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Impact Assessment of Schistosomiasis and Soil-Transmitted Helminthiasis Following Ten (10) Years (2009-2019) of Continuous Treatment with Praziquantel and Albendazole in Endemic Area, Plateau State

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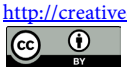

Abstract

Schistoisomiasis and Soil-transmitted helminthiasis infections are common public health challenges in developing countries. This study determined the status of these infections among inhabitants of Gille and Wulmi communities of Pankshin Local Government Area, Plateau State following 10 years (2009-2019) of Mass Medicine Administration (MMA). 525 Urine and stool samples were collected from each subject of the two communities where Praziquantel and Albendazole were distributed continuously for ten (10 years 2009-2019). Urine was examined for haematuria using haemastix test and positive ones were confirmed by microscopy using the simple sedimentation method while faecal samples were examined using Kato-Kartz technique. The result shows that 0 (0%) infection for schistosomiasis while STH (Soil-transmitted Helminths) showed 12 (2.29%). Males had higher 8 (3.24%) infections compared to females 4 (1.44%). In relation to age groups, age 21 - 30 years showed 1 (1.39%), 31 - 40 years 1 (1.54%), 51 - 60 years 1 (2.33%), 0 - 10 years 4 (2.85%) and highest in age 11 - 20 years 5 (5.05%). Age 41 - 50, 61 - 70 and 71 and above had no infection 0 (0%). Soil-transmitted helminthiasis (STH) infections in the studied communities indicate low persistent transmission which is a risk, necessitating continuous routine deworming, Public enlightenment campaigns on the epidemiology and triad of transmission of schistosomiasis and Soil transmitted helminthiasis in the communities.

Subject Areas

Epidemiology

Keywords

Schistosomiasis, STH, Impact, Assessment, Paraziquantel, Albendazole, Pankshin LGA and Nigeria

1. Introduction

Schistosomiasis and Soil-transmitted Helminthiasis infections constitute major public health problem and share the majority burden of disease from the group of Neglected Tropical Diseases (Hotez *et al.*, 2014) [1]. These infections cause significant morbidity worldwide, particularly in sub-Saharan Africa. In most endemic countries, these infections often occur in the same individual (Raso *et al.*, 2004) [2]. STH Infections contribute heavily to intestinal damage, anemia, impaired physical, and mental growth in children, and for schistosomiasis, organ damage with important differences in males and females (Campbell *et al.*, 2018) [3]. In schistosomiasis-endemic areas, symptoms of both female and male genital schistosomiasis can manifest after many years of infection, commencing from preschool-aged exposure (Stothard, 2013) [4]. Studies have shown that school-aged children harbor the highest prevalence and intensity of schistosome infections, while a lower intensity of infection is observed in adults (Van der Werf *et al.*, 2003 [5]; Hotez & Kamath, 2009 [6]). Also, according to Uneke (2010) [7] children are the most vulnerable group of STH as noted in sub-Saharan Africa. In Nigeria, more than 90% of the age group is either in preschool, a primary or secondary school where the infection is acquired through playing with contaminated soil (Despommier, 2003 [8]; Fisher, 2003 [9]). Human infection is influenced by poverty, poor personal hygiene, inadequate sanitation and overcrowding (Alemu *et al.*, 2011) [10]. The lower intensity of infection observed in adults might be explained by behavioural changes toward risk areas such as avoiding water contacts or risk areas that come with an increase in age and slower development of partial immunity (Rujeni *et al.*, 2017) [11]. However, in high-transmission areas and in areas with a high frequency of human water contact associated with economic activities, a large number of both young adults and mature adults are infected with the disease (Rujeni *et al.*, 2017) [11]. Environmental survival of STH eggs and larvae including hatching and embryonation is determined by warm temperatures and adequate moisture which contributes to its prevalence (Booker *et al.*, 2006) [12]. Mass Medicine Administration for schistosomiasis and STH has presently been scaled up to 27 states in Nigeria which Pankshin Local government Council in Plateau state is inclusive with the Federal and state Ministries of Health (MoH) in 2000 and assistance from the Carter Center, have provided separate rounds of annual MMA with albendazole and praziquantel (Federal and state Ministries of Health, 2013). The WHO recommends that countries conduct an evaluation after five years of MMA to assess the impact on the prevalence of schistosomiasis and STH, and adjust the treatment distribution

plan based on the new prevalence data, if appropriate (WHO, 2011) [13].

It is therefore incumbent upon countries to monitor the impact of their programs, both to refine control strategies and to share successes and challenges with the global audience to advance knowledge about the control of these diseases. Additionally, the idea behind the present study is to complement global efforts towards the elimination of STH infections which would have been by 2020 as targeted by the WHO and the London declaration (WHO, 2012b) [14]. This data is also important for understanding the existing situation in relation to these infections, tracking the trends across the different regions of the country, and understanding the effect of control programs on the prevalence and intensity of infections.

2. Materials and Methods

2.1. Study Area

Pankshin is a Local Government Area in Central Plateau State Nigeria with the headquarter in Pankshin town (**Figure 1**). It has an area of 1.524 Km^2, located at 9˚20'0" North and 9˚27'0" above sea level. Pankshin is well known for its relatively cool temperature and the annual temperature is 22˚C and the rainfall averages is

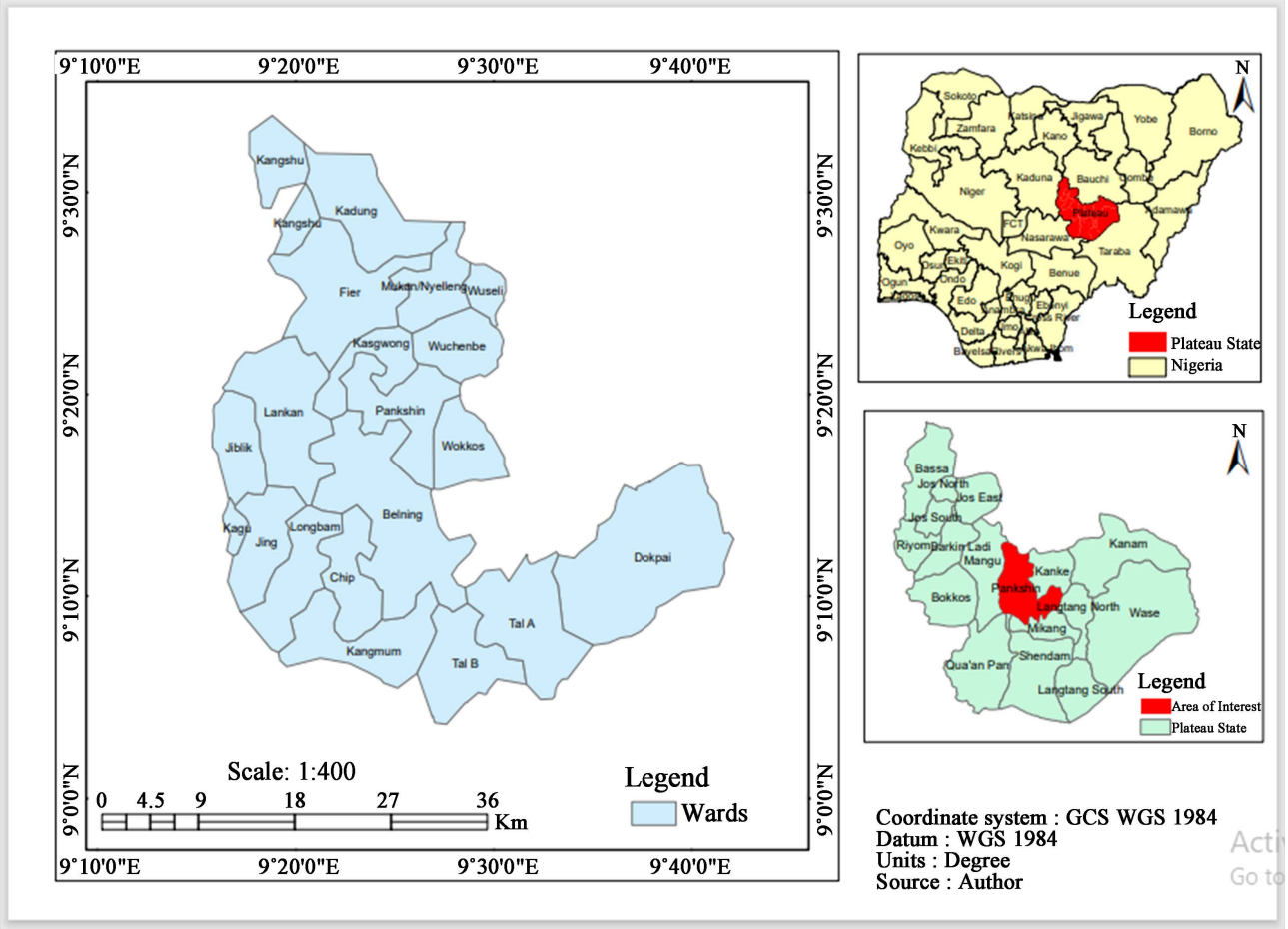

Figure 1. Study area map of Pankshin LGA.

1150 millimeters (45 in). The range of temperatures could be hottest from April to early June while heavy rainfalls are from late June to mid-August. The coldest temperature can be felt in mid-November to late February, January being the coldest month.

2.2. Study Sites

The study sites include areas that are being captured during the Mass Medicine Administration (MMA). The sites include Gille, from Wokkos District and Wulmi from Pankshin District. Gille is located on a hill with swampy areas. The inhabitants are predominantly farmers as they mostly grow vegetables. The soil texture in this study area is loamy and very fertile. Wulmi village is located near the Pankshin Dam with soil type as sandy. The inhabitants are predominantly farmers while some are fishermen. The sources of drinking water available in the two communities are well and river.

2.3. Ethics

Prior to the commencement of the research, an introductory letter was written to the Director of Health of Pankshin Local Government from the Head of Zoology Department, University of Jos. Permission was granted through the Monitoring and Evaluation of the Health department, who also supervised the researcher during sample collection and analysis. Consent was fully obtained from subjects who willingly filled the questionnaires and submitted their urine and stool samples for analysis.

2.4. Study Design

The design of this study was to compare samples taken from two communities in the study area after Mass Drug Administration of Praziquantel and Albendazole for 10 years (2009-2019).

In 2013, the state Ministries of Health and Education provided lists of communities in each LGA. From this list, the two communities were randomly selected because they had shown high rates of positivity during heme dipstick testing between 1999 and 2009 (unpublished data). A sample size of 525 individuals of both sexes (about 50% male and 50% female) was intended. The donors were selected systematically from within these two communities, using a sampling interval derived from the target sample size and the number present.

2.5. Sample Collections

Urine and stool samples were collected from willing subjects between 10:00 hours and 14:00 hours (Chessbourg, 2005) [15]. All subjects were supplied with two (2) clean universal bottles each; one for urine and another for stool. The specimens were thereafter transported to the College of Health Technology Pankshin for analysis. 291 samples were collected from Gille while 234 samples were collected from Wulmi community.

2.6. Sample Analysis

Samples were examined for haematuria with haemastix and positive ones were confirmed by microscopy, using the simple sedimentation method as described by Cheesbrough (2005) [15]. Faecal samples were first strained through two double-ply cotton gauze. A plastic template with a central hole 6 mm in diameter was placed on a clean glass slide and the hole filled with stool sediment. The template was carefully withdrawn from the slide leaving the faecal sample of about 14.7 mg on the glass slide. Two drops of malachite green solution were added to the sample on the slide and then mixed thoroughly. The mixture was covered with a cover slip and then examined under a light microscope for helminths eggs. Each morphologically different egg was counted using a tally hand counter (Kato-Kartz technique). The intensity of each helminth observed was determined by multiplying the number of eggs of the species counted by 24 to obtain the number of eggs per gram of faeces (WHO, 2016) [16].

2.7. Statistical Analysis

The recorded data were entered into Microsoft excel data base system and analyzed using Graphpad prism 8.0.1.244 version statistical software. Descriptive statistics was also computed Pearson's chisquare (x^2) was used to evaluate the association between variables (prevalence, gender and age). A P-value less than 0.05 (at 5% level of significance) were considered significant in all analyses.

3. Results

Distribution of Schistosomiasis and STH in Gille and Wulmi

Among the 525 subjects examined in Gille and Wulmi, Schistosomiasis incidence was 0 (0%) (Table 1). 12 (2.29%) were infected with STH (Table 2), out of

Table 1. Incidence of *Schistosoma haematobium* among the inhabitants of Gille and Wulmi Community of Pankshin LGA, Plateau State.

Communities	No examined	No (%) Infection
Gille	291	0 (0%)
Wulmi	234	0 (0%)
Total	525	0 (0%)

Table 2. Incidence of Soil-transmitted Helminthiasis among the inhabitants of Gille and Wulmi Community of Pankshin LGA, Plateau State.

Communities	No examined	No infected	No (%) Infection
Gille	291	8	8 (2.7)
Wulmi	234	4	4 (1.7)
Total	525	12	

χ^2 at $df(1) = 0.63$; P = 0.43.

291 subjects from Gille, 8 (3.44%) was recorded while 4 (1.71%) was recorded in Wulmi. There was no significant difference (P = 0.43, P > 0.05) in the prevalence of STH between the two communities.

Males had 8 (3.24%) infection while females had 4 (1.44%) (Table 3). Chi-square analysis showed that there was no significant difference (P = 0.17) in the prevalence of infection between males and females despite more females were examined (278) than males (247).

STH infection according to age group shows that 21 - 30 yrs 1 (1.39%) and 31 - 40 yrs 1 (1.54%) (Table 4). The prevalence was higher in age 51 - 60 yrs 1 (2.33%) and in age 0 - 10 yrs 4 (2.85%), age 11 - 20 yrs have the highest 5 (5.05%). Age 41 - 50, 61 - 70 yrs, 71 and above showed no infection 0 (0%). There was no significant difference (P = 0.76, P > 0.05) in the prevalence of infection according to age groups.

4. Discussion

4.1. Incidence of Schistosomiasis

No incidence (0%) of schistosomiasis observed in this study shows that the drug administration was effective and concurs with the 0.33% reported by Okpala *et al.* (2004) [17] among a focused group of pupils in Apata and Laranto areas in

Table 3. Incidence of Soil Transmitted Helminthiasis among the inhabitants of Gille and Wulmi Community of Pankshin LGA, Plateau State in relation to Gender.

Communitie	No examined	No infected	No (%) Infection
Male	247	8	8 (3.2)
Female	278	4	4 (1.4)
Total	525	12	

χ^2 at $df(1) = 1.90$; P = 0.17.

Table 4. Incidence of Soil Transmitted Helminthiasis among the inhabitants of Gille and Wulmi Community of Pankshin LGA, Plateau State in relation to Age.

Age group (yrs)	No Examined	No infected	No (%) infection
0 - 10	140	4	4 (2.85)
11 - 20	99	5	5 (5.05)
21 - 30	72	1	1 (1.39)
31 - 40	65	1	1 (1.54)
41 - 50	69	0	0 (0)
51 - 60	43	1	1 (2.33)
61 - 70	26	0	0 (0)
71 and above	8	0	0 (0)
Total	**525**	**12**	

χ^2 at $df(7) = 4.12$; P = 0.76.

Jos. This result agrees with the report of (Brozan, *et al.*, 2018) [18] showing a significant decrease in the prevalence of schistomiasis from 23.5% in 2009 to 5.0% in 2015 and also microhematuria, which served as a proxy measure for *S. haematobium*, declined from 21.0% at baseline to 4.2% in 2015 ($p < 0.001$). The prevalence of *S. mansoni* declined from 3.6% to 0.8% ($p < 0.001$). The low prevalence might be an indication of the level of awareness about the disease in the study areas and drug administration. Health education is a very effective means of improving knowledge about urinary schistosomiasis and has the potential to reduce the prevalence of the disease (Jamda *et al.*, 2007) [19]. Also, the low prevalence of this infection could probably be related to the availability of alternative sources of water and other recreational sites such as playgrounds which automatically leads to a reduction in water contact activities. According to Ugbomoiko *et al.* (2010) [20] and Abdullahi *et al.* (2011) [21] Subjects who lived close to bodies of water or irrigation canals are more exposed and therefore more vulnerable to S. *heamatobium* infections than those who lived further from the water hence, this could be a potential reason for the low prevalence of the infection.

4.2. Prevalence of Soil Transmitted Helminthiasis

The low prevalence of STH 12 (2.29%) reported in this study is consistent with (Brozan, *et al.*, 2018) [18] who reported a decrease in prevalence of STH from 31.5% to 11.6% in (2009-2015) after MMA with Hookworm as predominant STH at baseline.

The possible reasons for infection may be due to farming activities, as they are most engaged in dry season farming which could influence the spread and occurrence of the infection. Activities like irrigation with sewage water could be the source of infection, and also the proximity of Pankshin Dam to the community is a contributing factor.

Males show more infection than females which agrees with Odinaka *et al.* (2015) [22] who reported helminthic infection was more in males, 58 (38.4%), than in females, 28 (21.1%) among Primary School Children in Rural Community in Imo State, Nigeria. The higher prevalence observed among males compared with females could be attributed to the diverse outdoor activities engaged by males which exposed them to ova of Helminths during farming activities despite more females examined.

From the study, it is observed that prevalence of STH with respect to the age of the inhabitants of the communities follow same trend with low prevalences observed among the older age groups. This agrees with the report of Odinaka *et al.* (2015) [22] which explained that the observation might be related to behavioral differences which influence the degree of contact with infective ova in the environment. The prevalence in age 0 - 10 (2.85%) and age 11 - 20 (5.05%) could be attributed to the fact that children at this age are not mindful of the health risk that is associated with playing in a contaminated environment and they often spend their leisure time playing out-door while the younger ones are rela-

tively more protected by their parents. They are often in contact with soil and are found eating indiscriminately with unwashed hands (Adanyi *et al.*, 2011) [23]. STH infection was shown in the age groups 21 - 30 (1.39%) and 31 - 40 (1.54%), this low prevalence could also be due to the fact that as a child gets older; the child tends to be more cautious of hygienic habits and may not always get involved in playing in a dirty environment. Age 61 - 70 showed a prevalence of (2.33%) this could be due to farming activities and poor hygiene, and 41 - 50 (0%), 71 and above showed no infection (0%). The prevalence was high in age 51 - 60 (2.33%).

The open field used by pupils is often carpeted with dry and fresh human waste thereby increasing the risk of infection. Improper disposal of human wastes has been associated with infections of intestinal helminths in other countries thereby indicating that members of the public are at risk of infection with these helminthes, especially where open field defecation is commonly practiced. Hand washing habit after visiting toilet is another risk factor predisposing pupils to *A. lumbricoides* infection.

Generally, poor environmental and personal hygiene with respect to disposal of human faeces and hand washing after defecation and before eating are the driving forces of STH infection. Therefore, lack of personal hygiene and proper hand washing habit are some of the factors that predispose inhabitants of a community to soil transmitted helminths infection (Ogbaini-Emovon *et al.*, 2014) [24].

5. Conclusion

The study has revealed no incidence of Schistosomiasis (0%) and low Soil- transmitted helminthic infections (2.29%) in Gille and Wulmi of Pankshin Local Government, Plateau State, However, despite chemotherapeutic intervention the presence of STH infection was recorded, we, therefore, advocate continuous surveillance by way of identifying, testing and treatment of inhabitants of the community. In addition, governmental and non-governmental organizations should give more attention through periodic mass treatment, increase in public health awareness and provision of basic amenities towards eradicating these diseases.

6. Limitation of the Study

This study is a community-based research so we, examined a single urine and stool sample per individual. Due to the low sensitivity of the employed diagnostic technique, it is very likely that the true prevalence of schistosomiasis is considerably higher than the reported prevalence. We must mention here that due to the large size of population, we collected samples from communities, where there is at least, some degree of literacy; but in some poor settlements where children don't even go to school; they play around in sand and water and live in poor hygienic conditions the prevalence will be much higher than this reporting.

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Conflicts of Interest

The authors declare no conflicts of interest.

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