

The Association between Abo Blood Groups and Intestinal Schistosomiasis among Masero Primary School Children in Sanja, Northwest Ethiopia

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Abstract

Intestinal schistosomiasis, caused by the worm *Schistosoma mansoni* is one of the most common tropical diseases and poses serious health related morbidities. The effect of ABO blood group on intensity schistosomiasis has been studied, but there is discrepancy between the studies. The aim of this study was to assess the association of ABO blood groups and intestinal *S. mansoni* infection. A school-based cross-sectional study was conducted among Masero primary school children at Sanja, Northwest Ethiopia. A simple random sampling strategy was used to select study participants. All students (410) present during the study period were enrolled. ABO blood groups were typed by agglutination using commercial antisera and stool examination was done using the direct stool examination and Kato-Katz techniques. Finally the data were entered and analyzed using SPSS version 16 statistical software and a multivariate ordinary logistic regression analysis was applied to determine the associations of risk factors. From a total of 410 176 males and 234 females school children, (304 74.1%) were *S. mansoni* positive. The proportion of *S. mansoni* infection among 'AB' blood group were quit high (91.7%), followed by 'A' 78%, 'B' 75%) and the lowest infection were noted among O blood group (70.3%). The proportion of *S. mansoni* decreases with increasing age. In the multivariate analysis, reported AB blood group (AOR=4.2; 1.3, 13.7), low level of mothers educational status (AOR=2.2; 1.0, 4.6) and spring water source (AOR=1.7; 1.0, 2.8) were significantly associated with high egg intensity. Individuals with blood group AB are four times more likely to have risk of heavy egg intensity of *S. mansoni* infection, but blood group 'O' participants are less likely to have heavy egg intensity of *S. mansoni* infection. Hence, mass-treatment and health education should be given for school populations that found in the study area.

Keywords: ABO blood group; *Schistosoma mansoni*

Introduction

Schistosomiasis is one of the most widely spread parasitic disease. Most infections in human caused by *Schistosoma haematobium*, *S. japonicum* and *S. mansoni*, together with a minor contribution from *S. intercalatum* and *S. mekongi*. Intestinal schistosomiasis, caused by the worm *Schistosoma mansoni* is one of the most common tropical diseases and poses serious health hazard due to its associated morbidities [1,2]. It is endemic to over 70 countries in Africa and the Middle East [3]. Considers it as significant public health problem. About 200 million cases of schistosomiasis are suggested to occur in 74 countries of the world, of which about 80% live in sub-Saharan Africa where *S. haematobium* and *S. mansoni* are endemic [1,4]. Recent information indicates 20,000 deaths associated with the severe consequences of infection [2]. In Ethiopia, *S. mansoni* and *S. haematobium* have been known to be endemic [1,4]. Despite recent efforts to control the disease, schistosomiasis is still one of the leading causes of mortality and morbidity in Ethiopia [2].

Several factors are suggested to affect the transmission of schistosomiasis. Lack of access to clean water, population immigration without adequate provision of sanitation, water contact activities, development of water resource projects and lack of adequate sanitation are some of the risk factors for transmission of schistosomiasis [1,3,5]. Differences in bilharziasis rate can also be related to differences in religion and domestic habits like swimming and washing clothes in poor sanitation water bodies [6,3,7]. In countries like Ethiopia where about 82.4% of the population live in rural areas, these factors are reported to be obvious and the major risk factors for schistosomiasis transmission [7,8]. As a result, several studies were conducted in different parts of Ethiopia to determine the prevalence of schistosomiasis [9].

The pathogenesis and clinical manifestation of schistosomiasis

occurs in three stages, which include dermatitis, acute and chronic schistosomiasis. Infection with *S. mansoni* is often asymptomatic. However, some patients may progress into severe schistosomiasis. Several factors are suggested to affect the severity of infection by *S. mansoni* including developmental stages of the parasites egg intensity, affected organ or tissue and host factors [10-12]. Although several factors were suggested to affect the severity of infection by *S. mansoni* in human, the ABO blood group of the human host; which may assist the schistosomula to escape the host immune response is suggested to be the major one [13].

The possible effects of ABO blood group on severity of some diseases has been studied and close correlations demonstrated between blood groups and malaria, ascariasis and cholera [13-15]. Several human blood group systems, such as AB and Rh have counterparts in nonhuman primates. The evolution of blood group diversity within populations may have been influenced by selective pressure for resistance to various endemic infectious diseases [16]. There is a study report of A and B antigens are expressed at the surface of schistosomula. These host origin blood group antigens are acquired by the parasite

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Received November 30, 2015; Accepted December 30, 2015; Published January 06, 2016

Citation: Addisu A, Tekeste Z, Teshome A, Alemu A, Tesfa H, et al. (2016) The Association between Abo Blood Groups and Intestinal Schistosomiasis among Masero Primary School Children in Sanja, Northwest Ethiopia. J Trop Dis 4: 196. doi:10.4172/2329-891X.1000196

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during its development in the host. It is likely that these substances are also acquired by parasites in the bloodstream of man. They may serve to mask surface parasite antigens, and so enable schistosomes to evade parasite specific humoral or cellular immune responses [13].

The mechanism by which the ABO determinants use to affect severity of schistosomiasis is not well understood, but a logical explanation lies on the ability of schistosomula to adsorb host blood group antigens during schistosomiasis, young schistosomula adsorb host blood group antigens on to their surfaces to mask antigenic sites and prevent specific anti-parasite antibody from binding and resulting in higher chance of surviving and developing severe form of schistosomiasis [13].

As a result, studies on the relationship between 'ABO' blood groups and intestinal schistosomiasis and risk factors of schistosomiasis have been conducted and contradictory results are reported. These contradictory reports on the intensity of intestinal schistosomiasis infection prompted investigation of the situation in the *S. mansoni* endemic localities in Ethiopia particularly in the study area.

Materials and Methods

Study area and subjects

Sanja is one of the 105 woredas in the Amhara Region of Ethiopia, part of North Gondar. Based on figures published by the National Statistical Agency in 2005, the woreda has an estimated total population of 143,929, of whom 70,585 were men and 73,344 were women; 4.72% of its population are urban dwellers. The district's annual rainfall is 800-1800 mm and mean annual temperature ranging from 25°C to 42°C. The name Sanja town is derived from Sanja River that flow throughout the year. Based on unpublished data, intestinal helminthes are the most prevalent chronic disease in the area with highest prevalence of *Schistosoma mansoni* [17]. School based cross sectional study was conducted from April 30, 2013 to June 30, 2013 on school age children attending Maseru primary school.

Data collection and laboratory methods

A structured questionnaire was used to obtain socio-demographic information about age, residence, family educational status, family size, religion, bathing and cloth washing habit in a river, anti-schistosomiasis drug history, latrine availability.

ABO blood group typing

ABO blood groups were typed by agglutination using commercial antisera [18]. One drops of anti-sera for blood grouping was applied on three drops of whole blood placed in three different places of a grease-free clean glass slide. The blood cells and the antigen were mixed with applicator stick. Then the slide were tilted to detect for agglutination and the result was recorded accordingly [19].

Stool collection and examination

Students were provided a plastic stool container and asked to bring approximately 100 g of their own stool. For the direct stool examination, a drop of saline was placed on a slide. Approximately 0.05 g of stool was placed using an applicator stick, and mixed in a drop of saline and covered by cover slip. Finally the sample was examined microscopically at low power (10x objective) and high power (40x objective) magnifications for detection of intestinal parasites [19].

For the Kato-Katz, a small amount approximately 5 g) of feces was placed on to a piece of scrap paper. The stool was pressed on the top of the screen of the faecal sample using the applicator stick. After the

upper surface of the screen is scraped to sieve the faecal sample, the template was placed on a clean microscope slide and filled with the sieved fecal sample. Then the template was removed carefully so that all the faecal material remained on the slide. The remained fecal sample was covered with glycerol-soaked cellophane strip and examined on the 10x objective microscope. After the stool sample was processed and examined using Kato-Katz method, participants were classified as infected or not infected with *S. mansoni* [19].

Data quality control

Before starting the actual work, quality of reagents and instruments were checked by investigator. The specimens were also checked for serial number, quantity and procedure of collection. Pre-test was conducted on 5 % of the sample size at Jansuma primary school to ensure the validity of the data collection tool & to standardize the questionnaire. Laboratory professionals were given training how they perform the tests, adherence on the application of standard Operating procedures and how to record laboratory results on laboratory result sheet prepared for the research purpose.

Slides with saline only and glycerol-soaked cellophane strip only were used as negative controls for stool examination. Known ABO blood group types were also used to check the reliability of the anti- A, anti-B and anti-D antisera.

Data analysis

Data was sorted and checked for cleanness, quality and validity. Then the data was analyzed using SPSS version 16 statistical software. Chi-square (χ^2) was used to determine association between each blood group. Odds ratios (OR) was calculated with 95% confidence interval (CI). Values were considered to be statistically significant when P-values are less than 0.05.

Ethical consideration

Ethical clearance was obtained from Ethical Review Committee of School of Biomedical and Laboratory Sciences, University of Gondar College of Medicine and Health Sciences. Written informed consent was obtained from the school children, the school heads, and the parents/guardians after explaining the purpose and objective of the study. Confidentiality issues of study participants about the result was kept; according to the results the study participants were given health education, treatments and consulted to adhere to the medicines with the collaboration of the school and Kenfere Mariam Health Center.

Results

Risk factors of *S. mansoni* infection among study participants

From a total of 410 (176 males and 234 females) school children, the prevalence of *S. mansoni* was found to be 74.1%, 95% CI: 69.9, 78.4). Regarded to the residence prevalence of *S. mansoni* was 74.8% 95 % CI: (70, 79.5) in urban and 71.6% (95% CI 61.7, 81.5) in rural inhabitants. The prevalence was slightly higher among females (76.1%) 95% CI: (70.6, 81.5) than males 71.6%, 95% CI: (64.9, 78.3). The proportion of *S. mansoni* decreases from 83.6%, 75.5%, 65.6% to 33.3% with increasing age group 5-9, 10-14, 15-19, 20-24 respectively. Using a multivariate ordinary logistic regression, a significant association was observed among AB blood group, low level of mother education and spring water source with heavy egg intensity.

Among these 304 *S. mansoni* positives, (13570.3%), (8278%), (1191.7%) and (7675%) were O, A, AB and B blood groups respectively.

Considering heavy egg intensity of infection, there is a significant difference in frequency distribution between blood group O and the other blood groups (Table 1). Being blood group AB has four times high likely to have *S. mansoni* heavy egg intensity P-value < 0.05) compared to blood group O.

The frequency of O and non-O blood group types in relation to heavy, moderate and light egg intensity.

As compared to the heavy intensity of infection, the case of light intensity of infection was more likely to be of blood group type 'O' than blood group type 'B' and 'AB' L vs. H: O vs. B, odds ratio (2.68), 95% confidence interval (1.19, 6.01). L vs. H: 'O' vs. 'AB', the odds ratios (4.0), 95% confidence interval 0.4, 34.5. Furthermore, individuals with moderate vs. heavy intensity of infection were about two fold more likely to be of non-'O' blood group types 'O' as to be of 'O' blood group 'O' vs. Non- 'O', odds ratios (1.3), 95% confidence interval (0.5, 1.2), P values (0.3) (Table 2).

Discussion

In the present study the prevalence of *S. mansoni* in Maseru primary school children was found to be 74.1%, which indicates increased rate of infection when compared with previous studies in the N/Gondar Zone Zarema with prevalence reported 37.9%, but it is lower than Uganda study, which have a prevalence of 81.5% [1,20,7]. This discrepancy might be due to geographical difference, awareness of the people for *S. mansoni* infection and transmission and lack of personal hygiene and sanitation. Among grade eight completed and above mothers, *S. mansoni* prevalence in the study participants was decreased; this is similar with the study conducted in Delgi, which shows the prevalence of *S. mansoni* was higher in children with less educated mothers [7]. This may be due to educated mothers may teach their children about *S. mansoni* infection and transmission.

When age of students increase, *S. mansoni* prevalence decrease, which is related with study conducted in Uganda that shows the prevalence of *Schistosoma mansoni* infection increased with age [21].

Water source like spring water usage shows high *S. mansoni* infection, this is also similar to the study conducted in Gorgora which indicates, water contact habits on water bodies has positive associated risk factors for *S. mansoni* infection [22]. In urban dwelling study participants the prevalence of *S. mansoni* infection increased. Which is similar with a study conducted among school children in Sierra Leone showed *S. mansoni* infection was positively associated with population density [23].

From a total of 304 *S. mansoni* positive study participants, (13570%) were O, (8278%) were A, (1192%) were AB and 7675%) were B blood groups, but according to a study conducted in Zimbabwe from 115 *S. mansoni* positives; *S. mansoni* infection was detected among 65 30.70% blood group 'A', 37 10.10% blood group 'O' and 13 8.30% blood group 'B' children [24]. In addition, a study conducted in Swaziland school children, individuals infected with *S. mansoni* show significantly increased frequency of infection among blood group B [25]. This difference might be due to population racial distribution difference, genetic variation of the population.

In this study, being blood group AB has four times high likely to have *S. mansoni* heavy intensity of infection with 4.2 Odds ratio 95% CI:1.3, 13.7, which is different from a study report in Zimbabwe that shows *S. mansoni* intensity and incidence of infection is high among children of blood group 'A' [26]. This difference might be due to racial related population distribution difference.

Among all blood groups, blood group O is less likely to have heavy *S. mansoni* intensity of infection, which is similar with a study conducted in Zimbabwe that shows blood group 'O' children are less likely to have *S. mansoni* infection [27,28], this might be due to the absence of A and B red cell antigens that can be used by the schistosomula stage of *S. mansoni* to mask its body and escape the human protective immune system or might be due to the presence of anti-A that may afford partial protection against different disease [28]. Following blood group 'O' blood group 'A' is less likely to have *S. mansoni* heavy intensity of infection with 0.8 Odds ratio 95% CI 0.5, 1.5), which is similar with

Variables	Characteristics	negatives No (%)	Light No (%)	Moderate No (%)	Heavy No (%)	Total No (%)	Adj. Odds [95%CI], P-value
Sex	Male	53 (30.1)	19 (10.8)	54 (30.7)	50 (28.4)	176 (42.9)	R
	Female	58 (24.8)	33 (14.1)	78 (33.3)	65 (27.8)	234 (57.1)	1 (0.7,1.4), 0.9
Age [year]	5-9	11 (18)	9 (14.8)	23 (37.7)	18 (29.5)	61 (14.9)	R
	10-14	65 (25.7)	32 (12.7)	81 (32)	75 (29.6)	253 (61.7)	0.8 (0.5,1.4), 0.5
	15-19	33 (35.5)	11 (11.8)	28 (30.1)	21 (22.6)	93 (22.7)	0.5 (0.3,1), 0.05
	20-24	2 (66.7)	0 (0)	0 (0)	1 (33.3)	3 (7)	.3 (0.02,3.9), 0.4
Mother educational status	Illiterate	52 (30.8)	24 (14.2)	46 (27.2)	47 (27.8)	169 (41.3)	1.7 (0.8,3.6), 0.2
	Can read and write	45 (21.6)	25 (12)	77 (37)	61 (29.4)	208 (50.7)	2.2 (1.4,6), 0.03*
	Grade eight and above	14 (42.4)	3 (9.1)	9 (27.3)	7 (21.2)	33 (8)	R
Water Source	River	15 (40.6)	2 (5.4)	9 (24.3)	11 (29.7)	37 (9)	0.8 (0.4,1.7), 0.7
	Spring	17 (20.5)	10 (12.1)	24 (28.9)	32 (38.5)	83 (20.3)	1.7 (1.2,8), 0.02*
	Tap	79 (27.2)	40 (13.8)	99 (34.1)	72 (24.9)	290 (70.7)	R
Blood group	O	58 (30.2)	28 (14.6)	61 (31.8)	45 (23.4)	192 (46.8)	R
	B	26 (25.7)	12 (11.9)	33 (32.7)	30 (29.7)	101 (24.6)	1.3 (0.9,2.1) 0.2
	AB	1 (8.3)	1 (8.3)	3 (25)	7 (58.4)	12 (3)	4.2 (1.3, 13.7) 0.02*
	A	26 (24.8)	11 (10.5)	35 (33.3)	33 (31.4)	105 (25.6)	1.5 (0.9,2.3) 0.09

Key: OR=Odds ratio 95%CI= 95%Confidence interval, *=significant association, P-value.

Table 1: Ordered logistic regression analysis of *S.mansoni* infection with the predictor variables among school children at Maseru, North Gondar, Ethiopia, 2013.

Blood Groups	L vs. H	L vs. M	M vs. H
O vs. A	(1.50.7, 3.2)0.35	(1.20.6, 2.7) 0.8	(0.80.5, 1.5) 0. 6
O vs. B	(1.70.8, 3.9) 0.2	(1.30.6, 2.9) 0.5	(1.30.7, 2.5) 0.4
O vs. AB	(40.4,34.5) 0.17	(1.30.1, 13.3) 0.8	(30.7, 12)0.1
O vs. (A,B,AB)	(1.70.8, 3.2) 0.1	(1.3 0.7, 2.4) 0.5	(1.30.5, 1.2) 0.3

Key: M: Moderate egg intensity L: Light egg intensity H: Heavy egg intensity, Odds ratio 95%Confidence interval), P-value, *= significant association)

Table 2: The frequency of O and non-O blood group types between the three study categories: students with heavy H), Moderate M), and light L) intensity of infection in Masero primary school children in Sanjawereda, North Gondar, Ethiopia, 2013.

a study conducted in Zimbabwe shows *S. mansoni* intensity and incidence of infection is high among blood group 'A' when compared with 'O' blood group [26].

Conclusion

Intestinal schistosomiasis, caused by the worm *Schistosoma mansoni* is one of the most common tropical diseases and poses serious health problem due to its associated morbidities. In this study area, the prevalence of *S. Mansoni* was high when compared with bordering localities like Delgi and Zarema. *S. mansoni* prevalence is high in females and urban inhabitants. Among *S. mansoni* positive study participants, blood group AB has four times more likely to have heavy *S. mansoni* infection when compared to blood group O.

All children's with a positive finding of *Schistosoma mansoni* were referred to Kenferemariam health center for treatment.

Recommendation

The community should give a special care for school children since they are found in high *S. mansoni* prevalence and transmission in Masero primary school.

It needs further study on the population ABO blood group distribution with a large sample size in the community.

The regional health bureau should give a great attention for school children, especially for AB blood groups, in high intestinal Schistosomiasis prevalent areas since they are at high risk of intestinal Schistosomiasis and heavy intensity of infection.

Acknowledgements

I would like to acknowledge Department of Medical Parasitology, School of Biomedical and Laboratory Sciences, University of Gondar, for giving me the chance to develop this research.

I would also like to acknowledge Masero primary school children and teachers and Kenferemariam health center staffs for their participation and help during the treatment of the children.

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