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Full Length Research Paper

Intestinal parasitic infections among prison inmates at theMACA – Maison-d'Arrêt-et de Correction d'Abidjan, Côte d'Ivoire

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Intestinal parasitic infection epidemiology in the Ivorian prisons is little documented. The purpose of this study was to estimate the prevalence of intestinal parasites carriage at MACA. This cross-sectional study (January to July 2013) was carried out among 300 inmates aged 16 – 84 years. Single stool samples were collected and analyzed using the direct examination, the Kato-Katz and Baermann techniques. The overall prevalence of parasitic intestinal infections prevalence was 69.3%, (95%CI = 63.9 – 74.4). Regarding the intestinal protozoa, amoebas *Entamœba coli*-(54.0%) and *Endolimax nana* (6.0%) were the most encountered. *Giardia intestinalis* (1.4%) was the only flagellated found. Among helminths, hookworms (6.0%) was the predominant parasites, followed by *Ascaris lumbricoides* (3.0%), *Trichuristrichiura*, (3.0%) and *Strongyloïdesstercoralis,* (0.7%). Prisoners under 45 years old (OR=2.2, 95%CI=1.2-4.3), illiterate inmates (OR=5.8, 95%CI=3.1-10.5), duration of incarceration (OR=5.6, 95%CI=3.2-9.9) were significant risk factors of intestinal parasitic infections among prisoners in MACA. This study urges the setting up of a program to fight against the intestinal parasitic infections in the Ivorian prisons.

Keywords: Intestinal parasitic infections, prisons, Abidjan, Côte d'Ivoire.

INTRODUCTION

Intestinal parasitic infections are very widespread in the world and constitute a real public health problem notably in developing countries (Utzingeret al., 2012). About 1.5 billion people are affected by Soil-transmitted helminth infections (WHO, 2017). Affected children suffer from physical (Stoltzfuset al., 1997; Moore et al., 2001), nutritional (Stephenson et al., 2000; Crompton and Nesheim, 2002), anemia (Rodriguez-Guardado et al., 2013), and cognitive impairment (Watkins and Pollitt, 1997; Stoltzfuset al., 2001; WHO, 2017). These diseases contribute to perpetuating poverty by jeopardizing intellectual faculties (WHO, 2005) and the growth of children (Moore et al., 2001). They play a role in the reduction of the adults' productivity (WHO, 2005). The intestinal parasites often complicate the health conditions of patients with severe diseases such as the

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HIV/AIDS (Wokem et al., 2008; Alemu et al., 2011), and malaria (Degarege et al., 2010).
In Côte d'Ivoire, the studies carried out in schools on the epidemiology of the intestinal parasites, mostly the intestinal worms, were the most reported generally. Their prevalence varies from 20.6-% to 59.7-% (Oga et al., 2004; Evi et al., 2007; Menan et al., 1997a, 1999, 2008; Kassi et al., 2008;-Schmidlin et al., 2013; Yapi et al., 2014). The climatic and the environmental conditions, the sanitation level, the access to clean water as well as the hygiene education are factors that increase their frequencies and determine their epidemiology (Worrell CM, 2016). These factors are also found in prisons, fostering intestinal parasitic infections in these environments. In Côte d'Ivoire, the data on intestinal parasitic infection epidemiology in Ivorian prisons are very little known. The purpose of this work is therefore to estimate the prevalence of these infections and identify species responsible for them in MACA.

MATERIALS AND METHODS

Type of Survey and Area

This study took place in MACA from January to July 2013. MACA consists of six sections reserved for the inmates, four for male inmates, one for female inmates, and the sixth for minors. There is also, a health center and an anti-tuberculosis center.

Surveyed population and size of the sample

During that period, there were 3218 individuals incarcerated in the facilities originally built to house only 1 500 inmates as planned at the construction in the 70s. The survey included all the individuals with no distinction of age and gender, symptomatic or not, incarcerated in the above-mentioned prison.
The size of the sample required for this work was calculated on the basis of an intestinal parasite prevalence study in the general population which was estimated at 18.6 % (Menan et al., 1997b). With a significance level of 5 % and with a reliance interval of 95 %, the size of the sample was determined according to the following Schwartz formula.

$$n = \frac{\varepsilon^2 pq}{i^2}$$

p = 18.6 %, represents the previous prevalence of intestinal parasitic infections in the general population.

In this formula,

q = 1-p
ε = reduced discrepancy for the consented risk α=5% is 1.96,i = precision fixed at 5%
The application of the formula gives a minimum of n= 233 inmates to be selected.

METHODS

Before the beginning of the study, we got the official agreement of the prison administration manager. The purpose of the study as well as the procedures were explained to the inmates. The choice of inmates was made randomly according to the method of cluster sampling advocated by WHO (Spiegel et al, 1989) and proportionally to the number of the inmates. Only the inmates who gave their agreement in writing took part in the survey. The stool samples of each inmate were collected individually in clean sampling containers. The direct microscopic examination of fresh samples, the Kato-Katz (WHO, 1991) and Baermann (Baermann G et al. Eineeinfache, 1917) techniques were realized at the laboratory of parasitology and mycology of the Center for the diagnosis and research on AIDS and other infectious diseases (CeDRes). 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. 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.

Statistical analysis

The data were processed and analyzed by the software Epi Info 6.0. All the variables were described by group in order to calculate frequencies and averages in the distribution models. Odd-Ratios were determined for the parameter study linked to the disease with reliance intervals to 95% (CI 95%). The exact Fisher test was used to compare the relative frequencies and the proportions between the groups with the error α fixed at 5%.

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RESULTS

Socio-demographic features of the surveyed population

In this study 300 inmates out of 3218 were selected. Among the 300 inmates investigated 97% (291/300) were men and 3% (9/300) were women, that is a 32.3% gender ratio. The age of the subjects varied from 16 to 84 years with an average of 35 years ± 1.14.
The majority of the surveyed subjects (87.7%) were under 45 years old. More than half (57.6%) of the subjects of the study had some level of school education (primary, secondary and higher). 50.3% of the prisoners had been incarcerated for more than 3 months.

Prevalence of intestinal parasitic infections according to species

In total, 208 (69.3%, 95%CI=63.9 – 74.4) out of 300 inmates were carriers of intestinal parasites. The prevalence of intestinal parasitic infections according to species in the incarcerated population (table 1) shows that out of the 300 stool samples, 183 (61.0.%) contained forms of cystic protozoa and 40 (13.3%) contained eggs of helminths. Among the protozoa cysts, those of *Entamœba coli* (54.0%) and *Endolimax nana* (6.0%) were predominant. The prevalence of *Giardia intestinalis* (1.0%) was low. The prevalence of oral-faecal transmission parasites and cutaneous transmission nematodes were identical (6.6%). Two cases (0.7%) of *Strongyloïdesstercoralis* infection were observed.

Factors associated with Intestinal parasitic infections among prison inmate, in MACA and socio-demographic features

A statistically significant intestinal parasitic infections difference was not observed between genders (55.5% for female subjects against 69.3% for male) (p=0.7). The parasitic infection rate was higher for subjects aged 45 years or under compared to older ones (88.9% against 11.5% ; p = 0.015). The parasitic infection rate was 52.3% for an incarceration duration under 180 days; beyond 180 days it reached 86.15% (p <0.001). The intestinal parasitic infection rate was 87.7% for the investigated subjects with a level of school education (primary, secondary or higher) against 55.3% for illiterates; (p<0.001). Prisoners under 45 years old (OR=2.2, 95%CI=1.2-4.3), illiterate inmates (OR=5.8, 95%CI=3.1-10.5), duration of incarceration (OR=5.6, 95%CI=3.2-9.9) were significant risk factors of intestinal parasitic infections (Table 2).

DISCUSSION

In tropical Africa, where intestinal parasitosis is a public health problem in children, the, prevalence of 26.8%, 45.5% and 30% are respectively reported in a hospitals (Bourée, 2015; Diouf et al., 2016) and in schools (Saotoing et al., 2016). These prevalence are inferior to those reported in prisons (69.3%). It is estimated at 70% (Okolie et al., 2008) and at 71.5% (Zida et al., 2014) respectively in a population of prisoners in Owerri in Nigeria and with inmates in Ouagadougou in Burkina Faso. Another study on the prevalence of intestinal parasitosis among prisoners in Shewa Robit, in Ethiopia shows a prevalence of 72.7% (Mano, 2014). These results, close to ours point out that prisons are a risky place that expose prisoners to different pathologies notably intestinal parasitosis. Concerning the proportion of the two groups of intestinal parasites, our results can be matched with those reported in the Ouagadougou prison (Zida et al., 2014). *E. coli* is mostly found in both studies. This amoeba, even though it is a bit pathological**,** shows the inadequacy of faecal hygiene MACA. However, some results that are different from ours were noted in two other protozoa: *E. nana* and *G. intestinalis* were less prevalent in our study. Whereas, in the Ouagadougou prison, cases of infestation by: *Entamœba-histolytica* (10.4%), flagellated protozoa (16.6%), notably *Trichomonasintestinalis* (9.2%), followed by *G. intestinalis* (4.7%) are reported. The species *E. histolytica* and *Entamœba-dispar* which is like *E. coli* linked to the precarity of faecal hygiene were not found in our series. Furthermore, the infections by *Ascaris lumbricoides,* and by *Trichuris trichiura*, even though found at low rates reflect, a sanitation deficiency in the prison. MACA, hygiene is difficult to sustain. The building maintenance programs are not respected because of a lack of hygiene and maintenance products. Moreover, we noticed an accumulation of garbage in the cells and observed a high number of inmates in the different sections of the prison ranging from 10 to 100 inmates per cell, furthering interpersonal contacts. The kitchen is close to the toilets and the waste water evacuation system, yet the intestinal parasitosis are known to result from a defective hygiene (Benouis et al., 2013). Only one site is used for clean water supply; the procurement and storage of this water is done by means of buckets and cans that are not well maintained and kept uncovered, and could be the source of contamination (Wright et al., 2004; Naelah et al., 2011) by *E. coli* cysts. These adverse life conditions of the inmates could explain the association between the incarceration duration (p < 0.001) of the inmates and the

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Table 1. Distribution of intestinal parasites among prisoners in MACA, Abidjan Prison, July 2013.

Parasite species	Number-examined-(n = 300)	
	Number positive	Percentages-(95%CI)
Intestinal protozoa		
Entamœba coli	162	54.0 (48.3 - 59.6)
Endolimax nana	18	6.0 (3.7 - 9.1)
Giardia intestinalis	3	1.0 (2.3 - 2.7)
Helminths		
Nematodes		
Ascaris lumbricoiïdes	10	3.3 (1.7 - 5.9)
Trichuris-trichiura	10	3.3 (1.7 - 5.9)
Hookworm	18	6.0 (3.7 - 9.1)
Strongyloiïdes-stercoralis	2	0.7 (0.1 - 2.2)

Table 2. Factors associated with intestinal parasites among prisoners in MACA, Abidjan Prison, July 2013.

	Intestinal parasites				
Variables	No examined	No positive	Percentages (95%CI)	OR (95% CI)	*p-value*
Age group (in years)					
>45	43	23	53.5(38.6-67.9)	1	0.015
≤45	257	185	72.0(66.3-72.2)	2.2 (1.2-4.3)	
Gender					
Male	292	203	69.5(64.1-74.6)	1	0.7
Female	8	5(62.5)	62.5(27.8-89.4)	1.4 (0.3-5.9)	
Educational-status					
Literate	170	94	55.3(47.8-62.7)	1	<0.001
Illiterate	130	114	87.7(81.2-92.5)	5.8 (3.1-10.5)	
Duration in the prison (in days)					
<=180j	149	78	52.3(44.3-60.3)	1	<0.001
>180j	152	130	85.5(79.3-90.5)	5.6 (3.2-9.9)	

high parasite infection rate found in our study. A deficient hygiene in an environment where the sanitation is insufficient favours the sustaining and the dissemination of intestinal parasites (Schmidlin et al 2013).

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However, it is not excluded that the inmates may be infected by parasites before their incarceration. The results of our investigation disagree with those of some African authors in Ouagadougou and Ethiopia (Colman et al 2013; Mano, 2014; Zida et al., 2014) respectively. In their studies, these authors do not make any association between intestinal parasite infections and the incarceration duration. However, another study conducted in a prison in Ethiopia shows that intestinal parasite infections is inversely associated with the incarceration duration (Terefe et al., 2015). The *A lumbricoïdes* infections, frequently found in the vast majority of studies, concern about 819 million individuals in 2010 worldwide (Pullan, 2014). Our rate is lower than the one reported in Bedele prison in Ethiopia: 42.6 % of the helminths found (Terefe et al., 2015).

For the search for *S.stercoralis* larvae, only one examination was done per stool sample using the Baermann technique. This methodological approach could probably explain the low number of infections found in our series. Not repeating the Baermann method for the stool sample analysis for several successive days enables us to suppose that our results underestimate the actual strongyloidiasis prevalence. Serial and repeat stool examination is necessary because the parasitic output is often limited and dependent on the occurrence of larvae in stool. Therefore, examining multiple stool samples is recommended to identify uncomplicated strongyloidiasis (Gonzales DJ et-Climaco A, 2017). This result should be confirmed in a prison where the co-infection HIV/AIDS strongyloidiasis (Angal et al., 2015) is a threat for the prisoners.

The highest rate of intestinal parasites is found among subjects under 45 years old. This observation could be explained by the fact that in this age group, the most active subjects are more involved in the daily chores of the prison, exposing them to a high level of contamination.

The level of education constitutes a furthering factor of the occurrence of the intestinal parasite infections. It plays an important role in the application of hygiene measures that contribute to fighting against those infections. However, no association between the level of education and the occurrence of these affections was established in the study conducted in a prison in Ethiopia (Terefe et al., 2015). This difference of result could be explained by the fact that in our series, there could be a better awareness of individual hygiene among the inmates.

CONCLUSION

An Improvement of faecal hygiene as well as a better awareness of information focused on collective and individual hygiene could contribute to reducing intestinal parasitic infections in prisons in Abidjan.

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REFERENCES

Alemu A, Shiferaw Y, Getnet G, Yalew A, Addis Z (2011). Opportunistic and
other intestinal parasites among HIV/AIDS patients attending Gambi higher clinic in Bahir Dar city, North West Ethiopia. Asian Pac J Trop Med 4:661–665.

Angal L, Mahmud R, Samin , Yap NJ, Ngui R, Amir A, Ithoi I, Kamarulzaman
A, Lim YA (2015). Determining intestinal parasitic infections (IPIs) in inmates from Kajang Prison, Selangor, Malaysia for improved prison management. BMC Infect Dis. 29: 467.

Baermann G, Eineeinfache (1917). MethodezurAuffindungvonAnkylostomum (nematoden) Larven in Erdproben. Geneesk. Tijschrift Ned-indie. 57: 131-137).

Benouis A, Bekkouche Z, Benmansour Z (2013). Epidemiological study of
human intestinal parasotosis in the hospital of Oran (Algeria). IJIAS. 2: 613-620.

Bourée P (2015). Les parasitoses-intestinales-sont encore fréquentes. Med Sant Trop. 25: 130.

Colman S, Mangoro ZM, Isa L (2013). Incidence of intestinal and urinary-parasites among prison inmates. AJMR. 1: 11–15.

Crompton DW, Nesheim MC. Nutritional impact of intestinal helminthiasis-during the human life cycle-(2002). Annurev.nutr. 22:35–59.

Degarege A, Animut A, Legesse M, Erko B (2010). Malaria and helminthcoinfections in outpatients of AlabaKulito Health Center, southern Ethiopia: a cross sectional study. BMC res notes 3: 143.

Diouf JBN (2016). Persistance des géohelminthes en milieu hospitalierpédiatrique-dans la banlieue-dakaroiseau Sénégal.
Rev du CAMES: Science santé. 4(2).

Evi JB, Yavo W, Brro-Kiki PC, Menan EH, Kone M (2007). Intestinal helminthiasis in school background in six towns of south-western Côte d'Ivoire]. Bull Soc-Pathol-Exot. 100: 176-7.

Gonzales DJ, Climaco A. Strongyloidiasis (2017). StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing. 2017

Kassi FK, Menan EIH, Yavo W, Oga SSA, Djohan V, Vanga H, Barro PCK, Adjetey TAK, Kone M (2008).

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Helminthoses-intestinales chez les enfants-d'âge-scolaire de la zone rurale et urbaine de Divo (Côte d'Ivoire). Cah Santé Pub. 7: 51-60

Mamo H (2014). Intestinal parasitic infections among prison inmates and tobacco farm workers in Shewa Robit, north-central Ethiopia. PLoS One. 13: 9(6)

Menan E I H, Keita M, Nebavi N G F, Kiki Barro PC, Adjetey T A K, Kone M, Mamadou K (1999). Helminthiases-intestinales chez les enfants-d'âge-scolaire à Grand-bassam (Côte d'Ivoire) d'Abidjan. JSci Pharm Biol. 1: 11-19.

Menan EIH, Kassi FK, Yavo W, Djohan V, Vanga H, Barro PCK, Oga SSA, Konate A, Gbocho FY, Adjetey TAK, Kone M (2008). Helminthoses-intestinales chez les enfants-d'âge-scolaire de la zone rurale et urbaine de Tiassalé (Côte d'Ivoire). Méd Trop. 68: 658-9.

Menan EIH, Nebavi NGF, Adjetey TAK, Assavo NN, Kiki Barro PC, Moussa K (1997a). Profil des helminthiases-intestinales chez les enfants-d'âge-scolaire-dans la ville-d'Abidjan. Bull. Soc. Path. Ex. 1997; 90: 51-54.

Menan EIH, Roumba E, Ouhon J, Nebavi NGF, Adjetey TAK, Barro-Kiki PCMK, Penali KL, Kone M (1997b). Helminthiases-intestinales: résultats de cinqannées de coprologie-parasitaire à l'Institut Pasteur de Cocody (Abidjan – Côte d'Ivoire). MédAfr noire. 44: 415-419.

Moore SR, Lima AA, Conaway MR, Schorling JB, Soares AM, Guerrant RL (2001). Early-childhooddiarrhoea and helminthiases associatewith long-termlineargrowthfaltering. Int J. Epidemiol. 30:1457–64.

Naelah A. Alyousefi, Mohammed A. K. Mahdy, Rohela Mahmud, Yvonne A, Lim L (2011). Factors Associated with High Prevalence of Intestinal Protozoan Infections among Patients in Sana'a City, Yemen. PLoS One. 6(7): e22044.

Oga AS, Yavo W, Menan EIH, AtteyMA., Kouadio L, Kone M (2004). Helminthosesintestinales chez les enfantsd'âgescolaire: résultats-préliminaire-d'une-étude prospective à Agboville-dans le sud de la Côte d'Ivoire. Rev Santé. 14:143-147.

Okolie N (2008). Intestinal parasites distribution among inmates of Owerri prison. The Internet J Parasitic Dis. 4(1).

Pullan RL, Smith JL, Jasrasaria R, Brooker SJ (2014). Global numbers of infection and disease burden of soil transmitted helminth infections in 2010. Parasit Vectors. 7:37.

Rodriguez-Guardado A, Pozo E, Fernandez-Garcia R, Amo-Fernandez J, Nozal-Gancedo T (2013). Hookwormdisease as a cause of irondeficiencyanemia in the prison population. Rev Esp SanidPenit. 15 : 63-65.

Saotoing P, Djonyang R, Dereng DD, NjanNlôga AM (2016). Enquêteépidémiologique-sur les parasitoses-urinaires-et-intestinales chez les élèves des écoles-primaires de l'arrondissement de Maga, Extrême-Nord Cameroun. IJBCS.10(1):344-354.

Schmidlin T, Hürlimann E, Silué KD, Yapi RB, Houngbedji C, Kouadio BA, Acka-Douabélé CA, Kouassi D, Ouattara M, Zouzou F, Bonfoh B, N'Goran EK, Utzinger J, Raso G (2013). Effects of hygiene and defecation behavior on helminths and intestinal protozoa infections in Taabo, Côte d'Ivoire. PLoS One. 8(6) e65722.

Spiegel A, Moulia –Pelat JP, Daumerie D, Merlin M, Baudan D (1989). Le sondage en grappe. Type OMS: méthodologiepratique en épidémiologie descriptive. Méd-Afr noire. 36: 740-743.

Stephenson LS, Latham MC, Ottesen EA (2000). Malnutrition and parasitic-helminth infections. Parasitology. 121 Suppl:S23–38.

Stoltzfus RJ, Albonico M, Tielsch JM, Chwaya HM, Savioli L (1997). Linear-growth retardation in Zanzibarischoolchildren. J Nutr.127:1099–105.

Stoltzfus RJ, Kvalsvig JD, Chwaya HM, Montresor A, Albonico M, Tielsch JM, Savioli L, Pollitt E (2001). Effects of ironsupplementation and anthelmintictreatment on motor and languagedevelopment of preschoolchildren in Zanzibar: double blind, placebo controlledstudy. BMJ. 323(7326):1389–93.

Terefe B, Zemene E, Mohammed AE (2015). Intestinal helminth infections among inmates in Bedele prison with emphasis on soil-transmitted helminths. BMC Res Notes. 14: 779.

Utzinger J, Becker SL, Knopp S, Blum J, Neumayr AL, Keiser J, Hatz CF (2012). Neglected tropical diseases: diagnosis, clinical management, treatment and control. Swiss Med Wkly. 142: w13727.

Watkins WE, Pollitt E (1997). "Stupidity or worms": do intestinal worms impair mental performance? Psychol Bull. 121:171–91.

WHO (1991). Basic LaboratoryMethods in Medical Parasitology. World Health Organisation; Geneva: pp: 25-26).

WHO (2005). Deworming for health and development: report of the third global meeting of the partners for parasite control.

WHO (2017). Aide-mémoire N°366, WHO, Geneva, Switzerland.

Wokem GN, Chuku C, Nwachukwu BC (2008). Prevalence of intestinal parasites seen in HIV sero-positive subjects in Port Harcourt, Nigeria. Nig J Parasit 29(2): 115–120.

Worrell CM, Wiegand RE, Davis SM, Odero KO, Blackstock A, Cuéllar VM, Njenga SM, Montgomery JM, Roy SL, Fox LM. A Cross-Sectional Study of Water, Sanitation, and Hygiene-Related Risk Factors for Soil-Transmitted Helminth Infection in Urban School- and Preschool-Aged Children in Kibera, Nairobi. PLoS One 2016;11(3):e0150744.27.

Wright J, Gundry S, Conroy R. Household drinking water in developing countries: a systematic review of microbiological contamination between source and point of use (200).

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Trop Med Int Health. 9:106–117.
Yapi RB, Hürlimann E, Houngbedji CA, Ndri PB, Silué KD, Soro G, Kouamé FN, Vounatsou P, Fürst T, N'Goran EK, Utzinger J, Raso G (2014). Infection and co-infection with helminths and Plasmodium among school children in Côte d'Ivoire: results from a National Cross-Sectional Survey. PLoSNegl Trop Dis 2014. 8(6) e2913.
Zida A, Sangaré I, Bamba S, Sombié I, Traoré LK, Coulibaly SO, Menan H, Guiguemdé T (2014). [Intestinal parasites in prisoners in Ouagadougou (Burkina Faso)] Med Sante Trop. 24: 383-7.

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