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Original Research Article

Infection Status and Risk Factors Associated with Schistosomiasis among Pregnant Women in Jos, Nigeria

Ocheme Julius Okojokwu[1*], Rashida Adam Muhammad[1], Innocent Ajegba Onaji[2], Nanman Ladul Mwankat[1], Francis Ukah Ofuowoicho[1], Inemesit Dankat Bigwan[1], Rukaiyat Adamu[1], Mitu Cecilia Gideon[1], Bashiru Shafa Abubakar[3], Daniel Iduh Ejembi[1]

[1]Department of Microbiology, Faculty of Natural Sciences, University of Jos, Plateau State, Nigeria
[2]Department of Pharmaceutical Microbiology, Faculty of Pharmaceutical Sciences, University of Jos, Plateau State, Nigeria
[3]Department of Zoology, Faculty of Natural and Applied Sciences, Nasarawa State University, Keffi, Nasarawa State, Nigeria

***Corresponding author:** Ocheme Julius Okojokwu

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Abstract: Schistosomiasis is one of the most predominant neglected tropical diseases (NTDs) caused by systemic helminthes, *Schistosoma* sp. *S. haematobium* and *S. mansoni* are the main species that causes infection in the Sub-Saharan Africa causing urogenital schistosomiasis and intestinal schistosomiasis respectively. Schistosoma infection during pregnancy has been linked with low birth weight, still birth, maternal mortality and other adverse effects. The study was undertaken to determine the prevalence and risk factors associated with urinary schistosomiasis among pregnant women attending antenatal care at Plateau Specialist Hospital in Jos North Local Government Area, Plateau State. This study was carried out with a total of 200 samples collected from pregnant women who consented to participate in the study. The urine samples were collected from the consenting pregnant women and screened using POC-CCA urine cassette. Information on socio-demographic and risk factors were collected via structured questionnaire and analysed statistically. Out of the 200 women tested for *Schistosoma* circulating cathodic antigen, 138 were positive representing 69% (138/200) prevalence of schistosomiasis. None of the demographics nor the risk factors studied in the current research was found to be statistically associated ($\chi^2 > 0.05$) with schistosomiasis. *Schistosoma* infection is prevalent in Jos with 69.0% prevalence among women attending antenatal clinic in Plateau State Specialist Hospital with younger pregnant women (≤ 25 years) having a preponderance of the disease burden than the older women. Routine screening for schistosomiasis for all women attending antenatal care and appropriate treatment should be given. Education and awareness on the mode of transmission and detrimental effect of schistosomiasis is recommended.

Keywords: Circulating Cathodic Antigen, Schistosomiasis, *Schistosoma*, Pregnant women.

INTRODUCTION

Schistosomiasis is a water-borne, parasitic neglected tropical disease caused by infection with trematode worms of the family Schistosomatidae (Dawaki *et al*., 2016). It is one of the most predominant Neglected Tropical Diseases (NTDs) with an estimated global prevalence of 240 million cases (Mazzitelli *et al*., 2016). It is estimated that about 700 million people worldwide are at risk of this infection (Hotez *et al*., 2012). In Africa, Nigeria is one of the most endemic regions of urinary schistosomiasis with about 29 million cases and a risk population of 101 million people (Abdulkareem *et al*., 2018). Majority of these cases are associated with school children population (Adenowo *et al*., 2015).

Six (6) species of *Schistosoma: Schistosoma haematobium*, *Schistosoma mansoni*, *Schistosoma guineensis*, *Schistosoma intercalatum*, *Schistosoma japonicum* and *Schistosoma mekongi* have been linked to cause infection in humans. About 90% of Schistosomiasis cases are recorded in the Sub-Saharan Africa (Salawu and Odaibo, 2016), where the main species are *S. haematobium* and *S. mansoni* which are the causative agents of urogenital schistosomiasis and intestinal schistosomiasis respectively (Tonga *et al*., 2019). Infection occurs as a result of dermal contact with water containing the schistosome larvae called cercariae produced by the intermediate snail host of the parasite. This then penetrate the skin and matures in the human host (Otuneme *et al*., 2019). Beyond the

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relationship between the human host, snail host and the parasite as predisposing factor; environmental, biological, socioeconomic, complex demographic and cultural processes are also factors that contribute to the wide-spread of this disease (Salawu and Odaibo, 2016).

Women are more likely to be exposed to infection during domestic activities carried out in streams or rivers such as fetching water, washing clothes, bathing and some agricultural activities (Downs *et al*., 2011; Anchang-Kimbi *et al*., 2017). An estimate of 40 million women of childbearing age is recorded to be infected with schistosomiasis, with almost 10 million infected pregnant women in Africa (Wepnje *et al*., 2019). With this statistics, schistosomiasis in pregnancy has become a major area of public health concern (Mombo-Ngoma *et al*., 2016).

Some of the symptoms and adverse effect caused by this infection includes; fever, stunting chronic antigenic inflammation caused by the deposition of the Schistosome eggs in the wall of the urogenital bladder, which can result to haematuria and dysuria (Zida *et al*., 201; WHO, 2018). Complications are urothelial abnormalities, formation of granulomata, genital lesions, anaemia, kidney failure, chronic cystitis and bladder cancer (Zida *et al*., 2016; Wepnje *et al*., 2019). UGS has also been linked with difficulty in conception and ectopic pregnancy (Salawu and Odaibo, 2013), severe anaemia, maternal mortality, premature birth and low birth weight in pregnancy (Wepnje *et al*., 2019).

Preventive chemotherapy with praziquantel for control of schistosomiasis, a recommended strategy by the World Health Organization is primarily geared toward primary school children of 5 to 15 years since they have the highest number of infection (Deol *et al*., 2019). Other age groups, pregnant women inclusive are often neglected even with recent research showing the safety of praziquantel in human pregnancy (Friedman *et al*., 2017).

Due to the less attention given to the diagnosis and prognosis of this infection especially among women of reproductive age, this study was aimed at determining the prevalence and risk factors associated with urinary schistosomiasis among pregnant women attending antenatal care at Plateau Specialist Hospital in Jos North Local Government Area, Plateau State.

MATERIALS AND METHODS

Study Area

The study was conducted in Jos North Local Government Area of Plateau State, Nigeria located between latitude 9°55'42.56" N and longitude 8°53'31.63" E, among women attending antenatal care at Plateau State Specialist Hospital Jos, Plateau State Nigeria.

Sample Size and Study Population

The total samples collected for this study were 200. All consenting pregnant women attending antenatal care within the period of the study were enrolled for the research.

Ethical Approval

The study was granted ethical approval with reference number NHREC/05/01/2010b by the ethical committees of Plateau State Specialist Hospital Jos, Plateau State. Consent of the study participants were also sought before they were included in the study.

Data Collection

Structured questionnaire was used to obtained demographic details and other relevant information such as trimester of pregnancy, history of STI and urogenital symptoms from the participants.

Sample Collection

Midstream urine samples were collected from 10:00am to 12:00am over consecutive days from each of the participating pregnant women. The urine samples were transported promptly to the laboratory and processed within 30 minutes of collection.

Sample Analysis

Samples were analysed using Point-of-Care Circulating Cathodic Antigen (POC-CCA®) which is an immunochromatographic kit (Rapid Medical Diagnostics, Pretoria, South Africa) in accordance with the manufacturer's instructions. The test was performed at room temperature, following the manufacturer's instructions. One drop of urine was added to the well of the testing cassette and after being fully absorbed, one drop of buffer was added to the same well. After 20 minutes of incubation with the testing cassette in the horizontal position, the result was visually read. The test was only considered valid when the control band was visualised. Invalid tests were repeated using the same urine sample. Valid tests were scored as negative, trace (weak band), or positive.

Positive: appearance of 2 red bands at the test (T) and the control (C) regions of the test kit is indicative of positive result. The positive results showed that the sample contained *Schistosoma haematobium* antigen.

Negative: only one red band appeared at the control line of the test. The Negative results showed that *Schistosoma haematobium* antigen was not detected in the samples or the content is below the detectable range.

Invalidity: if there were no red bands at the control line or at the test bands, it indicates that the operation course was invalid. In this case, the samples were to be repeated.

Statistical Analysis of the Results

Data obtained from this study were analysed using statistical package for social science (SPSS) version 23 (IBM SPSS Inc., USA). Analysis of association with *Schistosoma* infection was performed on potential risk factors using the Pearson Chi-Square. Statistical significance was accepted at p-value of < 0.05.

RESULTS

Out of the 200 samples that were tested for *Schistosoma haematobium*, Table 1 revealed that 138 (69.0%) were positive for *S. haematobium*. The prevalence based on demographics shows the prevalence of *Schistosoma haematobium* in relation to age, that the age group 16-20 (75.0%) had the highest number of infections followed by age group 21-25 (70.0%). The age group 26-30, 31-35, 36-40, 41-45 had the prevalence of 68.8%, 68.4%, 64.3% and 100.0% respectively. This was not statistically significant (χ^2 = 0.680; p-value = 0.984) (Table 1).

Married women had the highest prevalence of 124 (69.7%) than in single 12(66.7%) but this was not statistically significant (χ^2 = 0.379; p-value = 0.827). Table shows the prevalence of *Schistosoma haematobium* in relation to educational status. Women who had secondary education had the highest prevalence of *C. trachomatis* of 74.5%, tertiary 65.0%, primary 63.6% and informal education 50.0%. The difference was however not statistically significant (χ^2 = 1.442; p-value = 0.696). With respect to occupational status, traders had the highest prevalence 58 (74.4%) followed by those who had no occupation 32 (69.6%), students 40 (66.7%) and farmers 8 (50.0%). The difference was also not not statistically significant (χ^2 = 1.954; p-value = 0.582). Women who were unemployed had the highest prevalence 76 (77.6%), others 38 (63.3%) and employed 24 (57.1%). This was not statistically significant (χ^2 = 3.506; p-value = 0.173) (Table 1).

Table 2 presents prevalence of *Schistosoma haematobium* based on risk factors with women in first trimester had the highest prevalence 28 (77.8%), second trimester 72 (67.9%) and third trimester 38 (65.5%). This was not statistically significant (χ^2 = 0.841; p-value = 0.657). Women who had no access to pipe-borne water had a higher prevalence 74 (74.0%) while those with access to pipe-borne water were 64 (64.0%). Though this was not statistically significant (χ^2 = 1.169; p-value = 0.280). Those who had source of water to be other sources has the prevalence 18 (81.8%), well 54 (69.2%), river 4 (66.7%) and tap 62 (66.0%). This was not statistically significant (χ^2 = 1.057; p-value = 0.787).

With respect to water contact habit, fishing had the highest prevalence 2 (100.0%), agricultural work 6 (75.0%), washing 98 (72.1%), play and bath 28 (63.6%) and no contact 4 (40.0%). This shows that water contact habit was not significantly associated (χ^2 = 3.076; p-value = 0.545) with *S. haematobium* infestation. Women who have had treatment for schistosomiasis had the highest prevalence 24 (70.6%) while those who have not received treatment had the prevalence 114 (68.7%). The difference was also not statistically significant (χ2 = 0.024; p-value = 0.876).

Table 1: Prevalence based on demographics

Variables	No. of sample	No. positive (%)	χ^2	p-value
Age (years)				
16 – 20	8	6 (75.0)	0.680	0.984
21 – 25	60	42 (70.0)		
26 – 30	64	44 (68.8)		
31 – 35	38	26 (68.4)		
36 – 40	28	18 (64.3)		
41 – 45	2	2 (100.0)		
Total	200	138 (69.0)		
Marital status				
Single	18	12 (66.7)	0.379	0.827
Married	178	124 (69.7)		
Divorced	4	2 (50.0)		
Total	200	138 (69.0)		
Educational status				
Primary	22	14 (63.6)	1.442	0.696
Secondary	94	70 (74.5)		
Tertiary	80	52 (65.0)		
No formal education	4	2 (50.0)		
Total	200	138 (69.0)		

Occupation				
Student	60	40 (66.7)	1.954	0.582
Farmer	16	8 (50.0)		
Trader	78	58 (74.4)		
None	46	32 (69.6)		
Total	200	138 (69.0)		
Employment status				
Employment	42	24 (57.1)	3.506	0.173
Unemployment	98	76 (77.6)		
Others	60	38 (63.3)		
Total	200	138 (69.0)		

Table 2: Prevalence based on risk factors

Variables	No. of sample	No. positive (%)	χ^2	p-value
Trimester				
First	36	28 (77.8)	0.841	0.657
Second	106	72 (67.9)		
Third	58	38 (65.5)		
Total	200	138 (69.0)		
Presence of pipe-borne water				
Yes	100	64 (64.0)	1.169	0.280
No	100	74 (74.0)		
Total	200	138 (69.0)		
Source of water				
Tap	94	62 (66.0)	1.057	0.787
Well	78	54 (69.2)		
River	6	4 (66.7)		
Others	22	18 (81.8)		
Total	200	138 (69.0)		
Water contact habit				
Play and bath	44	28 (63.6)	3.076	0.545
Washing	136	98 (72.1)		
Agricultural work	8	6 (75.0)		
Fishing	2	2 (100.0)		
No contact	10	4 (40.0)		
Total	200	138 (69.0)		
Treatment of schistosomiasis				
Yes	34	24 (70.6)	0.024	0.876
No	166	114 (68.7)		
Total	200	138 (69.0)		

DISCUSSIONS

Urine circulating cathodic antigen (CCA) test is a rapid antigen detecting test of active schistosome infection, particularly *Schistosoma mansoni*, as the gastrointestinal tract of schistosome is a cul-de-sac, the parasite regurgitates undigested particulate materials at regular intervals. The gut of the parasite is also associated with glycoproteins (Tchuem Tchuente *et al*., 2012). CCA is one of the major antigens regurgitated by the adult worm which is in turn expelled from the host's body alongside the urine. The high sensitivity of CCA in this study is consistent with previous studies (Standley *et al*., 2010; Shane *et al*., 2011; Tchuem Tchuente *et al*., 2012). The results of this observational study demonstrates that urinary schistosomiasis is being transmitted in the study area. High prevalence (69.0%) of urinary schistosomiasis amongst pregnant women attending selected hospitals in Jos metropolis was observed in the present study. Such findings have potential public health implication as the infected pregnant women stand the risk of anaemia. Steketee (2003) asserted that anaemia during pregnancy is an important contributor to maternal ill-health and mortality, especially around the time of delivery. The high prevalence of *S. mansoni* could be attributed to the high sensitivity and specificity of POC-CCA test kit in detecting CCA in urine in active *S. mansoni*-infected individuals, especially in individuals with light infection intensity (Legesse and Erko, 2008; Colley *et al*., 2013; Adriko *et al*., 2014).

The high prevalence of *Schistosoma* circulating cathodic antigen in the study population is a reflection of high exposure of the women to

Schistosoma infestation which could be attributed to dependence on natural water sources such as ponds, rivers and streams for domestic activities, bathing and economic activities such as paddy rice cultivation and fishing. The findings of this study corroborates the prevalence of 63.5% reported by Ajanga *et al*. (2006) in Tanzania. On the other hand, in contrast to the high level of infestation in this study, lower prevalence of schistosomiasis amongst pregnant women were reported by Eyo *et al*. (2012) (23.8%) in Nigeria and Achang-Kimbi *et al*. (2017) in Cameroon. The differences in the prevalence of *Schistosoma* infestation may partly be explained by the differences in the detection method employed by the researchers in the various studies. While the current study used POC-CCA test, the aforementioned studies deployed urine filtration method followed by microscopy. In Plateau State Nigeria, there is no cultural restrictions or prohibitions or pregnant women from visiting natural bodies as is the case in the other climes (Eyo *et al*. 2012).

The study reveals that majority of the women had no access to pipe-borne water. This could increase the risk of infestation among women in the study area as they are culturally charged with the responsibility of fetching water, laundry, and washing of dishes which are often carried out in streams, ponds and other natural water bodies. Where such water bodies are infested with the infective developmental stages of the schistosome parasite, the risk of infestation and intensity of schistosomiasis is often heightened (Sousa-Figueiredo *et al*., 2012; Anto *et al*., 2013). Anto *et al*. (2013) reported that the risk of infestation associated with schistosomes increases with increase in the number and duration of contact with infested water. Therefore, enlightenment of women, especially pregnant women, to avoid or make less contact with infested surface-water is pertinent to control the infestation. This behavioural change will significantly reduce the risk of *Schistosoma* infestation (Achang-Kimbi *et al*. 2017). In addition, it is advisable that government provides pipe-borne water to the populace to reduce incidences of *Schistosoma* infestation. In Brazil, prevalence of schistosomiasis was shown to be reduced by provision of communal water supply (Wepnje *et al*., 2019).

In consonance with previous studies (Salawu and Odaibo, 2013; Ntorifor *et al*., 2015), schistosome infestation was higher in younger pregnant women. The age group ≤ 25 years was observed to be more infested with the parasite. The reduced risk of infestation with schistosomes observed in older women (> 25 years) is attributable to age-acquired immunity to reinfection and probably changes in water contact habit and frequency as age increases (Etard *et al*., 1995). Typically, in schistosome-endemic communities, infestations are accumulated early in life, peak in childhood and decline thereafter with age (Murenjkwa *et al*., 2020). The age-associated decline in infestation could be driven by development of immune-mediated resistance (Mutapi *et al*., 1997), increasing years of education and enlightenment (Mutsaka-Makuvaza *et al*., 2019), changes in physiology (Fulford *et al*., 1998; Jarilla *et al*., 2006), and water contact behaviour (Yirenya-Tawiah, 2011; Hegertun *et al*., 2013; Galappaththi-Arachchige *et al*., 2016).

Though pregnancy trimester was not associated with the prevalence of schistosomiasis in the present study, prevalence of the disease decreases with increasing trimester pregnancy. During pregnancy, when increasing levels of oestrogens and progesterones are produced to allow for foetal development, the susceptibility to parasitic infection is often increased and potentiated (Shirahata *et al*., 1992; Menendz, 1995). Owing to the above reason, women in the third trimester would be expected to be at the highest risk, given their increased levels of reproductive hormones and corticosteroids (Salawu and Odaibo, 2013). The findings of our study obviously contradicts this assumption because women in the earlier trimester (first trimester followed by second trimester) had higher burden of schistosomiasis.

CONCLUSIONS

The prevalence of *Schistosoma haematobium* infection is 69.0% among women attending antenatal care in Plateau State Specialist Hospital, Jos North LGA of Plateau State. Younger pregnant women were more infected than older pregnant women. The infection is a big public health treat considering the adverse effects such as cervical cancer, anaemia, kidney failure, bladder cancer and also causes complications to the mother and her neonate. Routine screening for schistosomiasis for all women attending antenatal care and appropriate treatment should be given to pregnant women since the infection has been associated with complications during pregnancy. Education of women and awareness on the mode of transmission and detrimental effect of schistosomiasis should also be given a top priority.

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