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## THE ASSOCIATION BETWEEN SHISTOSOMIASIS AND ENTERIC FEVER IN A SINGLE SCHISTOSOMA ENDEMIC AREA IN SUDAN

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**ABSTRACT:** Schistosomiasis is a major communicable disease with a great impact on both public health and socioeconomic status of the developing world. It is highly prevalent in tropics and causes morbidity and mortality in developing countries including Sudan. Because of its chronicity and robust immunomodulatory activity, the effects of Schistosomiasis on other diseases such as allergies, autoimmunity and infectious diseases have been studied extensively in both epidemiological and experimental settings. *Salmonella* spp. is a common water- and food-borne cause of gastrointestinal and systemic diseases worldwide. Approximately, 2 million individuals die each year of diarrhea and *Salmonella* is a leading cause of this illness. A relationship between persistent as well as recurrent *Salmonella* bacteremia and schistosomiasis has been described both in adults and children. The present cross-sectional study was conducted to determine the relationship between schistosomiasis and salmonellosis in Helat Mahajoub in AL-Gezira Agricultural Scheme. Urine and faecal samples were collected from 288 individuals and investigated for *Schistosoma* ova using the modified Kato thick smear technique and the concentration technique. 207 subjects were positive for schistosomiasis and were thence subjected to bacteriological cultures of *S. typhi*, *S. paratyphi* A and *S. paratyphi* B. *Salmonella* species were detected in 64 schistosomiasis patients (30.9%). *Salmonella* infection was found to increase when the duration of schistosomiasis infestation was more than one year.

**INTRODUCTION:** Schistosomes are parasitic helminthes that infect human, with life cycles involving snails as intermediate hosts. Schistosomiasis occurs in 78 developing tropical and subtropical countries in which over 200 million people are infected.

Of those, 120 million patients show symptoms with 20 million of them being severely infected. There are 14,000 deaths per year due to schistosomiasis <sup>1</sup>.

Both *Schistosoma hematobium* (*S. hematobium*) and *Schistosoma mansoni* (*S. mansoni*) are present in Sudan and the risk factors for bilharziasis are widespread especially in the major irrigation systems in Al-Gezira area between the Blue and White Nile Rivers <sup>2</sup>. *Salmonella* spp. is a common water and food-borne cause of gastrointestinal and systemic diseases worldwide.

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Approximately 2 million individuals die each year of diarrhea and *Salmonella* is a leading cause of this malady. Typhoid and paratyphoid fevers are common in less-industrialized countries principally owing to the problem of unsafe drinking-water, inadequate sewage disposal and flooding<sup>3</sup>. There is a high incidence of chronic *Salmonella typhi* (*S. typhi*) and *Salmonella paratyphi* (*S. paratyphi*) infections and carriage in schistosomiasis endemic areas. Several lines of evidence suggest a synergistic bacteria-parasite interaction that results in a protracted course of *Salmonella* infection that has proven difficult to diagnose and to treat<sup>4,5</sup>.

More than 20 species of *Salmonella* of both human and animal origin have been found to cause this syndrome. On the other hand, *Schistosoma-Salmonella* interactions had been described with all species of *Schistosoma*<sup>5</sup>. *Salmonella* may be found in the tegument and intestinal tracts of *Schistosoma* which provide multiplication foci for this bacterium in the portal mesenteric system of the parasite<sup>6</sup>. The role played by a decreased host immune response following the schistosomiasis course may be explained by the delayed or prolonged infection with salmonella as well as that *Schistosoma* may protect *Salmonella* from antibiotics actions<sup>4,5</sup>.

*Schistosoma* associated *Salmonella* can evade a number of antibiotics by binding to adult schistosomes using fimbrial proteins implicated in adherence to mammalian cells<sup>5</sup>. These concomitant infections are characterized by an undulant febrile disease (several weeks to few years). The fever is usually high, irregular, continuous or intermittent and is often accompanied by headache, sweating, chills, weight loss, diarrhea, abdominal pain and bacteremia (with one or more species of *Salmonella*). Chronic salmonellosis is characterized by a significant hepatosplenomegaly with mild lymphadenopathy, eosinophilia (without leucocytosis) and severe anaemia. Epistaxis, petechiae, purpuric lesions, haematuria and proteinuria may also develop<sup>5</sup>.

**MATERIAL AND METHOD:** Each patient was a subject of a standard medical questionnaire which covered demographical data, health status and socioeconomic parameters. This was followed by a clinical examination and collection of faeces and

urine. Urine and faecal samples were collected from 288 individuals and analyzed. Fecal samples were investigated for *Schistosoma mansoni* ova using the modified Kato thick smear technique<sup>7</sup> while urine samples were examined for *Schistosoma hematobium* using centrifugation followed by examination of the urinary sediments.

**Bacteriological culture:** The urine samples were immediately inoculated onto *Salmonella-Shigella* Agar and XLD agar (including a subculture of Selenite-F broth). Then the plates were incubated at 37°C for 24-48 hours. Stool samples were processed for microbiological analysis as soon as they were delivered to the laboratory. A loopful of each stool sample was inoculated onto *Salmonella-Shigella* agar and XLD agar (including a subculture of Selenite-F broth). Afterwards, the cultures were incubated at 37°C for 24-48 hours.

**Identification of isolates:** Suspected colonies were identified using Gram's reaction, Kiligler iron agar, citrate test, lysine decarboxylate test, Urea broth and serological agglutination with specific antisera (Oxoid).

**RESULT AND DISCUSSION:** Out of the 288 subjects examined in this study, 207(72%) were found to be suffering from schistosomiasis infestations. Of these, 186 patients (89.8%) were males and only 21(10.1%) were females. Mean age of the patients was 13.5 (range: 6 to 55) years with the majority being between 11 and 16 years. Most of the patients (72%) were studying Quran at Khalwa school; others were laborers (9%), farmers (8%) and unemployed (11%). 125 patients (60.4%) were suffering from schistosomiasis for more than one year, 58(28%) for one year and 24 (11.6%) for less than one year.

Urinary schistosomiasis was found in 95 patients (46%), intestinal schistosomiasis was found in 83 patients (40%) and mixed types of schistosomiasis were detected in 29 patients (14%). Other parasites encountered in the present study were *Ascaris lumbricoides*, *hymenolepis nana*, *Giardia lamblia*, *Entamoeba histolytica*, *Enterobius vermicularis* and *Strongyloides stercoralis*. The duration of schistosomiasis infestation among *Salmonella*-infected patients is shown in **table 1**.

*Salmonella* infection was found to increase with the increase in the duration of schistosomiasis infestation. All schistosomiasis patients suffering from enteric fever were complaining of fever; others had symptoms of haematuria, abdominal pain and diarrhea. Some patients were having hepatosplenomegaly. *S. typhi* was found to be the most frequent (70.7%). *Salmonella* species are prevalent among schistosomiasis patients (Table

2). 19 patients (26.6%) were found to be infected with more than one species of *Salmonella*.

**TABLE 1: RELATIONSHIP BETWEEN THE NUMBER OF SALMONELLOSIS PATIENTS AND THE DURATION OF SCHISTOSOMA INFESTATION**

Duration	<i>Salmonella</i> infected patients
Less than one year	4
One year	20
More than one year	40
Total	64

**TABLE 2: DISTRIBUTION OF SALMONELLA SPECIES AMONG SCHISTOSOMIASIS PATIENTS\***

<i>Schistosoma</i> species	<i>S. typhi</i>	<i>S. paratyphi A</i>	<i>S. paratyphi B</i>
<i>S. haematobium</i>	33 (68%)	1 (2%)	5 (10%)
<i>S. mansoni</i>	6 (12%)	1 (2%)	1 (2%)
<i>S. haematobium</i> and <i>mansoni</i>	25 (52%)	6 (12%)	8 (17%)

\*19 patients were found infected with more than one species of *Salmonella*.

Risk factors assessment for bilharziasis infection showed that low awareness of bilharziasis as well as contact with open water such as during swimming; washing clothes and utensils and practicing agricultural activities with bare foot were associated with high risk of schistosomiasis infection.

In the present study, most patients were males (89.8%) whereas females represented 10.1% of the population studied. This may be due to the fact that males are more exposed to infections as per their personal daily activities such as hygiene related practices and swimming in canals and stagnant water. Professional activities such as fishing, rice cultivation and irrigation performance may also increase the chances of males acquisition of schistosomiasis.

Few studies were conducted to investigate this interaction. Salih *et al* were able to isolate *Salmonella* species from all of their 21 hepatosplenic schistosomiasis patients<sup>8</sup>. Hathout *et al* were able to isolate *Salmonella* organisms from all (100%) of their 61 *Schistosoma* patients studied and 51 of these cases had developed a carrier state<sup>9</sup>. In the present context, the detection rate of *Salmonella* was low (30.9%) compared to the 100% rate of Salih *et al*<sup>8</sup>. The increased rate of *Salmonella* isolation in that study may be explained by the type of specimens used for isolation of the causative agent where blood and stool were collected for diagnosis of salmonellosis.

*S. typhi* was detected more frequently (70.7%) than other salmonellae. This suggests that the frequency of typhoid fever among schistosomiasis patients is higher than paratyphoid fever. This finding is in agreement with that reported by Salih *et al*<sup>8</sup>. On the other hand, *S. paratyphi A* and *S. paratyphi C* were the commonest organisms isolated by Hathout *et al*<sup>9</sup>. They attributed this difference to some localized factors in the patients or to inherent features of the causative organisms<sup>9</sup>. The incidence of *Salmonella* bacteremia among schistosomiasis patients was higher in children than in adults. This may be attributed to the fact that children are more susceptible to schistosomiasis acquisition through washing, swimming and playing in irrigation canals.

In connection with adult age groups, young adults were found to be relatively more affected than other adult age groups. These remarks concerning children and young adults in the present study are consistent with those of Muniz-Junqueira and his co-workers who reported that the highest incidence of the co-infection was among people between 10 and 30 years<sup>5</sup>.

In our analysis, *Salmonella* species were positive in 64 schistosomiasis patients (30.9%). Compared to the results reported by Salih *et al*, this represents a relatively low frequency; however this can be attributed to the fact that Salih *et al* used Widal test in their study whereas the current one applied culture method.

In the present study, salmonella species were isolated from both *S. hematobium* and *S. mansoni* positive subjects. These findings outdistance those reported by Salih *et al* who had stated that chronic persistent salmonella bacteraemia has been described in association with *S. mansoni*<sup>9</sup>. In the current study the association of salmonella species was found more with urinary schistosomiasis compared to intestinal schistosomiasis.

In contrary to this conclusion, other studies detected more association with *S. mansoni*, *S. intercalatum* and *S. japonicum* weighed against urinary schistosomiasis<sup>5</sup>. *Salmonella* infection incidence was found to increase when the infestation of schistosomiasis lasts more than one year (**Table 2**). This observation is well correlated with more formation of antibodies upon prolonged exposure to infection, the cellular immune response and change in the phagocytic system<sup>5</sup>.

**CONCLUSION:** The incidence of infection with *Salmonella* species among schistosomiasis patients was higher in children than in adults. *Salmonella* infection incidence was found to increase when the infestation of schistosomiasis lasts more than one year.

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#### REFERENCES:

1. WHO: Schistosomiasis. 2013 [http://www.who.int/mediacentre/factsheets/fs115/en/index.html].
2. Humaida S, EL Gaddal A A and Homeida MM: Schistosomiasis: epidemiology and burden of disease in the Sudan. Sudan Medical Journal 2011; 47(2):63-68.
3. WHO: *Salmonella* 2013 [http://www.who.int/mediacentre/factsheets/fs139/en/].
4. Cheesbrough M: District Laboratory Practice in Tropical Countries. Cambridge University Press, Cambridge, Second Edition 2006.
5. Muniz-Junqueira MI, Tosta CE and Prata A: *Schistosoma*-associated chronic septicemic salmonellosis: evolution of knowledge and immunopathogenic mechanisms. Journal of the Brazilian Society of Tropical Medicine 2009; 42(4):436-45.
6. Barnhill AE, Novozhilova E, Day TA and Carlson SA: *Schistosoma*-associated *Salmonella* resist antibiotics via specific fimbrial attachments to the flatworm. Parasites & Vectors 2011; 4:123.
7. Mello-Silva CC, João RC, Augusto RC and Santos CP: A rapid diagnostic test for *Schistosomiasis mansoni*. Mem Inst Oswaldo Cruz, Rio de Janeiro 2013; 108(8): 1078-1080.
8. Salih S Y, Abu Sabaa H, Abu Asha H, *et al*. Salmonellosis complicating schistosomiasis in Sudan. Journal of Tropical Medicine and Hygiene 1977; 80:14-18.
9. Hathout S E, El-Gaffar Y A and Awn A Y. Chronic salmonellosis complicating schistosomiasis in Egypt . Am J Trop Med Hyg 1967; 16:426-427.

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