Asian Journal of Medicine and Health

18(1): 28-34, 2020; Article no.AJMAH.54810
ISSN: 2456-8414

Lipid Profile in School Children Infected with Urinary Schistosomiasis in Fante Akura-Yeji, Ghana

Ruth. C. Brenyah[1], Cephas Effah Boakye[2], Enos Amoako Oduro[2], Solomon Sosu Quarshie[3], Precious Kwablah Kwadzokpui[3] and Albert Abaka-Yawson[3*]

[1]Department of Clinical Microbiology, School of Medical Sciences, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana.
[2]Department of Medical Laboratory Sciences, School of Allied Health Sciences, University of Cape Coast, University Post Office, Cape Coast, Ghana.
[3]Department of Medical Laboratory Sciences, School of Allied Health Sciences, University of Health and Allied Sciences, P.M.B. 31, Ho, Ghana.

Authors' contributions

This work was carried out in collaboration among all authors. Authors RCB and CEB designed the study, searched literature, wrote the protocol and collected the data. Authors EAO and SSQ managed the preliminary statistical analysis and wrote the first draft of the manuscript. Authors PKK and AAY managed the final statistical analysis of the study and wrote the final manuscript. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/AJMAH/2020/v18i130177
Editor(s):
(1) Dr. P. Veera Muthumari, V. V. Vanniaperumal College for Women, Virudhunagar, Tamil Nadu, India.
Reviewers:
(1) Bekkouch Oussama, Mohamed Premier University, Morocco.
(2) K. Mohammed, Usmanu Danfodiyo University Sokoto, Nigeria.
Complete Peer review History: http://www.sdiarticle4.com/review-history/54810

Original Research Article

Received 11 December 2019
Accepted 17 February 2020
Published 03 March 2020

ABSTRACT

Background: Schistosomiasis remains one of the most common parasitic diseases worldwide causing considerable deaths especially among people in the Sub-Saharan region. This study determined the association between urinary Schistosomiasis and lipid profile among school children in Fante Akura, Yeji.
Materials and Methods: This simple randomized case-control study was conducted among 50 primary school students with *Schistosoma haematobium* infection and 50 healthy control students in Fante Akura, Yeji, from January, 2014 to March, 2014. Urine and blood samples were obtained

**Corresponding author: E-mail: albertayawson@ymail.com;*

and examined for the presence of *S. haematobium* and assessed their lipid profile respectively. A structured questionnaire was employed to obtain information from the study participants on their socio-demographic characteristics as well as on the risk factors that can predispose study participants to *S. haematobium* infection.

Results: The mean serum level of low-density lipoprotein cholesterol (LDL-C) was reduced significantly in schistosome-infected participants in comparison to controls (P<0.001). The mean serum levels of triglyceride (TG) (p=0.028), LDL-C (p=0.011) were significantly higher in participants with light *S. haematobium* infection intensity compared to participants with heavy *S. haematobium* infection intensity (P=0.028). The mean serum level of total cholesterol (TC) and high-density lipoprotein cholesterol (HDL-C) were higher (P>0.05) in participants with light SH infection intensity compared to participants with heavy SH infection intensity.

Conclusion: *S. haematobium* infection presented significant changes in serum levels of total cholesterol, triglycerides and low-density lipoproteins in participants infected with *S. haematobium* with a corresponding raised urine parasite count.

Keywords: Schistosomiasis; Schistosoma haematobium; lipid profile; total cholesterol; low- density lipoprotein; school children.

1. INTRODUCTION

Schistosomiasis is a fluke helminth infection affecting about 78 countries as well as about 207 million people globally [1,2]. This condition is among the most prevalent water-borne diseases globally and doubles as the third most devastating tropical disease, following malaria and intestinal helminthiasis with approximately 652 million people, mainly children and adults who engage in water-related activities put at risk [3]. Each year, about 300,000 deaths are recorded [1] with an estimated 93% (192 million) incidence of the world's estimated 207 million cases of schistosomiasis occurring in Sub-Saharan Africa [4].

Previous studies have shown that people infected with schistosomiasis have lower levels of serum cholesterol than uninfected controls [5]. A study by Faucher et al. [6] revealed that generally there is a reduced level of serum lipoproteins among individuals infected with parasites. *Schistosoma haematobium* infected subjects in south-west Nigeria reported a significantly reduced plasma concentration of triglycerides, total cholesterol, high-density lipoprotein cholesterol (HDL-C) and low-density lipoprotein cholesterol (LDL-C) regardless of their age and sex [7]. Dyslipidemia was revealed concomitantly by Doenhoff et al. [8] and da Fonseca et al. [9] in schistosomiasis patients as compared with control groups. However, according to Abdelsalam and colleagues, males infected with *S. haematobium* showed significantly elevated cholesterol levels compared to their female counterparts while heavily infected participants (ova>50) had recorded insignificant variations in their HDL-C levels [10].

The financial attachment, vis-à-vis the cost of getting tested for lipid profile in Ghana does not come easy for many parents most especially when they urgently require quick medical attention. Meanwhile, in Ghana, there is almost no established data on the influence of urinary schistosomiasis on an individual's lipid levels, especially in waterbody-bound areas. The study, therefore, saw it imperative to determine the lipid profile among school children with *S. haematobium* infection.

2. MATERIALS AND METHODS

2.1 Study Area

The study was conducted at Saint Mathias Catholic Hospital, Yeji, in the Atebubu District of Brong Ahafo Region. Yeji is an island fishing port, lying on the southern bank of the White Volta River in the Brong Ahafo Region of Ghana. During heavy rainfall, the White Volta River overflows its banks and leave streams and lagoons. The town serves as a terminal point on the main Kumasi-Tamale road via Mampong/ Ejura for travelers cross the Volta River; a major gateway to the north. Yeji is 225 km from Kumasi. The majority of the inhabitants of Yeji are peasant farmers. The 2010 Population and Housing Census estimated the region's population at 2,282,128 with the population of Yeji being 129,248 [11] and a total landmass of 39,557 sq. km.

2.2 Study Design/ Eligibility Criteria

A case-control study was conducted by convenient sampling among 50 Fante Akura primary school students with *S. haematobium* infection as cases and 50 control students from January, 2014 to March, 2014. School children infected with *Schistosoma haematobium* who were within the ages of 7-17 years were enrolled as cases. Healthy school children with similar age range as the cases were enrolled as controls. Participants who were on drugs or any form of medication, or conditions that will interfere with serum lipid levels were excluded. A questionnaire was used to obtain information on demographic variables including age and sex of participants.

2.3 Sample Collection and Processing

2.3.1 Urine sample collection

All Participants were given universal sterile urine containers and educated thoroughly on how to collect early morning midstream urine and clean catch urine. Participants were asked to produce about 10-15 ml of the early morning midstream urine.

2.3.2 Urine processing/microscopy

The urine samples obtained were examined for the presence and number of urine *S. haematobium*. Urine sample were analyzed using the centrifugation method as described by Chugh et al. [12] Ten (10) ml of each urine sample was pipetted and centrifuged at 3000 rpm for 5 minutes. The supernatant was discarded and the residue was put on a clean glass slide, covered with a coverslip and examined under x10 objective and later x40 objective lenses of the light microscope (Olympus American Clinical/Education CX® light microscope). The intensity was recorded as geometric mean egg count/10 ml urine. *S. haematobium* eggs were recognized by their larger size and their terminal spine [13]. Infections were graded as light (less than 50 ova per 10 ml urine), and heavy (more than 50 ova per 10ml urine) on the basis of the number of ova per 10 ml of urine [14].

2.3.3 Blood sample collection and analysis

Five (5) ml of venous blood was collected from each participant following standard operating procedures. The collected blood was allowed to clot and then centrifuged to obtain serum for the estimation of lipid profile. The lipid profile of participants was assessed using a biochemistry automated analyzer (Vital scientific product; Model selectra junior, Netherland). The serum was analyzed for total cholesterol, triglyceride and high-density lipoprotein (HDL) and low-density lipoprotein cholesterol (LDL-C).

2.4 Statistical Analysis

Data was entered using Microsoft Excel 2016 and analyzed using SPSS version 22.0 software. Chi-square test and logistic regression were used to determine associations between *S. haematobium* infection and corresponding lipid profiles of participants. Appropriate tables were used to describe results from the analysis. P-values less than 0.05 were considered statistically significant.

3. RESULTS AND DISCUSSION

3.1 Results

Table 1 summarizes the lipid profile of control and *S. haematobium* infected participants. The mean serum level of LDL cholesterol was reduced significantly in schistosome-infected participants in comparison to healthy controls ($p< 0.001$). The other parameters were similar when cases were compared to controls.

Of the 50 urinary schistosomiasis positive school children recruited, the majority (30), were females. The mean age of the males compared to the females was similar ($p>0.05$). The mean serum levels of total cholesterol were significantly reduced in *S. haematobium* -infected male participants compared to females ($P<0.05$); while the other variables were similar between the male and females ($P>0.05$) (Table 2).

In Table 3, the mean serum levels of triglyceride decreased significantly in participants with light *S. haematobium* infection intensity compared to participants with heavy *S. haematobium* infection intensity ($p=0.028$). Significantly elevated mean serum LDL-C levels in participants with light *S. haematobium* infection intensity compared to participants with heavy *S. haematobium* infection intensity was observed ($p=0.011$). All the other parameters were similar when participants with light infection were compared with those with heavy infection.

Table 1. Lipid Profile of participants

Variable	Control (n = 50)	Participants (n = 50)	P-value
Age(years)	10.50 ± 0.41	10.54 ± 0.33	0.949
Lipid profile			
TG (mmol/l)	1.44 ± 0.17	1.15 ± 0.14	0.200
TCHL (mmol/l)	3.55 ± 0.12	3.36 ± 0.08	0.187
LDL-C (mmol/l)	4.04 ± 0.15	1.66 ± 0.07	**< 0.001**
HDL-C (mmol/l)	1.26 ± 0.06	1.24 ± 0.07	0.792
Atherogenic index	-0.05 ± 0.51	-0.13 ± 0.05	0.275

Data are presented as mean ± standard deviation. TG-Triglycerides, TCHL-Total Cholesterol, LDL-C-Low Density Lipoprotein Cholesterol, HDL-C-High Density Lipoprotein Cholesterol. P-value significant at <0.05

Table 2. General characteristics of schistosome-infected participants stratified by gender

Variable	Male (n = 20)	Female (n = 30)	Total (n = 50)	p-value
Age (years)	10.15 ± 2.28	10.8 ± 2.31	10.54 ± 2.30	0.332
Lipid profile				
TG (mmol/l)	0.89 ± 0.17	1.32 ± 0.20	1.15 ± 0.14	0.134
TCHL (mmol/l)	3.10 ± 0.12	3.53 ± 0.10	3.36 ± 0.08	**0.008***
LDL-C (mmol/l)	1.60 ± 0.09	1.70 ± 0.09	1.66 ± 0.07	0.449
HDL-C (mmol/l)	1.17 ± 0.12	1.28 ± 0.83	1.24 ± 0.07	0.408
Atherogenic index	-0.20 ± 0.88	-0.08 ± 0.58	-0.13 ± 0.05	0.232

Data are presented as mean ± standard deviation. TG-Triglycerides, TCHL-Total Cholesterol, LDL-C-Low Density Lipoprotein Cholesterol, HDL-C-High Density Lipoprotein Cholesterol. P-value significant at <0.05

Table 3. Prevalence of SH infection stratified by the intensity in relation to demographic, lipid profile

Variable	Light (n = 39)	Heavy (n = 11)	P-value
Age(years)	10.79 ± 0.39	9.64 ± 0.45	0.141
Gender (n %)			
Male	14(35.9)	6(54.5)	0.265
Female	25(64.1)	5(45.5)	
Lipid profile			
TG (mmol/l)	0.99 ± 0.14	1.72 ± 0.39	**0.028**
TCHL (mmol/l)	3.37 ± 0.10	3.30 ± 0.13	0.707
LDL-C (mmol/l)	1.75 ± 0.71	1.35 ± 0.13	**0.011**
HDL-C (mmol/l)	1.26 ± 0.86	1.17 ± 0.74	0.593
Atherogenic index	-0.17 ± 0.50	0.34 ± 0.13	0.089

Data are presented as mean ± standard deviation for continuous variables and frequency and percentages in parenthesis. TG-Triglycerides, TCHL-Total Cholesterol, LDL-C-Low Density Lipoprotein Cholesterol, HDL-C-High Density Lipoprotein Cholesterol. P-value significant at <0.05

3.2 Discussion

The most devastating and prevalent human diseases which threaten a third of the world's human population with about 2 million deaths yearly can be traced to parasitic helminths and protozoa [10]. In an attempt to determine the serum lipid profile in *S. haematobium* infected school children as against healthy controls, this study discovered significantly low LDL-C ($p< 0.001$) among the infected participants (1.66 ± 0.07) relative to the controls (4.04 ± 0.15). Comparable findings among similar populations have been documented in Sudan and South-Western Nigeria [10,7]. A possible explanation for the reduced LDL-C as observed in this study could be attributed to a similar biochemical alteration that occurs in a *Schistosoma mansoni* infected individual. Existing knowledge has it that in the course of infection with *S. mansoni*,

oxidized LDL bind to the surface of schistosomula but the latter gets endocytosed into monocytes via the scavenger receptor [15,5]. The continuous cycle of LDL-C oxidation and endocytosis of the oxidized LDL-C (oxLDL-C) therefore could be a contributing factor for the reduced LDL-C observed in this study. Juxtaposed to findings from [7], outcomes from this study recorded insignificantly low total cholesterol, triglycerides and HDL-C levels among the *S. haematobium* infected participants recruited in this study. Period of incubation of parasite in the host from time of infection till time where significant blood chemistry alterations begin to surface could be an underwriting factor for this finding. Genetic variations could also be responsible for this observed biochemical disparity.

The gender-based variations of the lipids among the S. haematobium infected participants in this study revealed a comparable outcome of all the biochemical analytes measured vis-à-vis better HDL-C, best LDL-C and desirable total cholesterol and triglycerides. Although desirable (<5.2 mmol/L) [16], only TC showed a significant decrease ($p=0.008$) in males than observed in females; a finding which could be due to the overall low LDL-C observed among the total *S. haematobium* infected participants. Furthermore, in this study, majority of the cases, 78.0% (39/50) were diagnosed with light infection (less than 50 ova per 10 ml urine) which reiterates the earlier indication that most of these participants were infected with the parasite not too long to begin to show significant abnormalities with their serum lipid levels. This finding, however, compares well with that reported by Onuegbu et al. [7].

Of the 78.0% light infected cases studied, the majority were females whilst 54.5% (6/11) of the 22.0% heavy infected cases were males. A good cause of this finding could be as a result of the fact that males frequently get exposed to the infectious agent than do their female counterparts due to their habitual swimming, fishing and similar activities. The females due to some level of parental control and societal restrictions could only get exposed via fetching of the water and using it for household chores such as washing.

Significantly elevated triglyceride levels and reduced (though desirable) LDL-C levels among participants who presented with heavy infections were documented in this study. In a thin-layer chromatographic analysis, the major neutral lipid fractions of whole-worm extracts of male and female adult *S. haematobium* were free sterols, triacylglycerols and sterol esters. Traces of triacylglycerols/triglycerides and sterol esters were detected in worm-free incubates from separated worms [17]. This release of triglycerides from *S. haematobium* could account for the elevated TG levels observed in this study contrary to TG uptake by *S. mansoni* as reported by other studies [10,18]. Furthermore, according to Haseeb et al. [17], female *S. haematobium* incubated in a group of ten released more free fatty acids than ten incubated singly. This could mean that among heavily infected participants studied, increase the release of free fatty acids (FFAs) by adult worms in the venous plexus of the bladder could result in the formation of TGs from the combination of the FFAs and available glycerols. Per findings from this study, no significant gender or intensity difference of *S. haematobium* infection, was observed among the various lipids measured.

4. CONCLUSION AND RECOMMENDATIONS

The result of this study showed that Schistosoma infection made significant changes in serum levels of total cholesterol, triglycerides and low-density lipoproteins in participants infected with *Schistosoma haematobium* with a corresponding increase in parasitemia levels in urine. Further studies recruiting larger sample size should be carried out in order to obtain a more detailed and reflective variation in lipid profile among similar populations. Meanwhile, health promotion on schistosomiasis prevention and control should be intensified parallel with mass chemoprophylaxis administration as required by the World Health Organisation.

5. LIMITATIONS

A 24-hour urine would have been more appropriate for detecting the parasites since the excretion of Schistosoma eggs in urine is highest between 10 and 14 hours.

CONSENT AND ETHICAL APPROVAL

Ethical approval was sought from the Institutional Review Board (IRB/UCC) of the University of Cape Coast and the authorities of the hospital. Informed consent was also sought from the participant's parents, guidance or teachers before taking the data and samples. Records were kept strictly confidential.

ACKNOWLEDGEMENTS

We are grateful to the participants and staff in Fante Akura, Yeji, not forgetting the Ghana Education Service for their involvement and support during the conduct of the study.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Beltrame Anna, Guerriero Massimo, Angheben Andrea, Gobbi Federico, Requena-Mendez Ana, Zammarchi Lorenzo, Bisoffi Zeno. Accuracy of parasitological and immunological tests for the screening of human schistosomiasis in immigrants and refugees from African countries: An approach with latent class analysis. J PLoS Neglected Tropical Diseases. 2017;11(6):e0005593.
2. French Michael D, Evans Darin, Fleming Fiona M, Secor W, Evan Biritwum, Nana-Kwadwo Brooker, Simon J, King Charles H. Schistosomiasis in Africa: Improving strategies for long-term and sustainable morbidity control. J PLoS Neglected Tropical Diseases. 2018;12(6):e0006484.
3. WHO. Schistosomiasis. Fact Sheet. 2010;115.
4. Adenowo Abiola Fatimah, Oyinloye Babatunji Emmanuel, Ogunyinka Bolajoko Idiat, Kappo Abidemi Paul. Impact of human schistosomiasis in Sub-Saharan Africa. J Brazilian Journal of Infectious Diseases. 2015;19:196-205.
5. La Flamme AC, Harvie M, Kenwright D, Cameron K, Rawlence N, Low YS, McKenzie S. Chronic exposure to schistosome eggs reduces serum cholesterol but has no effect on atherosclerotic lesion development. J Parasite Immunology. 2007;29(5):259-266.
6. Faucher Jean-François, Ngou-Milama Edouard, Missinou Michel, Ngomo Raphaël, Kombila Maryvonne, Kremsner Peter G. The impact of malaria on common lipid parameters. Parasitology Research. 2002;88(12):1040-1043.
7. Onuegbu Jude A, Olisekodiaka Japhet M, Oladele Hassan A, Opeyemi Usman S, Igbeneghu Christopher A, Adeyeye Adetunji D. Lipid profile of subjects infected with *Schistosoma haematobium* in South-Western Nigeria. Journal of Medical Science. 2011;27(1):44-47.
8. Doenhoff MJ, Stanley RG, Griffiths K, Jackson CL. An anti-atherogenic effect of *Schistosoma mansoni* infections in mice associated with a parasite-induced lowering of blood total cholesterol. Parasitology. 2002;125(5):415-421.
9. da Fonseca, Caíque Silveira Martins, Pimenta Filho, Adenor Almeida, dos Santos, Bianka Santana, da Silva, Cesar Augusto, Domingues, Ana Lúcia Coutinho, Owen, James Stuart, de Menezes Lima, Vera Lucia. Human plasma lipid modulation in schistosomiasis mansoni depends on apolipoprotein E polymorphism. PloS One. 2014;9(7): e101964.
10. Abdelsalam KE, Alamin AA. The role of *Schistosoma haematobium* in alteration of serum lipid profile among Sudanese school children. International Journal of Biomedical Research. 2015;6(01):46-49.
11. GSS. Population and Housing Census, Pru Distruct; 2010.
12. Chugh KS, Harries AD, Dahniya MH, Nwosu AC, Gashau A, Thomas J, Onwuchekwa AC. Urinary schistosomiasis in Maiduguri, North East Nigeria. Ann Trop Med Parasitol. 1986;80(6):593-599. DOI: 10.1080/00034983.1986.11812073
13. CDC. Laboratory identification of parasites of public health concern; 2019. Available:https://www.cdc.gov/dpdx/schistosomiasis/
14. World Health Organisation, WHO. Division of Control of Tropical Disease: Schistosomiasis. WHO Update; 2004.
15. Khovidhunkit, Weerapan Kim, Min-Sun Memon, Riaz A, Shigenaga, Judy K, Moser, Arthur H, Feingold, Kenneth R, Grunfeld Carl. Effects of infection and inflammation on lipid and lipoprotein metabolism: Mechanisms and consequences to the host. The Journal of Lipid Research. 2004;45(7):1169-1196.
16. Mayo Clinic. Cholesterol test; 2019. Available:https://www.mayoclinic.org/tests-procedures/cholesterol-test/about/pac-20384601
17. Haseeb Muhammad A, Fried Bernard, Eveland LK. *Schistosoma haematobium*: Neutral lipid composition and release by adults maintained *in vitro*. Comparative Biochemistry and Physiology Part B: Comparative Biochemistry. 1985;81(1):43-45.

DOI:https://doi.org/10.1016/0305-0491(85)90158-0

18. Sturrock Hugh JW, Picon Diana, Sabasio Anthony, Oguttu David, Robinson Emily, Lado Mounir, Kolaczinski Jan. H. Integrated mapping of neglected tropical diseases: Epidemiological findings and control implications for northern Bahr-el-Ghazal State, Southern Sudan. J PLoS Neglected Tropical Diseases. 2009;3(10):e537.

© 2020 Brenyah et al.; This is an Open Access article distributed under the terms of the Creative Commons Attribution License (http://creativecommons.org/licenses/by/4.0), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Peer-review history:
The peer review history for this paper can be accessed here:
http://www.sdiarticle4.com/review-history/54810