

Original Research Article

Prevalence of Intestinal Protozoan Infections and the Associated Risk Factors among Children in Bushenyi District, Western Uganda

ABSTRACT

Aims: To determine the prevalence of intestinal protozoan infections and the associated risk factors in children.

Study design: A cross sectional study.

Place and Duration of Study: The study was conducted in four selected health facilities in Bushenyi District, Western Uganda, between June 2016 and January 2017.

Methodology: A total of 200 children aged 1-4 years were enrolled. Stool samples were collected and analyzed according to the established standard methods.

Results: Of the 200 children enrolled, 73(36.5%) had intestinal protozoan infections. The prevalence of *Giardialambliawas* the highest (16%) followed by *Entamoebahistolytica*(13%) compared to *Cryptosporidium* spp(4%) and *Cyclosporaspp*(3.5%). The highest prevalence was in the age group 1-4 years (26.8%, OR; 2.601, $P = .015$), mothers with no formal education (44.4%, OR; 3.240, $P = .002$) and those with primary level education (23.5%, OR; 1.812, $P = .027$) were significantly associated with intestinal protozoan infections. There was no significant difference in the prevalence of infections between the females (22.3%) and males (16.5%).

Conclusion: The overall prevalence of intestinal protozoan infections was 73(36.5%), *G. lamblia*(16%) was the most prevalent intestinal protozoan infection in the study. The intestinal protozoan infections were most prevalent among children aged 1-4 years whose mothers had no formal education. Prevention strategies need to be tailored to the respective levels of education.

Keywords: Protozoan, Infections, Association, *Goardialambliia*, Bushenyi District

1. INTRODUCTION

Intestinal protozoan infections (IPIs) are common among children resulting in considerable malabsorption syndromes, gastrointestinal morbidity and mortality especially in developing countries[1,2]. It is estimated that *E. histolytica*, the etiological agent of amoebiasis, kills between 40000 and 100000 people per year hence considered one of the deadliest parasitic infections worldwide[2,3]. *Cryptosporidium* spp. is, primarily affecting immunocompromised patients like HIV/AIDS patients[3,4]. Lack of access to clean water, poor sanitation and hygiene are strong risk factors for IPIs[2]. Establishing the prevalence of IPIs in communities is essential for prioritizing public health interventions[5,6,7]. Since the diagnosis of IPIs in low income countries is usually limited, data on the prevalence rates is scarce. In addition, the risk factors for the IPIs in sub-Saharan Africa are heterogeneous [2,8]. Therefore, this study aimed at determining the prevalence of IPIs and the associated risk factors with among children in Bushenyi District, Western Uganda.

2. MATERIAL AND METHODS

2.1 Study Design

A cross sectional study was carried out in four selected health facilities (Ishaka Adventist Hospital, Comboni Hospital, Bushenyi Health Centre IV and Kyabugimbi Health Centre IV) in Bushenyi District, Western Uganda between June 2016 and January 2017.

2.1.1 Inclusion criteria

The study included children aged 1 -12 years attending out-and-in patient clinics, who were confirmed to have intestinal protozoan infections signs and symptoms by the attending Clinician. Children with no history of treatment for intestinal parasites in the last two weeks and those who consented and assented to participate in the study.

2.1.2 Exclusion criteria

The study excluded the severely sick children that warranted admission in the Hospitals and Health facilities in the study area, those with history of treatment for intestinal parasites in the last two weeks and didn't consent to participate in the study.

2.1.3 Consent and counseling

A written consent was sought from the patients who satisfied the inclusion criteria. The Self-administered questionnaire and interview guide was carried out to capture demographic data, predicting factors for intestinal protozoan infections, and counseling for specimen collection. The study subject was then sent for specimen collection and the results were kept confidential.

2.1.4 Sample size

Two hundred (200) stool samples were collected from in-and-out patients with the help of trained nursing staff. The sample size (n) was calculated using the standard formula,

$$n = \frac{Z^2 \alpha P Q}{L} [9]$$

When n = sample size; Z_{α} = Level of significance (1.96) for confidence interval of 95%; P = Estimated prevalence (26%) [7]; and L = Desired precision or allowable error = 5% (0.05) $Q = (1 - P)$.

2.1.5 Collection of stool samples

All participants (parents/guardians of children) were given clear standard procedures prior to sample collection which stated the right sample, source, container, amount, how to collect and all necessary precautions necessary to avoid sample contamination. A stool sample container was given to participants and then given laboratory numbers for easy identification during sample processing and analysis. The samples were then transported on ice to the laboratory for standard parasitological analysis. The patients' biodata such as age, sex, and clinical history were recorded at the time of sampling.

2.2 Detection of Intestinal Protozoans

The stool samples were processed and analyzed immediately after collection by direct smear microscopy using normal saline and iodine wet preparations to detect trophozoites of *E. histolytica* and *G. lamblia* [10]. Concentration methods (i.e. Formalin-ether, saturated sodium chloride, and Sodium acetate-acetic acid formalin (SAF)) were used to detect cysts of *E. histolytica* and *G. lamblia*; oocysts of *Isosporabeli* and *Cyclospora cayentensis* [10,11]. The Modified ZeihlNeelsen (ZN) was used to detect oocysts of *Cryptosporidium* spp. in stool samples following the procedure previously described by [12]

2.3 Data Analysis

The data obtained from the participants was recorded in a field book, then entered into computer MS Excel which was exported to SPSS-16 software for analysis. Bivariate and Multivariate analysis was performed to obtain descriptive statistics for the prevalence of infections and association of risk factors using the Chi-square tests at 95% confidence interval.

3. RESULTS

3.1 Socio-demographic Characteristics of Respondents

A total of 200 children aged 1 -12 years were enrolled in this study and grouped into four age groups. The largest category was 1-4 years, 112 (56.0%) and the least was <1 year, 20 (10%). Out of the enrollees, 103 (51.5%) children were females and 97 (48.5%) males. Most of the children drank water from boreholes (41%) and taps (40%) while few consumed both pond water (10%) and tank water (9%). The largest percentage of the mothers had attained at most primary education level (45.5%) compared to those who had attained the University level (2%).

3.2 Prevalence of Intestinal Protozoa Infections

A total of 73 children (36.5%) had intestinal protozoa infections from various parasites including *Giardia lamblia* which was the most prevalent (16%) while *Cyclospora* spp was the least prevalent (3.5%). Of the 200 children, 14 (7%) had double protozoa co-infections and 2 (1%) had triple protozoa co-infections. Double infections of *G. lamblia* and *E. histolytica* (4%) were the most prevalent as showed in table 1 below.

Table1. Prevalence of intestinal protozoan infections

Protozoa	Prevalence (%)
Single infection	
<i>G. lamblia</i>	16
<i>E. histolytica</i>	13
<i>Cryptosporidium</i> spp	4
<i>Cyclosporaspp</i>	3.5
Total	36.5
Double infections	
<i>G. lamblia</i> + <i>E. histolytica</i>	4
<i>G. lamblia</i> + <i>Cyclosporaspp</i>	1
<i>E. histolytica</i> + <i>Cryptosporidium</i> spp	1
<i>E. histolytica</i> + <i>Cyclosporaspp</i>	0.5
<i>Cryptosporidium</i> spp+ <i>Cyclosporaspp</i>	0.5
Total	7
Tripleinfections	
<i>G. lamblia</i> + <i>E. histolytica</i> + <i>Cryptosporidium</i> spp	0.5
<i>E. histolytica</i> + <i>Cryptosporidium</i> spp+ <i>Cyclosporaspp</i>	0.5
Total	1

3.3 Risk Factors Associated with Intestinal Protozoa Infection among Children

From the Person's Chi- square tests, age ($P = .022$) and education level($P = .013$) were the factors statistically significantly associated with intestinal protozoa infections among children in the study area. Children aged between 1 to 4 years had the highest prevalence (26.8%), followed by those aged 9 to 12 years (15.2%) and least infected were aged 5 to 8 years old (5.7%). The children whose mothers had no formal education level (44.4%) were more prone to infections, followed by those with primary education level (23.5%) and least were those whose mothers had tertiary education level (6.9%). More females (22.3%) had infections compared to the males (16.5%).Interestingly a larger number of children with protozoa infections used borehole water (25.6%) as illustrated in table 2 below.

Table 2: Association between socio-demographic characteristics with single protozoan infections in children

Variable	Number of Respondents n (%)	Positive n (%)	p-value	95% CI
Age group (years)				
Less than 1	20(10%)	2(10.0%)	.022*	0.019-0.025
1-4	112(56.0%)	30(26.8%)		
5-8	35(17.5%)	2(5.7%)		
9-12	33(16.5%)	5(15.2%)		
Gender				
Female	103(51.5%)	23(22.3%)	.372	0.345-0.386
Male	97(48.5%)	16(16.5%)		
Education level of mother				
No education	18(9.0%)	8(44.4%)	.013*	0.011-0.015
Primary	85(42.5%)	20(23.5%)		
Secondary	64(32.0%)	8(12.5%)		
Tertiary	29(15.5%)	2(6.9%)		
University	4(2.0%)	1(25.0%)		
Source of drinking water				
Borehole	82(41.0%)	21(25.6%)	.342	0.333-0.351
Tap	80(40.0%)	12(15.0%)		
Tank	18(9.0%)	3(16.7%)		
Pond	20(10.0%)	3(15.0%)		
Total	200 (100%)			

*Statistically significant factors influencing protozoa infections prevalence at 95% level of confidence ($P \leq .05$).

In order to obtain the significant risk factors of the infection, binary logistic regression analysis (Odds ratios) was further done on age groups and education level of mother since they had a $P \leq .05$ in the bivariate analysis. The model used best fit the data ($P = .817$) and 81.5% of the children with protozoa infections were correctly classified. Children aged between 1 to 4 year had a 2.6 times likelihood of being infected with intestinal protozoa compared to those aged below 1 year holding other factors constant. This relationship was statistically significant ($P < .05$, CI : .001 - .024). The mothers who had attained primary education ($OR = 1.812$, $P < .05$, CI : .006 - .046) and no education level ($OR = 3.240$, $P < .05$, CI : .000 - .012) were also statistically significant predisposing risk factors for protozoa infections when other factors were held constant as shown in table 3 below.

Table 3: Binary logistic regression analysis for risk factors associated with intestinal protozoa infections

Variable	Odds ratio	P-value	95% CI
Age (years)			
1-4	2.601	.015*	0.001-0.024
5-8	0.513	.064	0.048-1.113
9-12	1.017	.058	0.021-1.104
Education level of mother			
No education	3.240	.002*	0.000-0.012
Primary	1.812	.027*	0.006-0.046
Tertiary	0.137	.476	0.082-0.349
University	0.411	.475	0.156-0.789

*Statistically significant risk factors associated with protozoa infections at 95% level of confidence ($p \leq .05$).

4. DISCUSSION

Worldwide, Intestinal Protozoal Infections (IPIs) have been recognized as one of the most significant causes of illnesses[13]. It is estimated that IPIs result in 450 million illnesses with an average prevalence rate of 50% in developed world, and almost 95% in developing countries[14]. These infections are ubiquitous and highly prevalent among the poor and socioeconomically deprived communities where overcrowding, poor environmental sanitation, low level of education and lack of access to safe water like in Uganda[15].

In this study we report an overall prevalence of 73(36.5%) IPIs among children aged 1-12 years of upcountry study area. This was in agreement with the most previous studies on IPIs, 36% in South-Eastern Nigeria, 35% in Saudi Arabia and 34.2% in Northwest Ethiopia[16,17,18]. However, the prevalence was higher in comparison to similar previous studies carried out in other parts of Uganda (20.9%), Nepal (19.8%), Nigeria (27.6%), and Saudi Arabia (27.8%)[13,20-23]. Nevertheless, we report a lower prevalence than the other reported studies from South Africa(64.8%), Pakistan (52%), GondamAzezo (72.9%) and Ethiopia (83.8%)[15,24-26]. The lower prevalence obtained in the present study compared to other related studies could probably be explained by the Health sector's periodic campaign for anti-protozoa drug administration, health education given by different LNGOs, INGOs to school children in Uganda[27].

The prevalence of *G. lamblia* infections among children was higher than other protozoa; *E. histolytica*, *Cryptosporidium* spp and *Cyclospora*spp which was in agreement with similar previous studies[20,21]. Our study showed 16% prevalence of *G. lamblia* infections which is in agreement with the previous studies conducted in Uganda 12% and 15.4% respectively[7,20]. However, our prevalence was higher than that obtained in a similar study conducted in Nigeria (1.3%)[28]. This could be due to the respective differences in levels of education, social economic status and implementation of the government public health policies.

The prevalence of *E. histolytica* (13%) single infections were slightly related to 10.0% infection rate reported among school going children elsewhere in Uganda[7]. However, the prevalence in our study was higher than that obtained in Uganda 2.5%, in Ethiopia 8% and in Ghaziabad, India 9.2%[13,18,20]. This is evidence that the risk factors are heterogeneous and vary from community to community. There were low levels of *Cryptosporidium*spp (4%) and *Cyclospora*spp (3.5%) infections of which the latter was slightly higher than 2.0% prevalence reported among children in Tanzania[27]. The prevalence of double and triple protozoan infections was 7.0% and 1% respectively which was in agreement with related studies

conducted by[29], who reported 5.7% (double infection) and 0.7% (triple infections) respectively. However, the double infections obtained were contrarily higher than 2.6% reported by[18], but the same study reported a higher prevalence of triple infections (2%) compared to that reported in this study. This is because the single infections of *E. histolytica* and *G. lamblia* were far higher compared to others in our study. Secondly, the degree of co-infections seems to be proportional to the degree of the respective single infections.

The children's age group was statistically significant ($P < .05$) with higher infections among those aged 1-4 years (26.8%) which was in agreement with the previous study in Uganda (26.0%)[7]. This age group was statistically significant predisposing factor to sources of protozoa infections because of the levels of engagement and activities characteristic of the age group ($OR = 2.601$, $P < .05$)[20]. However, this was contrary to the reported among Mexican children (20.0%) [27].

In this study, protozoan infections were higher in females (22.3%) compared to males (16.5%). This was in agreement with other study findings from Nepal reporting a prevalence of 22.0% and 16.9% in both girls and boys respectively[21]. However, in a study conducted in Malaysia, a higher infection rate of protozoa between male (73%) and female (73.3%) was reported compared to the present study[30]. According to [13], reported a lower infection rate in females (18.6%) and higher in males (18.4%). This indicates that the gender of children may or may not play a role in parasitosis depending on the region and other environmental or behavioral factors due to the reported statistical insignificance in these related studies[13]. It has been reported that the increased mobility and use of swampy ponds by the male increases their risk of infection while female have more soil contact during growing vegetables and eat raw vegetable with prepared food more often than males. Furthermore, infections among the males could probably be due to engagement in predisposing activities such as football, barefoot and playing in streams[28].

The findings of this study indicate that the prevalence of IPIs were significantly ($P < .05$) higher in children whose mothers had no formal education (44.4%) and primary level (23.5%) compared to other higher education levels. This was in agreement to studies conducted in Iraq, and in Northwest Ethiopia[18,24,29,31]. Therefore, parents' education level equipped them with knowledge about the necessary preventative precautions to guide their children accordingly.

The source of drinking water was insignificantly ($P > .05$) associated with the protozoan infections although higher prevalence were obtained for children who had drunk unboiled water from boreholes (25.6%), tank (16.7%), tap (15.0%) and ponds (15.0%). Similarly, related studies also showed the higher rate of infection among children who had drunk such untreated water than those who boiled drinking water[13,30,31]. However, this was contrary to related studies which reported higher infections (66.7%) with usage of unboiled tap water[15,32]. This high prevalence may be due to contamination of municipal water supplies with human waste, poor quality of water, faulty of sewage line and insufficient level of chlorine. Multiple studies have addressed the risk factors and the prevalence of parasitic infestation among children in developing countries as a result of poor sanitary conditions in the homes, peridomestic conditions like waste disposal methods, garbage disposal systems, number of children in the household, number of persons per latrine and source of water supply, food contamination by food handlers and by the use of sewage water for irrigation of crops are factors in protozoan epidemiology[27]. Nevertheless, the level of education of the care takers has not been prominent as an equally important risk factor.

5. CONCLUSION

The overall prevalence of intestinal protozoan infections was 73(36.5%), *G. lamblia*(10.5%) was the most common prevalent intestinal protozoan in the study. The intestinal protozoan infections were most associated among children aged 1-4 years and 9-12 years whose mothers were not educated and those with primary education.

Therefore, the Ugandan health sector should invest in education and sensitization of caretakers about these infections and the necessary preventive measures against intestinal protozoan infections. With the high prevalence of the intestinal protozoan infections detected in this study, there is need to carry out country wide survey to establish the overall burden of protozoan infections.

CONSENT

All authors declare that 'written informed consent was obtained from the patient. A copy of the written consent is available for review by the Editorial office/Chief Editor/Editorial Board members of this journal.

ETHICAL APPROVAL

The ethical approval of the study was sought from Kampala International University (KIU), institutional research and ethics committee (IREC) on human research, and Uganda National Council for Science and Technology (UNCST). All experiments were examined and approved by the appropriate ethics committees and performed in accordance with the ethical standards of the committees on human experimentation laid down in the Helsinki declaration of 1975 as revised in 2000.

REFERENCES

1. Feng Y, and Xiao L. Zoonotic potential and molecular epidemiology of Giardia species and Giardiasis. *CinMicrobiol Rev.* 2011; **24**:110-140.
2. Speich B, Marti H, Ame SM, Ali SM, Bogoch II, Utzinger J, Albonico M, Keiser J. Prevalence of intestinal protozoan infections among school-aged children on Pemba Island, Tanzania, and effect of single-dose albendazole, nitazoxanide and albendazole-nitazoxanide. *Parasites & Vectors.* 2013; **6**:3.
3. Lozano R, Naghavi M, Foreman K, Lim S, Shibuya K, Aboyans V, Abraham J, Adair T, Aggarwal R, Ahn SY, *et al.* Global and regional mortality from 235 causes of death for 20 age groups in 1990 and 2010: a systematic analysis for the Global Burden Diseases study 2010. *Lancet* 2012; **380**:2095-2128.
4. Jex AR, Smith HV, Nolan MJ, Campbell BE, Young ND, Cantacessi C, Gasser RB. Cryptic parasite revealed improved prospects of treatment and control human Cryptosporidiosis through advanced technologies. *AdvParasitol.* 2011; **77**:141-173.
5. Outtara M, N'Guessan N, Yapi A, N'Goran E. Prevalence and spatial distribution of *Entamoebahistolytica/dispar* and *Giadialamblia* among school children in Agboville area (Cote d'Ivoire). *PLoS Negl Trop Dis.* 2010; **4**:e574.
6. Matthys B, Bobieva M, Karimova G, Mengliboeva Z, Jean-Richard V, Hoimnazarova Z, *et al.* Prevalence and risk factors of helminths and intestinal protozoa infections among children from primary schools in Western Tajikistan. *Parasit Vectors.* 2011; **4**:195.
7. McElligott JT, Naaktgeboren C, Makuma-Massa H, Summer AP, Deal JL. Prevalence of intestinal protozoa in communities along the Lake Victoria region of Uganda. *International Journal of Infectious Diseases*, 2013;**17(8)**: e658-e659.
8. Alyousefi NA, Mahdy MAK, Mahmud R, Lim YAL. Factors associated with high prevalence of intestinal protozoan infections among patients in Sana'a City, Yemen. *PLoS ONE.* 2011; **6(7)**:e22044.

9. Martin SW, Meek AH, and Willeberg P. Veterinary Epidemiology. *Principles and Methods*. Iowa State University Press, Ames, Iowa. 1987; 343 pp.
10. Utzinger J, Botero-Kleiven S, Castelli F, Chiodini PL, Edwards H, Kohler N, Gulletta M, Lebbad M, Menser M, Matthys B, *et al*. Microscopic diagnosis of sodium acetate-acetic acid-formalin fixed stool samples for helminths and intestinal protozoa: a comparison among European reference laboratories. *ClinMicrobiol Infect*. 2010; **16**: 267-273.
11. Marti H, Escher E. SAF-an alternative fixation for parasitological stool specimens. *Schweiz Med Wochenschr*. 1990; **120**:1473-1476.
12. Garcia LS. Practical guide to diagnostic parasitology. *ASM Press Washington DC*; 1999.
13. Sah RB, Paudel I, Baral R, Poudel P, Jha N, Pokharel P. A Study of Prevalence of Intestinal Protozoan Infections and Associated Risk Factors among the School Children of Itahari, Eastern Region of Nepal. *Journal of Chitwan Medical College*, 2013; **3**(1): 32-36.
14. WHO. Control of Tropical Diseases. Geneva: World Health Organization 1998.
15. Mehraj V, Hatcher J, Akhtar S, Rafique G, Beg MA. Prevalence and factors associated with intestinal parasitic infection among children in an urban slum of Karachi. *PLoS One*, 2008; **3**(11), e3680.
16. Oguoma VM, Anyasodor AE, and Mbata TI. Prevalence of intestinal protozoan parasites among children aged 5-12 years in Owerri metropolis, South-Eastern Nigeria. *Tropical Journal of Health Sciences*; 2008; **15**(2): 43-48
17. Hawash YA, Dorgham LS, Amir EAM, and Sharaf OF. Prevalence of intestinal protozoa among Saudi patients with chronic renal failure: a case–control study.” *Journal of tropical medicine*, 2015; Volume 2015, Article ID 563478.
18. GelawA,Anagawa B, NigussieB,Silesh B, Yirrga A, Alem M, Endris M, and Gelaw B. Prevalence of intestinal parasitic infections and risk factors among schoolchildren at the University of Gondar Community School Northwest Ethiopia: a cross-sectional study. *BCM public health*, 2013; **13**(1): 304.
19. Kiros H, Nibret E, Munshea A, Kerisew B, Adal M. Prevalence of intestinal protozoan infections among individuals living with HIV/AIDS at Felegehiwot Referral Hospital, Bahir Dar, Ethiopia. *International Journal of Infectious Infectious Diseases*, 2015; **35**:80-86.
20. Buzigi E. Prevalence of Intestinal Parasites, and its Association with Severe Acute Malnutrition Related Diarrhoea. *Journal Biology Agriculture and Healthcare*, 2015; **5**(2).
21. Mukhiya RK, Rai SK, Karki AB, and Prajapati A. Intestinal protozoan parasitic infection among school children. *Journal of Nepal Health Research Council*; 2012; **10**(22):204-7.
22. Wellington O, Chika O, Teslim O, Oladipo O, Adetayo F and Godswill I. Cryptosporidium and other intestinal protozoans in children with Diarrhoea in lagoos, Nigeria. *Internet J Trop med*; 2008; **5**(2).
23. Akhter J, Markley Burdette J, Hussain Q. Aetiology of gastroenteritis at a major referral centre in Saudi Arabia. *Journal of International Medical Research* 1994; **22**: 47-54.
24. Nxasana N, Vasaikar SD, Longo-Mbenza B, Apalata T. Epidemiology of Intestinal Parasites among School Children in Mthatha, South Africa. *J Innov. Res. Health Sc. Biotech*. 2015; **1**(1): 25-30.
25. Idris NS, Dwipoerwantoro PG, Kurniawan A, Said M. Intestinal parasitic infection of immunocompromised children with diarrhoea: clinical profile and therapeutic response. *The Journal of Infection in Developing Countries*, 2010; **4**(05): 309-317.
26. Legesse M, Erko B. Prevalence of intestinal parasites among school children in a rural area close to the southeast of Lake Langano, Ethiopia. *Ethiopian Journal of Health Development*, 2004; **18**(2): 116-120.
27. Miguel M, Cabada MD. Intestinal Protozoa of Relevance Giardia, Cryptosporidium, and Cyclospora. Prepared as part of an education project of the Global Health Education Consortium and collaborating partners. 2007.
28. Houmsou RS, Kela SL, Suleiman MM, Ogidi JA. Endemicity and intensity of vesical schistosomiasis: epidemiological profile of two Local Government Areas of Benue State-Nigeria. *Internet J Health*; 2009; **9**(2): 11.

- 319 29. Okyay P, Ertug S, Gultekin,B, Onen O, and Beser E. Intestinal parasites prevalence and related
320 factors in school children, a western city Sample-Turkey. BMC public health, 2004; **4**(1): 64.
- 321 30. Ngui R, Ishak S, Chuen CS, Mahmud R, Lim YA. Prevalence and risk factors of intestinal parasitism
322 in rural and remote West Malaysia. *PloSNegl Trop Dis*, 2011; **5**(3),e974.
- 323 31. Hussein TK. Prevalence and related risk factors for *Giardialambli*a infection among children with
324 acute diarrhoea in Thi-Qar, Southern Iraq. *Thi-Qar Medical Journal* 2010; **4**(4): 68-74.
- 325 32. Mbae CK, Nokes DJ, Mulinge E, Nyambura J, Waruru, A and Karuiki S. Intestinal parasitic infections
326 in children presenting with diarrhoea in outpatient and inpatient setting in an informal settlement of
327 Nairobi, Kenya. BMC infectious diseases, 2013; **13**(1): 243.