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CURRENT STATUS OF SCHISTOSOMIASIS AND ITS SNAIL HOSTS IN ASWAN GOVERNORATE, EGYPT

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Abstract

Human schistosomiasis is one of the most important neglected tropical diseases. Ongoing control measures have markedly decreased the incidence of the disease. This study determined the prevalence of *Schistosoma hematobium and S. mansoni* infection among school children and adults and the snail intermediate hosts in Aswan Governorate.

A cross-sectional study was carried out in four villages, El-Molcata, Karor, El-Mocla and El-khatara. Parasitological examination of 1200 inhabitants' stool and urine samples was examined using direct stained smear and Kato-Katz concentration methods as well as urine sedimentation technique. Snail vectors were collected from different water streams, identified, and examined for schistosomes infective stages by shedding and crushing methods. Statistical analysis was conducted using SPSS, version 25.

The results showed that *S. hematobium* was 4.7% and *S. mansoni* was 1.25% among school children and adults, with risk factors; gender and exposure to canal water. Also, the freshwater snails were *Bulinus truncatus*, *Biomphalaria alexandrina*, *Valvata nilotica*, *Physa acuta*, & *Lymnaea truncatula*. *B. truncatus* was widely distributed but did not show cercariae shedding.

Keywords: Egypt, Aswan Governorate, *Schistosoma mansoni*, *S. hematobium,* Snails**.**

Introduction

Schistosomiasis is a water-borne parasitic disease with over 220 million people infected in sub-tropical and tropical regions across the globe, the vast majority of who live in Sub-Saharan Africa (WHO, 2019).

Barakat (2013) reported that in 1990, a study done in 9 Egyptian Governorates confirmed change in the pattern of schistosomiasis transmission in the Nile Delta. She added that there was an overall reduction in *S. mansoni* prevalence, but *S. haematobium* had continued to disappear. In Middle and Upper Egypt there was consistent reduction in the prevalence of *S. haematobium* except in Sohag, Qena, and Aswan Governorates, with foci of *S. mansoni* detected in Giza, Fayoum, Menya and Assiut. All schistosomiasis control projects implemented in Egypt from 1953 to 1985 adopted the strategy of transmission control and were based mainly on snail control by anti-bilharzial chemotherapy. But, Ahmed *et al.* (2021) reported that colonic schistosomiasis was still among the Egyptian Nile Delta's symptomatic rural inhabitants at a rate of 12.4%. Of them, 66.6% had significant endoscopic colorectal lesions. They added that the persistent schistosomiasis transmission in the Egyptian Nile Delta's rural community sounds the alarm for continuing governmental efforts and plans to screen the risky groups. Barsoum *et al.* (2013) in Egypt reported that the schistosomiasis clinical pictures pass by acute, sub-acute and chronic stages that mirror the immune response to infection. The later includes in succession innate, TH1 &TH2 adaptive stages, with an ultimate establishment of concomitant immunity. Some patients may also develop late complications, or suffer the sequelae of co-infection with bacteria or viruses. Acute pictures are species-independent; occur during early stages of invasion and migration, where infection-naivety and host's racial and genetic setting play a major role.

This work aimed to study prevalence of *S. haematobium* & *S. mansoni* infection among school children and adults in four schistoso miasis endemic rural villages in Aswan Governorate.

Materials and Methods

This study was conducted in four rural schistosomiasis endemic areas in Aswan Governorate, named El-Molcata, Karor, El-Mocla and El-Khatara. These areas depend on water streams as the main source for domestic and irrigation purposes, which create favourable snail- breeding places.

Study population: This study was conducted on 1200 children and adults aged (6 years to 40 years) in period from January 2020 to January 2021. A questionnaire was filled out on each participant or children's parents as to name, sex, age, domestic water supply, canal water contact, and previous history of parasitosis with stress on schistosomiasis.

The morning urine and stool samples were collected from each one in separate labeled containers. Urine was examined by sedimentation for *S. hematobium* eggs. Stool samples were examined macroscopically for consistency, gravid segments and pinworms, and then examined directly by wet mount smears using saline and iodine, and by Kato-Katz sedimentation methods (Katz *et al*, 1972).

Snails: Snails were collected from water streams at eight different sites by using long-handled snail traps (El-Shazly *et al*, 2002). The snails were collected in all seasons over a one year. Collected snails from were transferred into labeled plastic jars filled with water from the same site and transmitted immediately to the experimental lab, Department of Parasitology. Snails were identified by genus, and species using the standard key given (Lotfy and Lotfy, 2015).

Aquatic environment samples were collected by wire mesh scoop nets of (2mm) and 1.4m metal handle, but vegetation and debris were picked by gloves (Sharif *et al*, 2010).

Snail infectivity: Snails (4-5) were kept in glass containers maintained at 27-29°C filled with about 1.5L dechlorinated water each and were fed with lettuce leaves. The water in the containers was changed every 2 days. Snails were examined by using the traditional shedding and crushing methods. In the shedding method, 4–5 snails were put in a beaker with 5ml of clear, dechlorinated water and exposed to sunlight for one hour and checked for shedding of cercariae by a hand lens (Abo-Madyan *et al,* 2005). In the crushing method, the snails were squeezed between two glass slides and examined under a stereo-microscope for the presence of immature stages (Hung *et al*, 2015).

Ethical Consideration: After approval of the protocol from ethics committee of Faculty of Medicine, Aswan University. Informed consents were taken from all patients and parents of children before sample collection, according to Helsinki (1964) as human experimentation developed originally for the medical community

Statistical analysis: Data were analyzed by SPSS 22.0 software package, and expressed as a percentage. P value<0.05 was considered significant (Armitage, 1983).

Results

Participants were 682(57%) males and 518 (43%) females. Of whom (6-17 years) were 863(72%), and (18-40) were 337 (28%). A total of 70% didn’t have governmental piped water, and 67% reported exposed to canal water. The residency was (52%), in El-Sail and El Nafaq, and 48% in the other 3 villages. Prevalence of *S. haematobium* was 4.6 % (95% confidence interval 3.6-6), and *S. mansoni* was 1.25 % (95% confidence interval 0.75-2.06).

Details were given in tables (1, 2, 3, 4, 5, 6, 7 & 8) and figures (1, 2, & 3).

Table 1: Residence of participants (n=1200).

Village	Number	Percentage
Molcata & Khatara	188	15.6%
Mocla	177	14.8 %
Karror	210	17.5%
El-sail and El Nafaq	625	52%

Table 2: Demographic data of 1200 participants.

Variables	Number (%)
S. haematobium	56 (4.7%)
S. nansoni	15 (1.25%)
Male	682 (57%)
Female	518 (43%)
Children (6-17 years)	863 (72%)
Adults (18-40 years)	337 (28%)
Piped water source Yes	360 (30%)
Piped water source No	840 (70%)
Exposure to canal Yes	800 (67%)
Exposure to canal No	400 (33%)

Table 3: Prevalence of schistosomiasis.

Schistosomiasis	Prevalence (CI 95%)
S. haematobium	4.67% (3.6- 6)
S. mansoni	1.25% (0.75- 2.06)

Table 4: Demographic data of participants with *S. haematobium* & *S. mamsoni*.

Variability	*S. haematobium*			*S. mansoni*.		
	56 (100%)	Test	p-value	15 (15%)	Test	p-value
Male	46 (82%)	Chi ^2	< 0.001***	9 (60%)	Chi^2	0.803
Female	10 (18%)			6 (40%)		
6-17 years	41 (73%)	Chi^2	0.825	10 (67%)	Fisher exact	0.773
18-40 years	15 (27%)			5 (33%)		
Piped water Yes	16 (29%)	Chi^2	0.811	6 (40%)	Fisher exact	0.403
Piped water No	40 (71%)			9 (60%)		
Exposure to canal Yes	56 (100%)	Chi^2	< 0.001***	15 (100%)	Chi^2	0.006**
Exposure to canal No	0 (0%)			0 (0%)		

** Highly significant, ****very highly significant*

Table 5: Residence of participants with schistosomiasis.

Villages	*S. haematobium*	*S. mansoni*
Molcata and Khatara	7 (12.5%)	15 (100%)
Mocla	7 (12.5%)	0 (0%)
Karror	16 (29%)	0 (0%)
El-Sail and El Nafaq	26 (46 %)	0 (0%)

Table 6: Five recovered snails

Snails	Number	Prevalence (95% CI)
B. alexandrina	600	28.2% (26%-30%)
B. truncatus	1100	51.5% (49% -54%)
Valvata nilotica	240	11.2% (10%-12%)
Physa acuta	145	6.8% (5.7%-8%)
Lymnaea truncatula	50	2.3% (1.7%- 3%)

Table 7: Distribution of snail species in 4 villages of Aswan Governorate.

Snails	Molcata & Khatara	Mocla	Karror	Total
B. alexandrina	250 (42%)	170 (28%)	180 (30%)	600 (100%)
B. truncatus	680 (62%)	240 (22%)	180 (16%)	1100 (100%)
V. nilotica	150 (62%)	50 (21%)	40 (17%)	240 (100%)
Ph. acuta	90 (62%)	40 (28%)	15 (10%)	145 (100%)
L. truncatula	40 (80%)	6 (12%)	4 (8%)	50 (100%)
Total	1210 (56.67%)	506 (23.7%)	419 (76.3%)	2135

Table 8: Seasonal variation of snail species.

Snails	Summer	Autumn	Winter	Spring	Total
B. alexandrina	130 (22 %)	175(29%)	170(28%)	125 (21%)	600 (100%)
B. truncates	250 (22%)	320 (29%)	330 (30%)	200 (19%)	1100 (100%)
V. nilotica	90 (38 %)	50 (21%)	20 (8%)	80 (33%)	240 (100%)
Ph. acuta	105 (73%)	5 (3%)	5 (3%)	30 (21%)	145 (100%)
L. truncatula	20 (40 %)	15 (30%)	0(0%)	15 (30%)	50 (100%)
Total	595	565	525	450	2135

Discussion

The present study showed that *S. haematobium* was (4.6%) and (1.25%) was *S. mansoni*. Miller *et al.* **(**1981) in Aswan Governorate reported that *S. haematobium* was 4% in desert villages and 25% in agriculture ones without *S. mansoni* cases. Hailegebriel *et al.* (2020) in Africa reported that nearly 6% of freshwater snails were infected by either *S. haematobium* or *S. mansoni* that highlighted the importance of appropriate snail control strategies.

In the present study, incidence of *S. haematobium* (4.7%) more or less corresponded to other Egyptian Governorates, but the present of *S. mansoni* (1.25%) is significantly risky. Nour *et al.* (1990) in Bani-Suef Governorate found a prevalence rate of S. *haematobium* 5%. El-Khoby *et al.* (2000) reported that *S. mansoni* was rare in Upper Egypt, being consequential in only Fayoum, which had a prevalence of 4.3% and an average intensity of infection of 44.0 ova/g of stool. Risk factors for *S. haematobium* infection were male gender, an age <21 years old, living in smaller communities, exposures to canal water; a history of, or treatment for, schistosomiasis, a history of burning micturition or blood in the urine, and reagent strip-detected hematuria or proteinuria. Abdel-Wahab *et al.* (2000) in El Fayoum reported that *S. haematobium* ranged from 0 to 27.1% averaged 13.7%. El Baz *et al*. (2003) in El Fayoum reported that schistosomiasis *haematobium* was 7.9%, but *S. mansoni* was zero%. El-Hawy *et al.* (2000) in Gharbia Governorate reported an overall prevalence of *S. haematobium* was 0.3%, and risk factors for *S. mansoni* were male gender, an age >10 years, lived in smaller communities, exposures to canal water, prior therapy for schistosomiasis, or blood in stool (in children only). Morbidity detected by physical examination or ultrasonography did not correlate with *S. mansoni* infection in patients with the exception of periportal fibrosis.

Barakat (2013) reported that in the middle and upper Egypt, there was consistent reduction in the prevalence of *S. haematobium* except in the governorates of Sohag, Qena, and Aswan but, foci of *S. mansoni* were identified in Giza, Fayoum, Menya and Assiut. AbdEllah *et al. (*2015) in Nag Hammady City (Qena Governorate) reported S. *haematobium* was 30.96% mainly among school-age children and youth and *S. mansoni* was 0.69%

In the present study, *S. mansoni* prevalence was (1.25 %) more or less varied with other Egyptian Governorates. El Sharazly *et al.* (2016) in Gharbia reported the prevalence of *S. mansoni* was 1.8% in children aged 6-15 years. Nooman *et al.* (2000) in rural Ismailia Governorate reported that *S. haematobium* infection was rare, but the prevalence and intensity of *S. mansoni* infection was high. They added that the risk of schistosomiasis was associated with environmentally detected factors and behaviors.

Meanwhile, Lotfy *et al.* (2015) in Egypt reported that Praziquantel (PZQ) is a highly efficacious anthelmintic against many flatworms including schistosomes. PZQ has been in use for more than 25 years, and concern was increasing that resistance emerged in human schistosomes in Egypt and other endemic countries. Abou-El-Naga (2013) in Egypt reported that the National *Schistosoma* Control Program has made great strides with respect for schistosomes eradication, however, there was unfortunately re-emerging of *Schistosoma mansoni* resistant to praziquantel. Besides, numerous factors have influenced the prevalence of snails in Egypt, including the construction of water projects, the increase in reclaimed areas, global climate change and pollution. Thus, continued field studies in addition to the cooperation of several scientists were indicated to obtain an accurate representation of the status of this risky disease and its snail vector. Moreover, the determination of the genome sequence for *B. alexandrina* and the use of modern technology would allow tostudy host-parasite relationship at a molecular level and paving the way for feasible control measures.

da Silva *et al.* (2017) in France reported that both PZQ and OXA have limitations, as low efficacy in treating acute schistosomiasis, low activity against *S. mansoni* in immature stages and resistance or tolerance, which is the reason why further research are still necessary for the development of a second generation of antischistosomal drugs.

In the present study, snails recovered were *B. alexandrina*, *B. truncates*, *V. nilotica*, *Ph. acuta* and *L. truncatula*, of which *B. truncatus* was the most common and *L. trucatus* was the least one. However, all snails were abundant in the four seasons, but with different abundance. Hammam *et al.* (2000) in Qena reported that snail intermediate host of *S. haematobium* (*B. truncatus*) was present in abundance; some of them were infected with *S. haematobium.* But, *B. alexandrina* (intermediate host of *S. mansoni*) was detected in only one site at the Northern tip of the lake, but none of them was infected

Khalil (1936) reported that the Egyptian Ministry of Health installed mobile units to examine and treat all pupils at a large number of elementary, primary and secondary schools thus stopping the disease in early childhood. The number of these units increased from 6 in 1924 to 56 in 1933 with the number of annual treatments increasing from about 47000 to 311000. Chimbari *et al.* (1998) reported that Biotic factors such as plants and food supply have a particular influence on the local abundance and distribution of snails. Predator and competitor species such as other species of snails, fish and insects also control snail populations.

Conclusion

The results showed that schistosomiasis in the 4 villages were *S. haematobium* (4.7 %) and *S. mansoni* (1.25%) Risk factors were small aged patients who always play in canal water, mainly boys. Five species of freshwater snails were detected with the abundance of *B. truncates*. Presence of actively infected patients and snail intermediate hosts must be considered by the Health Authorities. Also, health education to students is a must to avoid this risky water-borne disease

References

AbdEllah, OH, Zaytoun, SS, Ahmed, AE, Hussein, AA, Ahmed, MA, 2015: Schistosomiasis in Nag hammady City, relationship between infection and anemia among children and youth, Qena Governorate, Egypt. J. Egypt. Soc. Parasitol. 45, 2:397-402.

Abdel-Wahab, MF, Esmat, G, Ramzy, I, Narooz, S, Medhat, E, *et al*, 2000: The epidemiology of schis-tosomiasis in Egypt: Fayoum Governorate. Am. J. Trop. Med. Hyg., 62, 2:S55-64.

Abo-Madyan, AA, Morsy, TA, Motawea, SM, El Garhy, MF, Massoud, AMA, 2005: Spot light survey on freshwater snails of medical importance in Al Fayoum Governorate, Egypt. J. Egypt. Soc. Parasitol. 35, 1:49-58.

Abou-El-Naga IF, 2013: *Biomphalaria alexandrina* in Egypt: Past, present and future. J. Biosci. 38:665-72.

Ahmed, MH, Emara, MH, Elfert, AA, El-Saka, AM, Elfert, AA, 2021: Persistent colonic schistosomiasis among symptomatic rural inhabitants in the Egyptian Nile Delta. Mediterr. J. Hematol. Infect. Dis. 13, 1:e2021033. doi: 10. 4084/MJHID.2021.033

Armitage, P, 1983: Statistical Methods in Medical Research. Blackwell Scientific Publications, Oxford, London.

Barakat, RMR, 2013: Epidemiology of schistosomiasis in Egypt: Travel through time: Review. J. Adv. Res. 4, 5:425-32.

Barsoum, RS, Esmat, G, El-Baz, T, 2013: Human schistosomiasis: Clinical perspective: Review. J. Adv. Res. 4, 5:433-44

Chimbari, M, Madsen, H, Ndamba, J, 1998: The potential of using fish to control intermediate host snails for schistosomiasis in Zimbab we. Parasitol. Int. 47:278- 84.

da Silva, VB, Campos, KL, de Oliveira, JF, Decout, JL, Lima, MCA, *et al*, 2017: Medicinal chemistry of antischistosomal drugs: Praziquantel and oxamniquine**.**Bioorg. Med. Chem.25, 13:3259-77.

El Baz, MA, Morsy, TA, El Bandary, MM, Motawea, MM, 2003: Clinical and parasitologic al studies on the efficacy of mirazid in treatment of schistosomiasis *haematobium* in Tatoon, Etsa Center, El Fayoum Governorate. J. Egypt. Soc. Parasitol. 33, 3:761-76.

El-Hawey, AM, Amer, MM, Abdel Rahman, AH, Elibiary, SA, Agina, MA, *et al*, 2000: The epidemiology of schistosomiasis in Egypt: Gharbia Governorate. Am. J. Trop. Med. Hyg. 62:42-8.

El-Khoby, T, Galal, N, Fenwick, A, Barakat, R, El-Hawy, A, *et al*, 2000: The epidemiology of schistosomiasis in Egypt. Am. J. Trop. Med.

Hyg. 62, 2:S88-99.

El-Shazly, AM, Helmy, MM, Haridy, FM, El-Sharkawy, EM, Morsy, TA, 2002: *Fasciola* immature stages sought in *Lymnaea* species and *Biomphalaria* species in the water bodies of Dak ahlia Govenrorate. J. Egypt. Soc. Parasitol. 32, 1:109-18

El Sharazly, BM, Abou Rayia, DM, Antonios, SN, Eissa, SH, 2016: Current status of *Schistosoma mansoni* infection and its snail host in three rural areas in Gharbia Governorate, Egypt. Tanta Med. J. 44:141-50.

Hailegebriel, T, Nibret, E, Munshea, A, 2020: Prevalence of *Schistosoma mansoni* and *S. haematobium* in snail intermediate hosts in Africa: A systematic review and meta-analysis J. Trop. Med. September DOI: 10.1155/2020/8850840.

Hammam, M, Zarzour, A, Moftah, F, Abdel-Aty, M, Hany, A, *et al*, 2000: The Epidemiology of schistosomiasis in Egypt: Qena Governorate. Am. J. Trop. Med. Hyg. 62, 2:S80-7.

Hung, NM, Dung, T, Lan, NT, Van, PT, et al, 2015: Current status of fish-borne zoonotic trematode infections in Gia Vien district, Ninh Binh Province, Vietnam. Parasit Vector 8:21-30.

Katz, N, Chaves, A, Pellegrino, J, 1972: A simple device for quantitative stool thick-smear technique in *schistosomiasis mansoni*. Rev. Inst. Med. Trop. Sao Paulo 14:397-400

Khalil M, 1936: Individual variation in the excretion of drugs as an important factor in their therapeutic results. A practical method for detecting the schistosomiasis cases with so called idiosyncrasy to anatomy to avoid fatalities and complications. J. Egypt. Med. Assoc. 19:285–305.

Lotfy, WM, Lotfy, LM, 2015: Synopsis of the Egyptian freshwater snail fauna. Folia Malacol. 23, 1:19-40

Lotfy, WM, Hishmat, MG, El Nashar, A, Abu El-Einin, HM, 2015: Evaluation of a method for induction of praziquantel resistance in *Schistosoma mansoni*. Pharm, Biol. 53, 8:1214-9.

Miller, F, Hussein, M, Hilbert, M, Monto, A, Barakat, R, 1981: An epidemiological study of *Schistosoma haematobium* and *S. mansoni* in 35 Egyptian villages. Trop. Geogr. Med. 33:355-65.

Nour, NM, Fayed, MA, Hussein, SM, Shahin, HI, Abdel-Rahman, RS, 1990: Prevalance and morbidity of schistosomiasis among preschool children in Bani-Suef governorate. J. Egypt. Soc. Parasitol. 20, 3:793-803.

Nooman, ZM, Hasan, AH, Waheeb, Y, Mishriky, AM, Ragheb, M, *et al*, 2000: The epidemiology of schistosomiasis in Egypt: Ismailia governorate. Am. J. Trop. Med. Hyg. 62, 2:S35-41.

Sharif, M, Daryani, A, Karimi, SA, 2010: A fanatic survey of cercariae isolated from lymnaeid snails in central areas of Mazandaran, Iran. Pak. J. Biol Sci.13: 158-163.

WHO, 2019: Schistosomiasis: Fact Sheet, World Health Organization, Geneva, Switzerland.

Explanation of figures

Fig. 1: Aswan map showed villages: 1- Molcata & Khatara, 2- Mocla, 3- Karror & 4- El-sail and El Nafaq.
Fig.2: *Schistosoma haematobium* egg (×400).
Fig.3: *Schistosoma mansoni* egg (×400).
Fig. 4: *Biomphalaria alexandrina*