimeyong (37)	3 (8.1)	0 (0)	1 (2.7)	2 (5.4)	4 (10.8)	29 (78.4)
Quartier Général (48)	7(14.6)	2 (4.1)	3 (6.2)	2 (4.1)	6 (12.5)	30 (62.5)
X^2	3.341	8.316	12.858	8.22	2.778	12.63
P	**0.648**	**0.139**	**0.02**	**0.144**	**0.734**	**0.03**

Analysis of risk factors

The univariant analysis of risk factors associated with the various intestinal pathogens infestations by the Chi-square test identified seven potential risk factors: the distance between home and refuse dump site (*P* = 0.004); hand washing with soap before meal (*P* = 0.001), frequency of abdominal pain (*P* = 0.001), date of last anti parasitic treatment (*P* = 0.003), number of persons in each household (*P* = 0.01), Water type (*P* = 0.002) and distance between the dump site and water source(*P* = 0.001). Also, high exposure to contamination with resistant

forms of intestinal pathogens was noted in people that live about 50m from the dump site, in whom there is an absence of hand washing with soap before each meal (98.8%) or after using the toilet (84.5%), and frequency of abdominal pain (95%). Contamination rate according to age remained high and varied very little according to the different age groups, while hand washing or not after emptying waste has little influence on the risk of pathogens contamination

Multivariant logistic regression revealed water availability is significantly correlated to contamination of *A. lumbricoïdes* (*P* =0.043), *Entamoeba histolytica* (*P* =0.04) and *Candida* spp. (*P* =0.05) while participants who had well as water source are 3.11 (OR=3,11 ; IC at 95%= 0.2-2.4), 1.765 (OR=1.76 ; IC at 95%= 0.6-5) and 9.34 (OR=9.34 ; IC at 95%= 2.3-37.3) times more susceptible of being infested by *A. lumbricoïdes, Entamoeba histolytica/dispar* and *Candida* spp. (*P* =0,05). *T. trichiura* infestation was significantly linked to age group (*P* = 0.01) and to the date of last treatment (*P* = 0.02). Participants between 1 and 10 years were 26.18 times more susceptible at risk of infestation compared to those above 20 years (OR=26.18 ; IC at 95%= 0.1-56.1).

Table III: Analysis of risk factors associated with intestinal pathogens infestation.

Variables	NE	NI (%)	X^2	*P*
Garbage emptying				
Yes	234	194 (82.9)	0.97	**0.85**
No	18	15 (83.1)		
Sex				
Female	133	112 (84.2)	0.32	**0.50**
Male	119	97 (81.5)		
Age group				
[0-10[	58	49 (84.5)	0.59	**0.74**
[10-20[	90	76 (84.4)		
>20	104	84 (80.8)		
Refuse dumpsite				
HYSACAM trucks	10	8 (80.0)	1.46	**0.83**
HYSACAM refuse bins	191	160 (83.3)		
Road side	29	24 (82.7)		

Rivers	20	15 (75.0)		
Others	2	2 (100.0)		
Distance from home to dumpsite				
<50m	102	99 (97.1)	150.6	**0.01**
50m	86	85(98.8)		
100m	8	8 (100.0)		
200m	22	11 (50.0)		
>200m	34	6 (17.6)		
Hand washing after emptying				
Yes	171	140 (91.9)	0.2	**0.5**
No	81	69 (85.2)		
Hand washing before each meal				
Yes	238	201 (84.5)	6.96	**0.01**
No	14	8 (57.1)		
Regularity of abdominal pain				
Yes	160	152 (95.0)		**0.001**
No	92	34 (36.9)	42.95	
Hand washing after emptying waste				
Yes	171	140 (91.9)	0.20	**0.5**
No	81	69 (85.2)		
Date of last treatment			8.90	**0.03**
2 weeks	45	33 (73.3)		
1 month	51	23 (76.5)		
2 months	72	60 (83.3)		
3 months	84	77 (91.7)		
Number of persons in each household			7.80	**0.05**
3 persons	35	24 (68.4)		
4 persons	42	33 (78)		
5 persons	71	63 (88.7)		
>5personns	104	89 (85.7)		

Water type			8.10	**0.02**
Tap	133	103 (77.4)		
Forage	55	46 (83.6)		
Well	64	60 (93.8)		
Distance from water source to dumpsite			1,01	0.06
<25m	95	76 (80)		
50 m	74	62 (83.8)		
100 m	83	71 (85.5)		

NE: Number examined; NI: Number infected; (%): Percentage; P: level of significance;

DISCUSSION

The present study that shows treats of human health in residents living closer to the HYSACAM dumpsites is one of the first to be conducted in Cameroon in general and in Yaoundé city in particular. Approximately, majority of the world's population reside in conditions that generate stress due to nutritional imbalance or parasitic diseases infection. Insalubrity is one of the major risk factor of disease dissemination with many deaths occurring per year [13, 14, 15]. Others have revealed the contribution of HYSACAM refuse dumpsites collection points in the development and propagation of human pathogens resistant forms [1]. In the course of this study, 82.9% of the sample population harbored at least one intestinal pathogen indicating high exposure risk of the population to infestation with these pathogens following the high level of insalubrity that reigns in these different neighborhoods. Irregularity in emptying the domestic waste by the HYSACAM company has been observed in Cameroon coupled to poor management of these dumps sites by the company, despite the great quantity of waste produced per day (1800 tons of waste produced daily with only 1100 tons evacuated per day) [16]. It has been demonstrated that these dumpsites constitute favorable media in the development of parasites resistant forms and their propagation towards neighboring household what could lead to subsequent contamination of human population [1]. Non-inclusion of the adult urban population in mass deworming campaigns in particular could be another indicator of the diseases transmission chain maintenance. Our result is in line with that observed in Douala in the Littoral region, which is characterized with a high level of insalubrity [13]. However the result is lower than that obtained in Yaoundé (57.5%) [17] but similar to that obtained in the Fako Division

(82.6%) in HIV patients [18]. This disparity between the numbers could be explained by variations related to the environmental conditions in which the population is exposed to, socioeconomic conditions, individual behaviors, and immunological status of participants, stool examination methods, sample size and duration of the study [19, 13].

Among the pathogens identified, yeast cells represented by *Candida spp.* had the highest occurrence rate (76.1%). Self-medication or use of prescript broad-spectrum antibiotics could be a frequent cause in the reduction of the normal bacterial flora, thus leading to excessive proliferation of intestinal yeast cells represented by *Candida* spp. [20]. Indeed, it has been shown that broad-spectrum antibiotics in particular improve fungal colonization and the risk of candidiasis by destroying competing bacterial flora [21].

Parasitic protozoa were the second most prevalent parasite group (25.8%) with *E. coli* being the most predominant (13.5%). The presence of this amoeba is due to poor hygienic conditions and the existence of resistant cysts in natural environment. However, the low prevalence of *E. histolytica* / *E. dispar* (11.5%) could be explained by inadequate environmental conditions for the survival of their cysts (Benetton et al., 2005). Studies have shown that cysts of *E. histolytica* / *E. dispar* would be less resistant than those of *E. coli* [22].

Participants suffer the same risks of infestations regardless of sex. Also, individuals under the age of 20 were the most infested. Generally, children under 20 years are mostly the ones who empty domestic waste irrespective of sex, what could highly exposed them frequently at unsanitary environments and consequently being more exposed to high risk of contamination such as walking barefoot and playing around the garbage collections sites [5].

Several risk factors were associated to pathogens infestation in the different neighborhoods. Studies have demonstrated that living in or being in contact with an unhealthy environment increases morbidity caused by gastroenteritis. Also, up till 846,000 people have died from gastroenteritis diseases ether because they live or work in an unhealthy environment [23]. This could explain the high infestation rate recorded in people who live closer to the household waste collection points less than 50 m (64.3%) and 200 m (77.3%).Water source (wells and forages) used was significantly associated with the increased risk of infestation in the households surveyed. Various types of garbage are found at the level of collection points including human and animal excreta that could contain resistant forms of pathogens posing thus major threats to groundwater resources. Studies on the effects of waste dumps on the soil and

underlying shallow aquifers have shown that soil and groundwater systems can be polluted due to poorly designed waste disposal facilities [24, 25] or subjected to either groundwater underflow or infiltration from precipitation [26, 27].

In addition, the date of the last deworming was significantly associated with the risk of infestation with highest values observed in people who did not receive treatment 03 months ago (91.7%). This could be related to parasitic accumulation in the participants, what could consequently lead to continuous environmental contamination and propagation of parasites resistant forms [28, 1].

The factor age was not associated with the risk of pathogens infection with high values observed in all age groups. This could be explained by the same level of exposure to different contamination risk, (poor hygiene practice during emptying) and family contaminations. Concrete conclusions are still pending on the influence of age group on the prevalence of parasite infestation, because it may or may not play a role depending on region and environmental factors [29, 30].

CONCLUSION

The results of our study show that the household waste disposal points located in certain districts of the city of Yaoundé pose major public health problems for the neighboring populations. Human population are exposed to active contamination of intestinal pathogens (82.9%) including *A. lumbricoïdes, T. trichiura,* hookworms, amoeba species *(E. coli and E. histolytica/E. dispar)* and yeast cells (*Candida spp*.) which are all pathogens with risk factors related to poor environmental hygiene. Distance between the home and the collection point , hand washing with soap before meals, regularity of abdominal pain, the date of the last deworming, promiscuity, water supply and the distance between the water source and the collection point were the main risk factors related to contamination. However, the distance from water source to collection points could equally have a none negligible impact on the transmission of pathogens. . This study calls for the need to put in place adequate intervention strategies for a better management of the refuse dumpsites by the authorities in charged and neighborhood population. Also, studies on environmental factors that could favor the multiplication of pathogens around the dumpsites are also vital to draw concrete managing strategies.

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