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SOIL-TRANSMITTED HELMINTHS CO-INFECTED WITH *SCHISTOSOMA* IN FLOOD-PLAIN COMMUNITIES, SOUTHERN, NIGERIA

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Abstract

This study evaluated the soil transmitted helminths (STH) and *Schistosoma* co-infection and its epidemiological factors in flood subjected communities. Fecal samples from 672 consented individuals between 5-24 years in Aviara, Igbide, Otor-Owhe and Owhelogbo community were examined using Kato-Katz technique and questionnaires. Of 672 samples, 434(64.58%) were infected with STHs and *Schistosoma mansoni* co-infections. The parasites in a descending were *Ascaris lumbricoides* (56.40%), *Trichuris trichiura* (54.32%), hookworm (38.69%) and *S. mansoni* (7.59%), with significant differences. Female 325 (48.36%) were more infected than male 317(47.17%). But, among all communities, there was no significant difference in gender prevalence. The general prevalence correlated to infection intensity. Ages of 5-9 years old were more vulnerable to STHs infections. Helminthes was not significant ($p<0.05$) with age of children except *A. lumbricoides* which significantly different with age (t = 5.16, 95% CI = 5.44 and 60.12, P = 0.036). Age-community prevalence accounted for <0.1% of total variance (P = 0.859, F = 0.033). Effect of toilet type, toilet paper and washing of hands after defecation was significant (P<0.05). ANOVA showed a strong significant impact (p<0.005) in maternal educational and water source in each community. This study revealed that STH and intestinal schistosomiasis were highly prevalent among children of 5-14 years. There is need for prompt wash and mass drug administration (MDA) to reduce prevalence/intensity and morbidity in the study area

Keywords: Isoko, NTDs, geohelminths, bilharziasis, coinfections

Introduction

Soil transmitted helminths (STHs) and *S. mansoni* infections are group of Neglected Tropical Diseases (NTDS) with chronic, debilitating and severe conditions that occur in tropical and subtropical countries (Ito and Egwunyenga, 2017), particularly in underdeveloped countries (Ito, 2019).

Helminthes are transmitted by contact soil or water, feca-oral or walking barefoot (Taiwo *et al,* 2017), with great impact on the human and animal health (Östan *et al,* 2007), mainly schistosomiasis (Ito and Egwunyenga, 2015). Infections children were more severe (Hotez *et al*., 2004).

More than 1.5 billion people or 24% of the world population are infected with STHs (WHO, 2022), and Over 500 million people in sub-Saharan Africa heminthes wre second to malaria in particular Nigeria (Ito and Utebor, 2023). Treatments are anthelminthic drugs (Ito and Egwunyenga, 2017).

This study aimed to evaluate helminthic infections in Delta State, Nigeria (Aviara, Igbide, Otor-Owhe & Owhelogbo) to be on control helminthes by with 2030.

Materials and Methods

The study area is Isoko South and North Local Government Area, Delta State, which fall within the ever-green tropical rain forest belt of Niger-Delta Southern Nigeria. This investigation was conducted in Aviara (latitude 5.42 & longitude 6.25), Igbide (Lat. 5.37 & Long. 6.15) (Isoko South) and Otor-Owhe (Lat. 5.56 & Long. 6.16) and Owhelogbo (Lat. 5.60 & Long. 6.18) in Isoko North, faceing wet season (April to October) and dry one (November to March). Isoko is densely populated, with approximately 300 people/km^2 compared with the average of 198 for Delta State and 130 for Nigeria without definitive population numbers, The available one of 2006 population census (Aviara= 18,823, Igbide= 10,224, Owelog bo= 13,200 and Otor-Owhe= 9,500), nowadays were controversial and unsupportable (Ito, 2019).

Subjects and Ethical Permission: A total of

672of both sexes aged 5-24years were randomly selected from July-September 2021. A total of 154, 181, 208 & 129 fecal samples were obtained from these areas respectively after permissions from community head/kings and Ethical committee, Delta State Asaba Ministry of Health.

Samples collection for parasitological examinations, and questionnaires adopted for demographic information. Morning fecal samples were microscopically by direct smears and flotation stained if indicated and eggs number (EPG) were counted intensity following recommendation by WHO

Statistical analysis: Data were subjected to statistical analysis using Instate Graph pad software Incorporation San Digeo, USA for windows and significant difference between variables were tested using ANOVA and chi square at 5% level of significance.

Results

Of 672 (317 males & 325 females), 434 were infected with at least one parasite/*S. mansoni*.

Details are given in tables (1, 2, 3, 4, 5 & 6) and Figures (1 & 2).

Table 1: General prevalence of soil-transmitted helminths by species in four communities

Communities	Overall	Overall	*A. lumbricoides*	*Hookworm*	*T. trichiura*	*S. mansoni*
	No. examined	No. infected (%)	No. infected (%)	No. infected (%)	No. infected (%)	No. infected (%)
Aviara	154	98 (63.64)	85 (55.19)	65 (42.21)	79 (51.30)	9 (5.84)
Igbide	181	110 (60.77)	98 (54.14)	55 (30.39)	97 (53.59)	27 (14.92)
Otor-Owhe	208	149 (71.63)	131 (62.98)	89 (42.79)	122 (58.65)	14 (6.73)
Owhelogbo	129	77 (59.69)	65 (50.39)	51 (39.53)	67 (51.94)	1 (0.78)

Males had a prevalence of 47.17%, lower than 48.36% recorded for the females. Relative to gender and communities, males and females in Otor-Owhe had the highest prevalence of 72.97 and 70.10% respectively, without significant difference (p>0.05) in male and female prevalence (F = 0.12. P = 0.75). They accounted for 0.11% of the total variance; was 75% chance of randomly but without significant.

Table 2: Helminths infection among males and females

	Aviara	Igbide	Otor-Owhe	Owhelogbo
Gender	No. infected (%)	No. infected (%)	No. infected (%)	No. infected (%)
Males	42 (64.62)	43 (51.81)	81 (72.97)	32 (55.17)
Females	56 (62.92)	47 (68.37)	68 (70.10)	45 (63.38)
Totals	98 (63.64)	110 (60.77)	149 (71.63)	77 (59.69)

Ascaris gave 36,384%, then *T. trichiura* (33,168), hookworm (21,216) and *S. mansoni* (4296).

Table 3: Prevalence and intensity of Selected STHs and *S. mansoni* co-infection

Parasites	No. infected (%)	No. of eggs/slide	Mean egg/gram	Intensity
A. lumbricoides	379 (56.40)	1516	96.00	36384
Hookworm	260 (38.69)	884	81.60	21216
T. Trichinura	365 (54.32)	1382	90.87	33168
S. mansoni	51 (07.59)	179	84.23	4296

Age 5-9 years were 72.67%, least was 45.59% among 20-24 with significant differences

Table 4: Helminthes infection by ages

Age (years)	Subjects	Number infected	Positive %
5-9	300	218	72.67
10-14	181	115	63.54
15-19	123	70	56.91
20-24	68	31	45.59
Total	672	434	64.58

A. lumbricoides was (77.27%) in Aviara for age 5-9 years, Igbide (59.49%) and Owhelogbo (60.78%) but was Otor-Owhe (77.88%). *T.trichiura* was (65.15%), hookworm was (54.54%), without *S. mansoni*. *A. lumbricoides* and *T. trichiura* were low prevalence of 43.59%, followed by 53.85, 59.09 and 64.41% respectively with significant difference (p<0.05, t= 3.27, P= 0.047, 95% CI = 0.36& 26.38) without significant (P>*0.05*)

Table 5: Prevalence of helminthes by species and community among school-age children

Communities	Ages years	Infected No. (%)	*A. lumbricoides*	Hookworm	*T. trichiura*	*S. mansoni*
			No. infected (%)	No. infected (%)	No. infected (%)	No. infected (%)
Aviara	5-9	51(77.27)	45 (68.18)	36 (54.54)	43 (65.15)	0 (0.00)
	10-14	24 (61.54)	19 (48.72)	14 (35.89)	17 (43.59)	6 (15.38)
	15-19	17 (54.84)	15 (48.38)	11 (35.48)	12 (38.71)	3 (9.68)
	20-24	6 (33.33)	6 (33.33)	4 (22.22)	7 (38.89)	0 (0.00)
Igbide	10-14	49 (62.03)	47 (59.49)	31 (39.24)	46 (58.23)	0 (0.00)
	15-19	27 (61.39)	26 (59.09)	13 (29.55)	26 (59.09)	11 (25.00)
	20-24	23 (58.97)	17 (43.59)	9 (23.08)	19 (48.72)	15 (38.46)
	10-14	11 (57.89)	8 (42.11)	2 (10.53)	6 (31.58)	1 (5.26)
Otor-Owhe	5-9	81 (77.88)	81 (77.88)	59 (56.73)	67 (64.42)	0 (0.00)
	10-14	42 (71.19)	35 (59.32)	22 (37.29)	38 (64.41)	13 (22.03)
	15-19	19 (61.29)	11 (35.48)	5 (16.13)	11 (35.48)	0 (0.00)
	20-24	7 (50.00)	4 (28.57)	3 (21.43)	6 (42.86)	1 (7.14)
Owhelogbo	5-9	37 (72.55)	31 (60.78)	22 (43.14)	33 (64.71)	0 (0.00)
	10-14	22 (56.41)	17 (43.59)	19 (48.72)	21 (53.85)	1 (2.56)
	15-19	11 (50.00)	10 (45.45)	7 (31.82)	9 (40.91)	0 (0.00)
	20-24	7 (41.18)	7 (41.18)	3 (17.65)	4 (23.53)	0 (0.00)

There was significant difference (F=9.083; P = 0.015) between toilets with 1.5% chance ($p< 0.05$), with prevalence of 33.75%. Significant difference ($p<0.05$) was between helminthes and toilet type.

Toilet paper was 32.79% (F = 7.09, P = 0.0263), with 2.6% chance ($p<0.05$) that differed between subjects with or without hand-washing and helminthes infections ($X^2= 2.679$, $p = 0.44$).

Table 6: Some risk factors and prevalence associated with helminthes infection

Risk factors	Parasites	Aviara	Igbide	Otor-Owhe	Owhelogbo
		No. infected (%)	No. infected (%)	No. infected (%)	No. infected (%)
Toilet: Water closet	*A. lumbricoides*	26 (53.06)	14 (35.90)	21 (48.84)	9 (33.33)
	T. trichiura	21 (42.86)	16 (41.03)	19 (44.19)	11 (40.74)
	Hookworm	15 (30.61)	7 (17.95)	13 (30.23)	10 (37.04)
	Schistosomiasis	0 (0.00)	3 (7.69)	1 (2.33)	0 (0.00)
Toilet: Pit latrines	*A. lumbricoides*	36 (57.14)	31 (52.54)	43 (63.24)	38 (53.52)
	T. trichiura	32 (50.79)	35 (59.32)	35 (51.47)	32 (45.07)
	Hookworm	34 (53.97)	19 (3220)	29 (42.65)	27 (38.03)
	Schistosomiasis	1 (1.59)	7 (11.86)	4 (5.88)	0 (0.00)
Toilet: Nearby bush	*A. lumbricoides*	23 (54.76)	53 (63.86)	67 (69.07)	18 (58.06)
	T. trichiura	26 (61.90)	46 (56.10)	68 (70.10)	24 (77.42)
	Hookworm	16 (38.10)	29 (34.94)	47 (48.45)	14 (45.16)
	Schistosomiasis	8 (19.05)	17 (20.48)	9 (9.28)	1 (3.23)
Toilet paper: Always	*A. lumbricoides*	13 (39.39)	19 (46.34)	9 (42.86)	7 (25.93)
	T. trichiura	13 (39.39)	16 (39.02)	9 (42.86)	10 (37.04)
	Hookworm	9 (27.27)	3 (7.32)	6 (28.57)	8 (37.04)
	Schistosomiasis	0 (0.00)	0 (0.00)	0 (0.00)	1 (3.70)
Toilet paper: Sometimes	*A. lumbricoides*	41 (64.06)	44(50.57)	47 (63.51)	19 (48.72)
	T. trichiura	34 (53.13)	49(56.32)	40 (54.05)	21 (53.85)
	Hookworm	24 (37.50)	24(27.59)	26 (35.14)	21 (53.85)
	Schistosomiasis	0 (0.00)	21 (24.14)	3 (4.05)	0 (0.00)
Toilet paper: Never	*A. lumbricoides*	31 (54.39)	35 (66.06)	75 (66.37)	39 (61.90)
	T. trichiura	32 (56.14)	32 (60.38)	73 (64.60)	36 (57.14)
	Hookworm	32 (56.14)	28 (52.83)	57 (50.44)	22 (34.92)
	Schistosomiasis	9 (15.79)	6 (11.32)	11 (9.73)	0 (0.00)
Handwash: Yes	*A. lumbricoides*	32 (61.18)	57 (55.34)	107 (58.15)	39 (81.25)
	T. trichiura	49 (57.65)	64 (62.14)	111 (60.33)	24 (50.00)
	Hookworm	39 (45.88)	23 (22.33)	81 (44.02)	29 (60.42)
	Schistosomiasis	7 (8.24)	19 (18.45)	11 (5.98)	1 (2.08)
No	*A. lumbricoides*	33 (47.83)	41 (52.56)	24 (100.00)	26 (32.10)
	T. trichiura	30(43.48)	33 (42.31)	11 (45.83)	43 (53.09)
	Hookworm	26 (37.68)	32 (41.03)	8 (33.33)	22 (27.16)
	Schistosomiasis	2 (2.90)	8 (10.26)	3 (12.50)	0 (0.00)

Discussion

This first current study showed the overall prevalence (64.58%) of helminthes distributed (Aviara (63.64), Igbide (60.77%), Otor-Owhe (71.63%) and Owhelogbo (59.69%). But, Ito and Egwunyenga, (2017) found a

rate of 84.83% in these areas except Aviara. This was higher than 20.9% (Goshu *et al*, 2021) and 18.1% (Zeynudin *et al,* 2022).

In the present study, among 5-9 years children *A. lumbricoides* was (56.4%), and *S. mansoni* was (7.59%). But, Pukuma *et al.* (2022) in Quetta reported 11.69% in 7-9 years children. High prevalence may be due the flooding seasonal, low socio-economy, poor sanitation, bad defecation habitat (Ito and Egwunyenga, 2023).

In the present study, the children growth deficits were attributed to STHs such as *A. lumbricoides, T. trichiura* and hookworms, which agreed with Sowemimo and Asaolu (2011) and Sam-Wobo *et al.* (*2012).* Winter *et al.* (2013) reported that the hook-worms infection was related to the child and caused nutritional iron intake. WHO (2002) reported that *A. lumbricoides, T. trichiura* and *S. manosi* infections with were highest in 5-14 years, but Ito and Egwunyenga (2017) reported a decline in frequency of these parasites in the adulthood. These floorings overflows latrine and causes the availability of hookworm and schistosome larval which penetrate hosts skin (Ito and Egwunyenga, 2015).

The present high rates of these parasites were due the water closet and latrines. Ito and Egwunyenga (2023) found that the high prevalence was due to poor sanitation, improper waste disposal, and walking barefoot. Hot climates rapidly maturate *A. lumbricoides* & *T. trichiura* eggs (van der Werf *et al,* 2013).

Behavioral aberrations such as eating with unwashed hands, nail biting, and thumb sucking have been postulated as risk factors that increases STHs and *S. mansoni* infection (Ito, 2014). These aberrations are most common in children and predispose them to heavy intensity of helminths infections (Idowu *et al,* 2022). Hand washing was a risk factor and the prevalence associated with it in this study are in agreement with Akinsanya *et al.,* (2021) who reported high prevalence among respondents who did not was hands after defecation.

The observations in this study are similar to findings in Côte d'Ivoire and Brazil were children with increasing infection intensity were coinfected with *S. mansoni* and hookworm (Keiser *et al,* 2002). The use of latrines does not always reduce hookworm transmission or prevalence. This was shown to be the case three decades ago in the Burma valley of Zimbabwe (Bradley, 1993). However, latrine facilities have been documented to reduce the prevalence of hookworm by 4% (Albonico *et al,* 1999).

Conclusion

STHs and schistosomes co-infections in post-COVID era were major public health problem mainly more among children. Infection severity in Delta State was increased with suitable environmental conditions; and bad health educations

The authors declared that they have neither competing interest and agreed in the paper publication

Recommendation

Real effort was made in a holistic manner in health improvement combining nutritional supplements, water improvement and sanitation, to help to achieve the SDG goals of reducing diseases among children

Large-scale use of anthelminthic is a must.

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References

Akinsanya B, Taiwo, A, Adedamola, M, Okonofua, C, 2021: An investigation on the epidemiology and risk factors associated with soil-transmitted helminth infections in Ijebu east local government area, Ogun St-ate, Nigeria. Sci. Afr. 12:e00757.

Albonico, M, Crompton, DW, Savoili, L, 1999: Control strategy for human intestinal nematode infections. Adv. Parasitol. 42: 277-341.

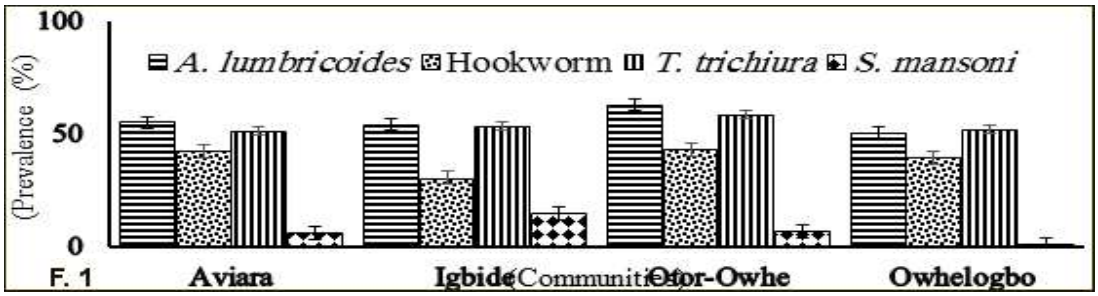
Bradley, M, Chandiwana, SK, Bundy DAP, 1993: The epidemiology and control of hookworm infection in the Burma Valley area of Zimba-

bwe. Trans. R. Soc. Trop. Med. Hyg. 87:145-7.
Dahal, AS, Francis, EO, Francis, JE, Wamtas, FI, 2019: Soil-transmitted helminths and associated risk factors among elementary school pupils in Dadin Kowa, Jos. Nig. Med. J. 60, 4:181-5.
Goshu, A, Alemu, G, Ayehu, A, 2021: Prevalence and intensity of soil-transmitted helminths and associated factors among adolescents and adults in Bibugn Woreda, Northwest Ethiopia: A community-based cross-sectional study. J. Trop. Med. 2021:Article ID 7043881. doi.org/10.1155/2021/7043881.
Hotez, PJ, Bethony, JM, Oliveira, SC, Brindley, PJ, Loukas, A, 2008: Multivalent anthelminthic vaccine to prevent hookworm and schistosomiasis. Expert. Rev. Vacc. 7:45-752.
Hotez, PJ, Brooker, S, Bethony, JM, Bottazzi, ME, Loukas, A, *et al,* 2004: Hookworm infection. New Engl. J. Med. 351:799-807.
Idowu, OA, Babalola, AS, Olapegba, T, 2022: Prevalence of soil-transmitted helminth infection among children under 2 years from urban and rural settings in Ogun State, Nigeria: Implication for control strategy. Egypt. Pediat. Assoc. Gaze. 70:5. doi.org/10.1186/s43054-021-00096-6.
Ito, EE, 2019: Hyper-endemicity of urinary schistosomiasis among school children in two communities in the Lower Niger-Delta, Nigeria. Nig. J. Parasitol. 40, 1:76-81,
Ito, EE, Egwunyenga AO, 2015: Schistosomiasis: The aftermath of 2012 floods in Delta State, Southern Nigeria. Intl. Med J. 22, 4:218-23.
Ito, EE, Egwunyenga AO, 2017: Soil-transmitted helminthiasis in Aviara Community: An observation from primary school children in Nigeria. Intl. Med. J. 24, 2:205-8.
Ito, EE, Utebor, EK, 2023: Anti-*Schistosoma* efficacy of *Occimum gratissimum* (scent leaf) and *Andrographis paniculata* (king of bitters) against *Schistosoma haematobium* cercaria. Sci. Afr. 21:e01839.
Ito, EE, Egwunyenga, AO, 2023: Seasonal prevalence, intensity and risk factors of geohelminthiasis among children in peri-urban settings, Abraka, Southern, Nigeria. Nig. J. Parasitol. 44, 1:219-32.
Keiser, J, N'Goran, EK, Traoré, M, Lohourignon, K.L, Singer, BH, *et al,* 2002: Polyparasitism with *Schistosoma mansoni*, geohelminths, and intestinal protozoa in rural Cote d'Ivoire. J. Parasitol. 88:461-6.
Östan, I, Kilimciolu, AA, Girginkardeler, N, Özyurt, CB, Limoncu, ME, *et al,* 2007: Health inequities: Lower socio-economic conditions and higher incidences of intestinal parasites. BMC Pub. Hlth 7: 342-50.
Pukuma, MS, Thadawus, D, Augustine, LM, 2022: Soil transmitted helminths among school aged children in Hong Local Government Area of Adamawa State, Nigeria. Anim. Res. Intl. 19, 1:4318-23.
Sam-Wobo, SO, Asiwaju, R, Idowu, OA, Eromosele, CO, Adeleke, MA, 2012: Communal evaluation of Intestinal Helminthes in some Guineaworm-controlled communities in Ogun State, Nigeria. J. Entomol. Nematol. 4, 2:7-11.
Sam-Wobo, SO, Garba, AD, Vlaminck, J, Levecke, B, Adekunle, ON, *et al,* 2021: The efficacy of a single oral dose of albendazole against soil-transmitted helminthiasis in Ogun State, Nigeria. Nig. J. Parasitol. 42, 2:360-5.
Sowemimo, OA, Asaolu, SO, 2011: Current status of soil-transmitted helminthiases among preschool and school-aged children from IleIfe, Osun State, Nigeria. J. Helminthol. 85, 3:234-8.
Taiwo, OT, Sam-Wobo, SO, Idowu, OA, Talabi, AO, Taiwo AM, 2017: Comparative assessment of intestinal helminths prevalence in water, sanitation and hygiene (WASH) intervention and non-intervention communities in Abeokuta, Nigeria. Asian Pacific J. Trop. Biomed., http://dx.doi. org/ 10.1016/j.apjtb.2017.05.006.
van der Werf, N, Redpath, SA, Azuma, M, Yagita, H, Taylor, M, 2013: Th2 cell-intrinsic hypo-responsiveness determines susceptibility to helminth infection. PLoS Path. 9, 3:e1003 215.
WHO, 2002: Prevention and control of schistosomiasis and soil-transmitted helminthiasis. Tech. Rep Series, 912:1-57.
WHO, 2022: Soil-transmitted helminth infections: WHO Fact Sheet N°366 (Updated October).
Winter, AD, McCormack, G, Myllyharju, J, Page, AP, 2013: Prolyl 4-Hydroxlase activity is essential for development and cuticle formation in the human infective parasitic nematode *Brugia malayi*. J. Biol. Chem. 288, 3:1750-61.
Zeynudin, A, Degefa, T, Tesfaye, M, Suleman, S, Yesuf, EA, *et al,* 2022: Prevalence and intensity of soil-transmitted helminth infections and associated risk factors among household heads living in the peri-urban areas of Jimma town, Oromia, Ethiopia: A community-based cross-sectional study. PLoS One 15:e0274702.

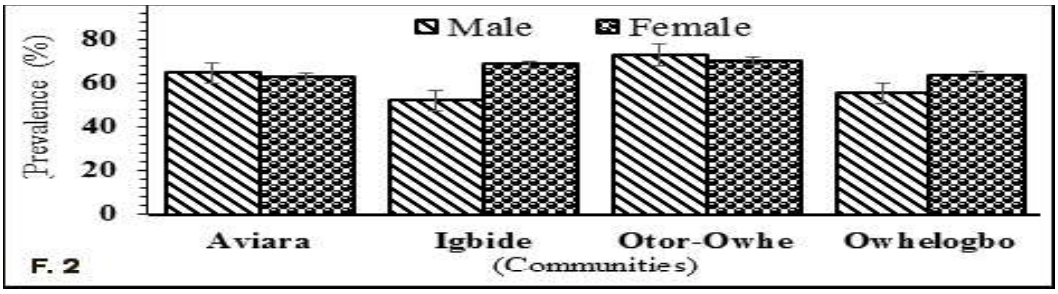
Explanation of figures

Fig. 1: Comparative prevalence of STH parasites based on communities investigated/

Fig. 2: Comparative gender prevalence of STHs and *S. mansoni* co-infections



F. 1



F. 2