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Urinary Schistosomiasis on Full Blood Count Among Six Hundred Post-Primary Willing School Children Living in Some Communities Around Kiri Dam, Shelleng Local Government Area, Adamawa State, Nigeria

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Abstract: In Nigeria, urinary schistosomiasis is a serious public health problem with about 29million infected cases and 101 million people at risk of infection. Consequently, the objective of this paper was to examine the effect of urinary schistosomiasis on full blood count among six hundred (600) post-primary willing school children living in some communities around Kiri Dam, Shelleng Local Government Area, Adamawa State, Nigeria using appropriate standard techniques. Results obtained show that the effect of urinary schistosomiasis on haemoglobin (Hb) at light infection (0-49) affected the Hb to14.2, at moderate infection (50-99) was at13.9and heavy infection (>100).The effect on lymphocytes on light infection was 2.72, moderate infection 2.70 and heavy infection 2.45.The intensity of infection on Neutrophils on light infection was 4.60, moderate infection 4.45 and heavy infection 4.40.The effect of urinary schistosomiasis on full blood count were statistically significantly notice along the rows from light to heavy despite results of variables within normal range

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In Nigeria, urinary schistosomiasis is a serious public health problem with about 29million infected cases and 101million people at risk of infection (Hotez *et al.* 2012; WHO, 2013). Recent reports showed unabated increase of infection in all the geographical zones of the country particularly among school children (Singh *et al.* 2016; Abdulkadir *et al.,* 2017). Epidemiological studies in many endemic communities have attributed sustained infection to many factors including routine agricultural practices, human behavior like swimming, bathing, fishing, and failed water projects to meet the needs of people (WHO, 2016). *S. haematobium* infection usually occur in school age children resulting in increased morbidity and mortality among affected populations. Majority of *S. haematobium* infections are asymptomatic; therefore, persons living in low resource areas only visit healthcare facilities after complications have developed (Prual, 2012). Clinical presentations such as dysuria, haematuria, pyuria, and lesions of the bladder have been implicated in urinary schistosomiasis (Mostafa *et al.* 2010). Iron deficiency anaemia is one major haematological presentation of heavy *S. haematobium* infection (Ayoya *et al.,* 2012).

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In acute cases, eosinophilia and leukocytosis have mostly been reported. In hepatosplenic patients, anaemia is common, usually normochromic and often macrocytic, likewise a significant rise inmonocytes, lymphocytes, and neutrophils (Mohammed *et al.* 2016). Meanwhile, Nagi *et al.* (2015) has also reported mild eosinophilia, leukocytosis, and mild neutropenia rather than anaemia as a feature of acute urinary schistosomiasis. Haemoglobin, white blood cell (total) counts, neutrophil, and lymphocyte levels have also been reported to be normal among primary school children in Ibadan, Nigeria (Nwabueze *et al.,* 2017). Interestingly, a significant relationship between the degree of eosinophilia and the intensity of infection has also been reported by Mohammed *et al.* (2016); Nwabueze *et al.* (2017). In Ghana, studies conducted by Mohammed *et al.* (2016); Ayeh–Kumi*et al.* (2015); Bosompem *et al.* (2011), have reported on the prevalence of *S. haematobium* infection. However, limited data exist on the effect of this infection on haematological indices. Also, most of these were cross-sectional studies which attempted to address the interactions between schistosomiasis and anaemia but have rather generated some conflicting results which render the magnitude of the relationship unclear. Hence, the objective of this paper is to examine the effect of urinary schistosomiasis on full blood count among six hundred (600) post-primary willing school children living in some communities around Kiri Dam, Shelleng Local Government Area, Adamawa State, Nigeria

MATERIALS AND METHODS

Study Area: Kiri Dam is situated along Latitude 9.40'47''N and longitude 12.00'51''E located in Shelleng Local Government Area (LGA), Adamawa State, Northeastern Nigeria, damming the Gongola River. It is a 1.2 km long, 20 m high zoned embankment with internal clay blanket.

The Dam was mainly completed in 1982. The reservoir has a capacity of 615 million m^3 for hydroelectric generation, provision of water for the irrigation of sugar cane for the Savannah Sugar Company (SSC) (Federal Ministry of Water Resources [FMoWR], 2010). A large-scale sugar cane plantation and processing company set up as a joint venture between the Federal Government of Nigeria and the Commonwealth Development Corporation [CDC], London and United States Trade and Development Agency [USTDA] (USTDA, 2011). The major water supply to the dam is from Dadin Kowa dam in Gombe State, and it is a tributary to River Benue via River Gongola

Ethical Considerations: An introductory letter from the University Modibbo Adama University [MAU], Yola was obtained and delivered to the State Ministry of Health with research proposal for research permission. Ethical clearance to use human subjects was obtained and forwarded to Adamawa State Universal Basic Education Board [ASUBEB] and Post Primary School Management Board along research proposals. From the State Headquarters to Shelleng LGA to the various study areas. Children who were willing to participate in the study signed informed consent form with the aid of their school teachers. Study participants were at liberty to decline participation or withdraw from the study at any stage without the fear of retribution. No data collection took place prior to obtaining informed consent. The benefits and the risks involved in samples collection were fully informed. Research participants were given the opportunity to ask questions for further clarification based on Helsinki Declaration, (1964).

Sample Size: A total of six hundred (600) school children were conveniently selected and categories into age groups from six major schools within communities along Kiri Dam. The choice for this study within the communities was based on the geographical proximity with Kiri Dam and the prevalence of urinary schistosomiasis from previous studies conducted by the Federal Ministry of Health (FMoH) in conjunction with Global Health in Adamawa State (2016) reported the prevalence of *S. haematobium* of 14.1% in Shelleng LGA. Recruitment of study participants was done through schools to class convenient selection for study participants.

Sampling Procedure: After successful official introduction and documentations, enlighten on study process and community stake holder's engagements was done to ease data collection. Samples collection was done with the help of the school teachers, community guide, research assistant and our laboratory scientist for acceptability by the pupils/students and also to make work faster not to compromise sample collections, transportation and storage. The researchers used schools for samples collection. Each study area were given a code number and participant were also given a unique identification number that was used throughout for answering questionnaires, samples collection, processing and the parasitological results of each study participants to avoid mixing data collected.

Blood Sample Collection Procedure: Blood samples collection was done for positive cases of schistosomiasis to assess the effect of *S.*

haematobium on FBC. Five (5) milliliters of venous blood was collected from all positive study participants into a specimen container of DipotassiumEthylenediaminetetraAcetic Acid (EDTA) tube for haematological analysis of the effect of schistosomiasis on the full blood count (WHO, 2016)

RESULTS ANDDISCUSSION

Effect of Urinary Schistosomiasis on Red Blood Cells (RBC): The effect of urinary schistosomiasis on red blood cells components isshown on Table 1 and was calculated based on normal range of the RBC variables (4.3-5.9 x 10^{12}/L) by WHO (2023) standard. The effect of urinary schistosomiasis on haemoglobin (Hb) at light infection (0-49) affected the Hb to14.2, at moderate infection (50-99) was at13.9and heavy infection (>100). The results show a statistically significant level (p value 0.060). The effect of urinary schistosomiasis on Haematocrit (Hct) with normal range of 38.8-46.2% was based on intensity of infection. Effect on Hct at light infection was 41, moderate infection 40.7 and heavy infection 39.95. The effect of urinary schistosomiasis onMean Corpuscular Volume (MCV) with normal range of 79.0-93.3(Fl) was based on intensity of infection. Effect on light infection was 85.0, moderate 84.6 and heavy infection was 84.15. The Mean Corpuscular Hemoglobin (MCH) normal range is 26.7-31.9 (pg). Effect of urinary schistosomiasis on light infection was 29.0, moderate infection 28.15and heavy infection 27.8. The Mean Corpuscular Hemoglobin Concentration (MCHC) normal range is 300-350(g/L). Effect of urinary schistosomiasis onlight infection was 296.5, moderate 294 and heavy infection 292.2. In conclusion, there is insignificant effect of urinary schistosomiasis on Haematocrit, Mean Corpuscular Volume, Mean Corpuscular Haemoglobin and Mean Corpuscular Haemoglobin Concentration (0.019, 0.001, 0.003 and 0.021) respectively with the exception of Hb (0.060*) which was significant at *p value 0.05.*

*Effect of Urinary Schistosomiasis Infection on White Blood Cells:*The effect of *S. haematobium* intensity of infection on lymphocytes on light infection was 2.72, moderate infection 2.70 and heavy infection 2.45.The intensity of infection on Neutrophils on light infection was 4.60, moderate infection 4.45 and heavy infection 4.40.The intensity of infection on eosinophil on light infection was 0.21, moderate infection 0.20 and heavy infection 0.18.The intensity of infection on basophils on light infection was 0.75, moderate infection 0.70and heavy infection 0.65. The intensity of infection on monocytes on light infection was 0.5, moderate infection 0.48 and heavy infection 0.45. The results show insignificant effect on Eosinophil and Basophil (0.011) and (0.002), respectively, while lymphocytes (0.082*), neutrophils (0.059*) and monocytes (0.051*) showed a significant effect on white blood cells at p < value 0.05 (Table 2)

Effect of Urinary Schistosomiasis Infection Levels on Platelets Counts: The effect of *S. haematobium* intensity of infection on Prothrombin Time (12-15.4 sec) on light infection was 13.4, on moderate infection it was 13.3 and on heavy infection it was 13.1. The intensity of infection on International Normalization Ratio (INR) with normal range of (0.0-1.1) with effect on light infection was 0.92, moderate infection 0.91 and heavy infection 0.89. The intensity of infection on Activated Partial Thromboplastin Time on light infection was 32.60, moderate infection 31.95 and heavy infection 30.90. The intensity of infection on Platelet Count (150-450g) on light infection was 290g, moderate infection 285g and heavy infection 282g. There was no statistically significant effect on Activated Partial Tthromboplastin Time and Platelet Count (0.003) and (0.003), respectively, however, the value of Prothrombin Time and International Normalization Ratio was significant (0.063*) and (0.054*), respectively, at p >0.05 (Table 3)

*Effect of Urinary Schistosomiasis on Red Blood Cells:*From our study, there was significant effect of schistosomiasis on haemoglobin while other sub set of red blood cells parametersdid not reveal any significant effect on red blood cells at *P value* 0.05.Previous studies conducted by Omranv*et al*. (1978) in the laboratory and Hussein (2013), Alkazzaz*et al*. (2018) and Dessiev*et al*. (2020) in humans reported anaemia with *S. mansoni,S. haematobium, S. Japonicum*. Anaemia is mostly associated with progressive decrease in haemoglobin level, RBCs count and the haematocrit value (HCT) with the progression of time of infection and decreased levels of mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC) which indicates the presence of hypochromacia as well as progressive decrease in MCV indicating microcytosis and microcytic hypochromic anaemia which indicate the etiology to iron deficiency anaemia (WHO, 2018).The exact mechanisms involved in schistosomiasis-associated anaemia is not well defined and many trials to explain the real cause of anaemia which may be due to blood loss, increased haemolysis and subsequent iron deficiency according to Issa and Shalaby,(2019). Studies conducted by Elmahdiv*et al*. (2013) and

Leonard *et al*. (2020) reported that no significant correlation exists between *S. haematobium*, *S. mansoni* and haemoglobin level's which could be due to drug treatment of urinary schistosomiasis case level.

Table 1: Effect of *S. haematobium* on red blood cells

Variables	Normal Range	Light (0-49)	Moderate (50-99)	Heavy (>100)	P-value
Hb(g/dL)	13.3-16.2	14.2	13.9	13.6	0.060*
Hct (%)	38.8-46.2	41	40.7	39.95	0.019
MCV (Fl)	79.0-93.3	85.0	84.6	84.15	0.001
MCH (pg)	26.7-31.9	29.0	28.15	27.8	0.003
MCHC (g/L)	300-350	296.5	294	292.2	0.021

χ^2_{cal} =0.02, df=8, χ^2_{Tab} = 15.50

Key: *Hb= Haemoglobin; Hct=Haematocrit; MCV=Mean Corpuscular Volume; MCH=Mean Corpuscular Hemoglobin; MCHC=Mean Corpuscular Hemoglobin Concentration;* ***Note:*** ** = No significant difference at p > 0.05*

Table 2: Effect of *S. haematobium*on White Blood Cells

Variables	Normal Range	Light (0-49)	Moderate (50-99)	Heavy (>100)	P-value
Lymphocyte	1.5-4.0	2.72	2.70	2.45	0.082*
Neutrophils	2.0-7.5	4.60	4.45	4.40	0.059*
Eosinophils	0.04-0.4	0.21	0.20	0.18	0.011
Basophils	0.5-1	0.75	0.70	0.65	0.002
Monocytes	0.2-0.8	0.5	0.48	0.45	0.051*

χ^2_{cal} =0.01, df=8, χ^2_{Tab} = 15.50

*Note: * = No significant difference at p > 0.05*

Table 3: Effect of *S. haematobium*on Platelet Counts

Variables	Normal Range	Light (0-49)	Moderate (50-99)	Heavy (>100)	P-value (%)
PT (sec)	12-15.4	13.4	13.3	13.1	0.063*
INR (ratio)	0.0-1.1	0.92	0.91	0.89	0.054*
APTT (sec)	26.3-39.4	32.60	31.95	30.90	0.003
PC (mm^3)	150-450g	290g	285g	282g	0.003

χ2cal =0.01, df=6, χ2Tab = 12.59

Key: *PT = Prothrombin Time: INR = International Normalization Ratio: APTT = Activated Partial Thromboplastin Time, PC= Platelet Counts;* ***Note:*** **= No significant difference at p > 0.05*

The insignificant effect of urinary schistosomiasis on RBC from the study participants could be as a result of low infection, strain of schistosomecercaria, immunity level of study participants, sample handling/laboratory analysis, level of parasiteamia, recent prophylaxis, sample size, age, endemicity/recurrent exposure to urinary schistosomiasis among the study population.

Effect of Urinary Schistosomiasis on the White Blood Cells: Our study revealed an increase rise in total leukocyte count levels among the study population which corroborate the reports of Mohammed *et al*. (2016) and Afrifa *et al*. (2017) among Sudanese and Ghanaian school children, respectively. The high level of total leukocytes count observed might be in connection with the host immune response against the presence of adult schistosomes in the body tissues, and the particular role of eosinophils in the defense against helminth infection is generally well recognized according to Issa and Shalaby (2019). Similarly, our results show a statistically significant increase in the levels of thrombocyte count among *S. haematobium* infected children. Based on what was demonstrated in their study on brown rats (Joseph *et al.,* 1983), we hypothesis that thrombophilia (blood cloth) is related to active defense mechanisms directed against adult worms. Previous studies from Ahmed *et al*.(2014); Mohammed *et al*. (2016) and Nwabueze *et al*. (2017) shows that there was elevation of white blood cells regards to urinary schistosomiasis on white blood cells as reported from different research conducted with a significant leukocytosis (elevation in WBC's counts) clinically which may be due to stimulated cellular production against the schistosomes and/or their ova as a defense mechanism by attaching to the parasite surface and secrete schistosomicidal substances as cationic proteins, hydrolytic enzymes, and oxidants leading to damage of schistosomes. The high white blood count levels we found among children with schistosomiasis corroborate the reports of Mohammed *et al*. (2016) and Afrifa *et al*. (2017) among Sudanese and Ghanaian school children, respectively. We hypothesize that the high level of total leukocytes count observed is to be seen in connection with the host immune response against the presence of adult schistosomes in the bloodstream, and the particular role of eosinophils in the defense against helminthic infections is generally well recognized according to Issah *et al*. (2019). Other studies indicated presence of leukopenia (low WBCs) as reported by Mahmoud

and El-Bessoumy (2013), Azab *et al*. (2017), Allam (2019) and Dessie *et al*. (2020). However, Abdel-Mottaleb *et al*. (2008) and Afrifa *et al*. (2017) reported insignificant changes in the total leucocytic counts in infected hosts. The differential leucocytic counts in this study showed no steady state because of the difference in the implicated cells as there was progressive lymphocytosis in relation to the time of infection as reported by Allan *et al*. (2014) and Alkazzaz *et al*. (2018). But other studies reported lymphopenia (low lymphocytes) by Morenikeji *et al*. (2014); Dejon-Agobé *et al.* (2019), and no change was seen in lymphocytes in response to acute infection by Mahmoud (2013). Neutropenia was seen in an ascending manner in response to infection by Abdel-Mottaleb *et al*. (2018) and AlKazzaz *et al*. (2018). In contrast, Soliman and El-Shenawy (2013), Ahmed *et al*. (2014) Thabet *et al*. (2017), Allam (2019) and Dejon-Agobe *et al*. (2021) reported variable rates of neutrophilia. But Afrifa *et al*. (2017) proved that no change was seen in neutrophils in response to schistosoma infection. However, according to Soliman and El-Shenawy (2003), Thabet *et al*. (2007), Mahmoud and El-Bessoumy (2013), Ahmed *et al*. (2014), Afrifa *et al*. (2017), AlKazzaz *et al*. (2018), Abdel-Mottaleb *et al*. (2018), Allam (2019) and Dejon-Agobe*et al.* (2021) eosinophils flourished in infected hosts in progression to infection time. Monocytes and basophils were not significantly changed in schistosomal infection as reported by Abdel-Mottaleb *et al*. (2008), Allam (2019), AlKazzaz *et al*. (2018) and Dejon-Agobe *et al*. (2021). However, Soliman and El-Shenawy (2013) and Mahmoud and El-Bessoumy (2013) reported monocytosis (elevation of monocytes) in schistosomal infected cases. Statistically, there was significant effect of urinary schistosomiasis on white blood cells from our study participants this might be as a result of high immunity, parasite load of the study population and stage of infection.

Effect of Urinary Schistosomiasis on the Platelets Count: Effect of urinary schistosomiasis on platelet count in this study was statistically insignificantly notice with the exception of INR (13.7/sec). Although previous studies revealed that platelets derangement as a result of the effect of schistosomiasis affect clotting profile of the affected individual based on the stage of infection (Da'dara *et al.*2014; Hou *et al.*2015). The schistosome tegument contains several enzymatic activities that lead to the degradation of Adenosine Diphosphate (ADP), Palta *et al*. (2014). This results in the inhibition of ADP-mediated platelet activation and aggregation (Da'dara *et al.*2014 and Elzoheiry *et al.*2018). According to Elzoheiry *et al*. (2018) enzyme effect at the tegumental surface helps to limit blood clot formation around the worms by acting as an anticoagulant and permit the parasites from free movement within the vasculature. Thrombocytes play a protective role against schistosomiasis by exerting direct damaging effects on adult worms, with platelet count changes depending on the disease phase as they were shown to adhere to the surfaces of host tissues and to kill mechanically transformed schistosomula, leading to thrombocytopenia in early disease especially at 4–6 weeks after initial infection (Da'dara *et al.*2014 and Stanley *et al.* 2019). Thrombocytosis is generally attributed to elevated erythropoietin level due to the effect of haemolytic anaemia and autosplenectomy which can adversely affect blood viscosity and predispose to red cell sickling and vaso-occlusive crisis (VOC) which invariably may lead to vascular endothelial damage with subsequent exposure of sub-endothelial micro fibrils and collagen, both of which cause platelet activation and aggregation, thereby re-enforcing vaso-occlusion as described by Ahmed *et al.* (2014). El-Shenawy *et al*. (2008) and Dejon-Agobe *et al*. (2021) all of who reported significant increase in the platelet counts (thrombocytosis). In contrast, Omran *et al*. (1978), Stanley *et al.* (2003), AlKazzaz *et al*. (2018) and Eyayu *et al*. (2020) reported decrease in platelets counts (thrombocytopenia) whereas; Thabet *et al*. (2017) reported insignificant change in platelets count by schistosomiasis. Low infection level, sample size, schistosomes' strains, method of laboratory analysis might be one of the possible reasons of insignificant effect on platelets count as our opinion.

Conclusion: The effect of urinary schistosomiasis on full blood count were significantly notice along the rows from light to heavy despite results of variables within normal range among the study population after differential diagnosis was done to exclude other chronic diseases effecting FBC.

Declaration of Conflict of Interest: The authors declare that no known conflict of interest or personal relationships that could have influence the work reported in this paper

Declaration of Data Availability Statement: Data are available upon request from the corresponding author

REFERENCES

Abdel-Mottaleb, EM; El-Gharieb, HH; AbdelRahman, MAM (2008). Parasitological and clinic pathological studies on some herbal preparations in mice experimentally infected with *Schistosomamansoni*. *Egy. J. Com. Path. Clin.Path.*,21 (2): 269-299.

Abdulkadir, A; Ahmed, M; Abubakar, BM (2017). Prevalence of urinary schistosomiasis in Nigeria, 1994–2015 Systematic review and meta-analysis. *Afr. J. Uro.*,23 (3): 228-239.

Afrifa, J; Gyedu, D.; Ofori, GE; Essien-Baidoo, S; Mensah-Essilfie, I (2017). Haematological Profile and Intensity of Urogenital Schistosomiasis in Ghanaian Children. *J. Env. Pub. Heal.,*42 (1): 48-55.

Ahmed, SG; Kagu, MB; Ibrahim, UA (2014). Impact of urinary schistosomiasis on haematological parameters and frequency of vasoocclusive crisis among patients with sickle cell disease in northern Nigeria.*Egy.J. Haem.*,**39** (2): 58-63.

Alkazzaz, MA; Adel-Aziz, MR; Elmahalawy, EK; Hassan, AA (2018). Hematological Profile in Schistosomamansoni Infected Mice Treated with Commiphoramolmol Extract compared with Praziquantel. *PSM Bio. Res. J.*,**3** (3): 77-84.

Allam, G (2019). Immunomodulatory effects of curcumin treatment on murine Schistosomiasismansoni. *Clin. J. Immunobio.* **2** (14): 712-727.

Allan, LA; Kutima, HL; Muya, S; Ayonga, D; Yole, D (2014). The Efficacy of a Herbal Drug, Schitozim over Praziquantel in the Management of *Schistosomamansoni* Infection in BALB/c mice. *J. Bio. Agric. Healthc.*,4(1): 77-87.

Ayeh-Kumi, PF; Obeng-Nkrumah, N; Baidoo, D; Teye, J; Asmah, RH (2015). High levels of urinary schistosomiasis among children in Bunuso, a Rural Community in Ghana: an urgent call for increased surveillance and control programs. *J. Para. Dis.*, 39 (4): 613-623.

Ayoya, MA; Stoltzfus, RJ; Spiekermann-Brouwer, GM (2012). *Hepcidin* and *plasmodium falciparum* malaria in anemic school children in Mali, *Bul. Soc. Path.Exo.*, 102 (4): 219-220.

Azab, AE; Bayomy, MFF; Elsayed, ASI; Eltoukhy, AAE (2017). Pathological and biochemical alterations induced by synchronize lead intoxication and bilharzial Infection in mice. *J. Chem. Pharm. Sci.*, 10 (3): 1251-1261.

Bosompem, KM; Bentum, IA; Otchere, J (2011). Infant schistosomiasis in Ghana: a survey in an irrigation community, *Trop. Med. Inter. Heal.*, 9 (8) 917- 922

Da'dara, AA; Bhardwaj, R; Skelly, PJ (2014).Schistosomeapyrase SmATPDase1, but not SmATPDase2, hydrolyses exogenous ATP and ADP. *Puri. Sig. J.*, 10 (4): 573–580.

Dejon-Agobe, JC; Adegnika, AA; Grobusch, MP (2019). Haematological changes in *Schistosoma haematobium* infections in school children in Gabon. *J. infec. Dis.*, 24 (2): 34-36.

Dessie, N; Lema, W; Aemero, M (2021). Hematological and Biochemical Profile of Patients Infected with *Schistosomamansoni* in Comparison with Apparently Healthy Individuals at Sanja Town, *Pharm.Biosci. J.*, 9 (2): 41-52

Elmahdi, TEE; Abdalla, AM; Mustafa, MHI (2013). Measuring the impact of Schistosomiasis infection on different blood parameters. *J. Bio. Agri. Healthc.*, 3 (7):39-47.

El-Shenawy, NS; Soliman, MFM; Reyad, SI (2008). The effect of antioxidant properties of aqueous garlic extracts and Nigella sativa as anti-schistosomiasis agents in mice.*Rev.Insti. Med. Trop. Sao Pau.,* 50(1): 29- 36.

Elzoheiry, M; Da'dara, AA; El-Beshbishi, SN;Skelly, PJ (2018). The essential ectoenzyme SmNPP5 from the human intravascular parasite *schistosomamansoni* is an ADPase and a potent inhibitor of platelet aggregation. *J. Clin. Haem.,*11(6): 79-89.

Eyayu, T; Zeleke, AJ; Seyoum, M; Worku, L (2020). Basic Coagulation Profiles and Platelet Count among *Schistosomamansoni* Infected Adults Attending Sanja Primary Hospital, Northwest Ethiopia. *Res. Rep. Trop. Med.*, 11: 27-36.

Federal Ministry of Water Resources [FMoWR] (2010). Update Report on Kiri Dam Pp 23

Federal Ministry of Health [FMoH] (2016). National Protocol for Epidemiological Mapping and baseline survey of Schistosomiasis and Soil Transmitted Helminths in Nigeria. Pp55.

Hotez,PJ; Savioli, L; Fenwick, A (2012). Neglected Tropical diseases of the Middle East and North Africa: Review of prevalence, distribution, and opportunities for control of schistosomiasis. *PLOS Neg. Trop. Dis.*, 6(2) 23-26.

Hou, Y; Carrim, N; Wang, Y; Gallant, RC; Marshall, A; Ni, H (2015). Platelets in hemostasis and thrombosis: novel mechanisms of fibrinogen-independent platelet aggregation and fibronectin-mediated protein wave of hemostasis. *J. Biomed. Res.*, 29 (6): 437-444.

Hussein, JK (2013). *Schistosomahaematobium*infection in school children and women of reproductive age: the effect on anaemia, blood pathophysiological changes in selected parts of Kwale, Kilifi and birth

weight outcomes in Tanariver, county, Coast Province, Kenya. PhD Thesis, Department of Parasitology, the Jomo Kenyatta University of Agriculture and Technology, Kenya, Pp 33

Joseph, M; Auriault, C; Capron, A; Vorng, H; Viens, P (1983). A new function for platelets: IgE-dependent killing of schistosomes. *Nat.,* 303:810-2

Leonard, KTD; Khan, PV; Gustave, LL; Tiburce, G (2020). Some Haematological Parameters among Urinary Schistosomiasis-Malaria Coinfected Children in Suburb of Malentouen Health District, West Region Cameroon. *Inter. J. Trop. Dis. Heal.* 41(7): 34-44

Mahmoud, EA; El-Bessoumy, AA (2013). Effect of Curcumin on hematological, biochemical and antioxidants parameters *Schistosomamansoni* infected mice. *Inter. J. Sci.,*2:1-14.

Mohammed, AS (2011). The secretory glands of the cercariae of *S. haematobium* and *S. mansoni* from Egypt. *Ann. Trop. Med. Para.,* **26** (1):7-22.

Mohammed, EH; Eltayeb, M; Ibrahim, H (2016). Haematological and biochemical morbidity of *Schistosomahaematobium* in school children in Sudan. *Sul. Qab. Uni. Med. J.*, 6(6): 59-64.

Morenikeji, O; Quazim, J; Omoregie, C (2014). A cross-sectional study on urogenital schistosomiasis in children; haematuria and proteinuria as diagnostic indicators in an endemic rural area of Nigeria. *J. Afr. Heal. Sci.,* 14:390–6.

Mostafa, MH; Sheweita, SA; O'Connor, PJ (2010). Relationship between schistosomiasis and bladder cancer. *J. Clin. Micro.,* 12(1): 97–111

Nagi, MAM; Kumar, A; Mubarak, JS; Bamashmoos, SA (2015). Epidemiological, clinical and haematological profile of schistosomiasis in *East* Yemen. *Medit. Heal. J.*, 5(1): 177-181.

Nwabueze, AA; Fagbemi, BO; Opara, KN (2017). Haematological profiles of primary school children infected with urinary schistosomiasis in Ibadan, Nigeria. *Nig. J. Para.*, 28(2): 95-98.

Omran, SA; Hussein, AT (1978). Iron deficiency and Dyserythropoiesisin a bilharzial and Nonbilharzial patients. *Egy. J .Bil.*, 5: 1-13.

Palta, S; Saroa, R; Palta, A (2014). Overview of the coagulation system. *Ind. J. Anaes.,* 58(5): 515-523.

Prual, A (2012). Consequences of *Schistosomahaematobium* infection on the iron status of school children in Niger. *Ame. J. Trop. Med. Hyg.,* 47 (3) 291-297.

Singh, K; Muddasiru, D; Singh, J (2016). Current status of schistosomiasis in Sokoto, Nigeria Parasite Epidemiology and Control.*J.Trop. Med.*, 1(3): 239–244.

Soliman, MFM; El-Shenawy, NS (2003). Evaluation of the protective effect of two antioxidative agents in mice experimentally infected with *Schistosomamansoni*: haematological and histopathological aspects. *Pak. J. Bio. Sci.*, 6(100): 887-897.

Stanley, RG; Ngaiza, JR; Wambayi, E; Lewis, J; Doenhoff, MJ (2019). Platelets as an innate defence mechanism against *Schistosomamansoni* infections in mice. *Para. J. Immu.,*25: 467-73.

Thabet, SS; Thabet, HS; Atalla, SS (2017). Efficacy of medical ozone in attenuation of murine *Schistosomiasismansoni* infection morbidity. *J. Egy. Soc. Para.*, 37(3):915-944.

USTDA (2011). Princeton energy resources international (peri). Feasibility study for the Nigeria: Kiri Dam Hydroelectric Power Plant. *Task J. Rep.*, 36 (13) 25-26.

World Health Organization [WHO] (2013). Schistosomiasis Progress Report.2001–2011 and Strategic Plan 2012–2020.World Health Organization; Geneva. Accessed 10/10/2023 pp 8

WHO (2016). Global Report on impact of Tropical Diseases. Accessed 2/2/22 pp 6

WHO (2018). Update Report on Schistosomiasis in children in sub–Saharan Region. Accessed 20/1/ 2023. 15 pp 23