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Appraisal of Therapeutic Impact of One Round of Mass Praziquantel Administration (MPA) on Urinogenital Schistosomiasis in Benue State, Nigeria

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Abstract: Preventive chemotherapy through mass administration of praziquantel is the current global schistosomiasis control strategy recommended by the World Health Organization (WHO). We aimed to assess therapeutic impact of one round of mass praziquantel treatment on prevalence and intensity of *Schistosoma haematobium* infection. Longitudinal studies were carried out between March and November, 2018 in Katsina-Ala, Benue State, Nigeria following one round of mass praziquantel administration by the NTDs unit of CDC, Benue State in December, 2017. A total of 3,810 pupils, aged 5-19 years old were recruitedat baseline. Prevalence and intensity were determined using standard laboratory procedures for three successive phases (phase 1- three months; phase 2- six months and phase 3- nine months post treatment periods). Overall treatment coverage was 64.86%. Prevalence of infection was recorded in all the 3 phases, with the first phase having the highest prevalence (12.30%) followed by the third phase (9.12%) and the second phase (7.60%), the difference been significant ($P < 0.05$). The highest intensity of infection (16 ova/ 10 ml urine) was observed in the first phase, followed by the third phase (15.10 ova/10 ml urine) and the second phase (11 ova/ 10 ml urine). More males were infected than females. Prevalence and intensity were higher in untreated pupils than treated pupils in all the survey phases. The studies therefore, call for repeated mass treatment and integrated control measures to be adopted for total elimination of schistosomiasis.

Keywords: Mass Praziquantel Administration, Therapeutic Impact, Urinogenital Schistosomiasis, Nigeria

1. Introduction

Schistosomiasis (Bilharziasis) - a disease caused by one of the parasitic trematodes of the genus *Schistosoma,* with five species known to infect humans [17]. According to World Health Organization [24], it is endemic in 78 countries of the world, 42 of which are in Africa, 16 in the Eastern Mediterranean, 10 in the Americas, 6 in the Western Pacific, 3 in Southern Asia and one in Europe. In 2016, the disability-adjusted life years (DALYs) due to schistosomiasis were estimated at 2.521 million people globally. WHO estimated that 111.2 million school-aged children and 92.5 million adults are in need of preventive chemotherapy for schistosomiasis [11]. This estimate may likely be on the increase because of population growth, increase number of dams, unhygienic sanitary conditions, rural –urban exodus, as well as inconsistent control programmes [19].

According to the National Schistosomiasis Control Programmes (NSCP) of the Federal Ministry of Health, schistosomiasis is prevalent in all the 36 States of the Federation t including the FCT and 20-30 million pupils infected [18]. A recent report by the Neglected Tropical Diseases center, Benue State chapter showed the prevalent of the disease in 22 Local government Areas out of the 23 Local Government Areas of the state in which a prevalence of 48 and 41% was found in Kwande and Katsina –Ala Local

Government Area of the state.

Although the international research for the control of schistosomiasis started more than half a century, there is still embargo in the effective control of the disease. This may perhaps be responsible for its increasing prevalent in many under- developed Countries including Nigeria [19].

Preventive chemotherapy, through regular mass drug administration (MDA) of praziquantel, was endorsed by World Health Assembly in 2001 as the main strategy for schistosomiasis control through WHA resolution 54.19. Treatment with praziquantel at a dose of 40 mg/kg body weight aims to reduce morbidity and mortality, and prevent new infection by limiting transmission through the reduction of the human reservoir [13]. The WHO target is aimed at treating a minimum of 75% and up to 100% of all school-age children at risk of morbidity by 2010 [9]. This was not achieved and a new set of goals for 2020 was declared which were 100% geographic coverage, 75% national coverage and < 5% prevalence of heavy infections.

Nigeria is a signatory to the 54th World Health Assembly Resolution 54.19 which encourages member states to treat 75-100% of all school aged children, pregnant women and other vulnerable groups by 2020 [22]. Interestingly, part of the mandate of this resolution which was mass praziquantel administration has commenced fully in many states of Nigeria. It is therefore necessary to urgently assess the current prevalence and intensity of the disease in order to ascertain the therapeutic impact of the mass praziquantel administration on the disease. It would also show areas where the disease still persist, hence may attract another round of treatment to targeted people who really need it, in a cost effective manner or suggest other control measures

2. Materials and Methods

2.1. Study Location

This study was carried out in Katsina-Ala Local Government Area of Benue Sate, Nigeria. Benue State is located in the middle-belt region of Nigeria. The state lies within the lower river Benue trough in the middle-belt region of Nigeria. It lies between longitude 7.47 and 10.0 East of the Greenwich meridian and latitude 6.25 and 8.8 North of the equator. The state which has a total land mass 34,059 square kilometres shares boundaries with five other states of the federation namely: Nasarawa State to the North, Taraba State to the East, Cross River State to the South, Enugu State to the South-west and Kogi State to the West.

Benue State is an agrarian State; it is divided into three geopolitical zones sometimes referred to as agricultural zones namely; Zone A, B and C. The location of the experiment was in zone A, which is Katsina-Ala. It is a cosmopolitan settlement on the North Bank of the river from which the town takes its name. The people of Katsina-Ala Local Government Area are predominantly farmers. Over 75% of the population engages in agriculture, making agriculture the mainstay of economy of the people.

2.2. Study Design and Sample Size Determination

This study employed longitudinal survey methods. The studies were conducted in three successive phases with the same pupils (aged 5-19 years old) surveyed at each point of time. The sample size for this study was calculated according to [9] using the normal distribution formula:

$$(N=\mathcal{E}^2\ pq/i^2).$$

Where, N=the desired sample size

Ɛ=the normal Z score corresponding to the risk of error α=5%

p=baseline prevalence of schistosomiasis in the study area (40.1%) (CDC, Benue state chapter preliminary report, 2018)

$$q=1-p$$

I=the precision, fixed at 5%

$$N=(1.96)^2\ (0.401)\ (1-0.401)/0.05^2=363.$$

We considered the cluster effect, such that children from the same community attending the same school could incur the same risk for *S. haematobium* infection and expected attritions for various reasons; absence of participants at school during the day of screening, failure to provide urine sample or not being available during subsequent surveys. We therefore multiplied N (363) by 5% and add to the sample size, N to estimate the baseline sample size of the study at 381 for each council ward. Therefore, the total sample size at baseline was 3,810 school children. But due to refusal to continue, absence and migration away from the village during the course of the study, 3, 637 participants completed the study.

2.3. Ethical Approval and Informed Consent

Ethical Clearance (Ref. No: MOH/ STA/204/VOL.1/71) was obtain from Research and Ethics Committee unit of Benue State Ministry of Health & Human Services (MOH) while verbal consent / permission was obtained from Education Secretary, Katsina-Ala Local Government Area.

2.4. Praziquantel Administration

The Federal Ministries of Health provided the praziquantel through the Neglected Tropical Diseases Center, Benue State Chapter. Mass administration of the drug in a standard dose of (40 mg/kg) according to body weight to the respective schools/school children was done by the Local Government Area NTD coordinator assisted by some school Teachers.

2.5. Post Treatment Survey

Three successive surveys were conducted following mass administration of praziquantel to obtain basic data on prevalence and intensity of urinary schitosomiasis in primary school children in the study areas. The first survey was conducted in April, 2018 and was repeated after every 3 months up to November, 2019.

2.6. Urine Sample Collection and Parasitological Assessment

Urine samples of all the consented subjects were collected after a 20-30 minute brief physical exercise between 10:00 am and 2:00 pm in a plastic specimen bottles, tightly covered and preserved with two drops of 40% formaldehyde [8]. Parasitological assessment was performed using standard procedures.

2.7. Statistical Analysis

Chi square (χ^2) and Analysis of variance (ANOVA) were used to test for association and significant difference between the prevalence and intensity of infection.

3. Results

3.1. Prevalence of Urogenital Schistosomiasis by Post-Treatment Survey Phases and Council Wards

The results of post praziquantel treatment survey showed the occurrence of S. *haematobium* infection in all the Council wards during the three phases of post treatment examination except in Michihe Council wards where there was zero prevalence in the last phase (nine monthpost treatment survey) (Table 1). Eggs of *S. haematobium* were found in all the samples except in few cases where there was missed infection with *S. mansoni*. The overall prevalence was higher in three months and nine months post–treatment examination (12.30 (471/3810) and 9.2% (335/3637) than insix month post treatment examinations with infection rate of 7.6% (275/3,612). There was no significant difference ($P > 0.05$) in prevalence among the different phases of the post praziquantel treatment examinations.

3.2. Prevalence Urogenital Schistosomiasis by Age and Sex

In 3 months post treatment survey (Table 2), 3810, (2,447 males and 1,363 females) pupils from ages 5 – 19 years old were examined. Of the pupils infected, 14.0% (343/2,447) were males while 9.4% (128/1,363) were females. There was a significant difference (χ^2=6.64, df=1; $P < 0.05$) in prevalence between the sexes.

For males, the age related prevalence was as follows: 5-9 (9.52%), 10-14 (16.58%) and 15-19 (12.52%) while among females, prevalence of 6.78%, 8.93% and 10.78% were recorded for the age groups of 5-9, 10-14 and 15-19 years old respectively. The overall prevalence of infection was 12. 36%.

In 6 months post treatment survey (Table 3), a total number of 3,612 pupils (2,112 males and 1,500 females) were examined. 8.46% (66/780) males and 5.42% (30/554) females were infected, the difference being significant (χ^2=6.64; df=1; $P < 0.05$). Pupils of all ages were infected, the highest prevalence (10.01%) being recorded among pupils of age group 10 -14 years old in males while among females, the highest prevalence (5.51%) was recorded in age group 5 – 9 years old. The overall prevalence of infection was 7.20%.

Table 1. *Prevalence of urogenital schistosomiasis based on praziquantel post treatment survey in different council wards.*

Post treatment survey periods (month)						
Council	**Three months**		**Six Months**		**Nine Months**	
Wards	**No. Examined**	**No. infected**	**No. Examined**	**No. infected**	**No. Examined**	**No. infected**
Iwar	340	23 (6.8)	325	15 (4.6)	340	30 (8.8)
Ikurav-tiel I	226	30 (13.3)	220	20 (9.1)	221	27 (12.2)
Mbatyula	257	64 (25.0)	215	32 (14.9)	215	32 (14.9)
Mbacha	220	45 (20.5)	202	25 (12.4)	202	25 (12.4)
Michile	310	71 (23.0)	301	30 (10.0)	310	0 (0.0)
Mbayongu	434	29 (6.7)	415	12 (2.9)	410	2 (0.5
Kastina-Ala	1103	102 (9.2)	1,065	80 (8.0)	351	35 (10.0)
Yooyo	385	62 (16.10)	351	27 (8.0)	351	35 (10.0)
Utange	205	19 (9.3)	200	18 (9.0)	200	27 (13.5)
Ikurav-teil II	330	23 (7.0)	318	16 (5.0)	318	35 (11.0)
Total	3,810	471 (12.3)	3,612	275 (7.6)	3,637	335 (9.20)

Table 2. *Prevalence of uroginatal schistosomiasis based on sex and age ofschool children in a 3-months post treatment examination.*

Age Group	**Sex**					
	Male		**Female**		**Both sexes**	
	Number examined	**Number infected%**	**Number examined**	**Number infected (%)**	**Number examined**	**Number infected (%)**
5-9	420	409 (9.520)	236	16 (6.78)	656	56 (8.54)
10-14	1212	201 (16.58)	515	46 (8.93)	1727	247 (14.30)
15-19	815	102 (12.52)	612	66 (10.78)	1427	168 (11.8)
Total	2,447	343 (14.0)	1363	128 (9.4)	3,810	471 (12.36)

In 9 months post treatment survey, (Table 4), 3,637 pupils (2,125 males and 1,512 females) were examined. 10.16% (216/2,125) of males and 7.87% (119 /1,512) of females were infected. The difference in prevalence between the sexes being significant (χ^2=6.64, df=1; $p < 0.05$). For males, the age related prevalence was as follows: 5-9 (9.16%), 10-14 (11.21%) and 15-19 (9.50%) while among females, prevalence of 10.30%, 7.75% and 7.70% were recorded for

the age groups of 5-9, 10-14 and 15-19 years old respectively. The overall prevalence of infection was 9.21%.

Table 3. *Prevalence of uroginatal schistosomiasis based on sex and age of school children in a 6-months post treatment examination.*

Age Group	Sex					
	Male		Female		Both sexes	
	Number examined	Number infected%	Number examined	Number infected (%)	Number examined	Number infected (%)
5-9	420	34 (8.10)	236	13 (5.51)	656	47 (7.16)
10-14	912	98 (10.01)	710	34 (4.79)	1622	132 (8.14)
15-19	780	66 (8.46)	554	30 (5.42)	1334	96 (7.20)
Total	2,112	198 (9.40)	1500	77 (5.13)	3,612	275 (7.6)

Table 4. *Prevalence of uroginatal schistosomiasis based on sex and age of school children in a 9-months post treatment examination.*

Age Group	Sex					
	Male		Female		Female	
	Number examined	Number infected%	Number examined	Number infected (%)	Number examined	Number infected (%)
5-9	415	38 (9.16)	233	24 (10.30)	648	62 (9.57)
10-14	910	102 (11.21)	273	56 (7.75)	1633	158 (9.67)
15-19	800	76 (9.50)	556	39 (7.01)	1356	115 (8.48)
Total	2,125	216 (10. 16)	1,512	119 (5.13)	3,637	335 (9.21)

Mean intensity of Schitosoma haemalobium infection by age and sex

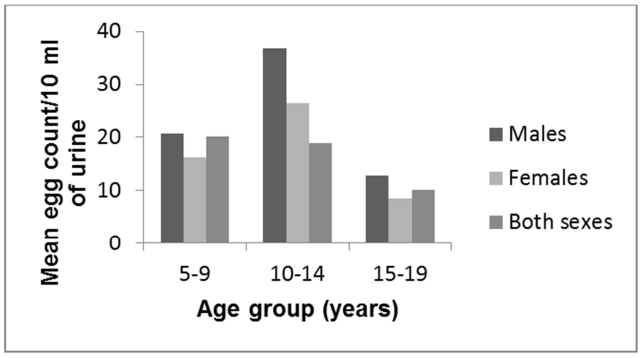

Figure 1. *Mean intensity of urogenital schistosomisis by age and sex of pupils based on one round of mass administration of Praziquantel in a 3-months post treatment examinations.*

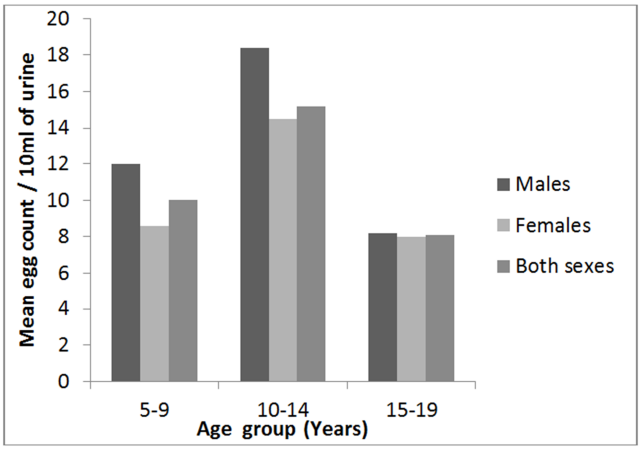

Figure 2. *Mean intensity of urogenital schistosomisis by age and sex of pupils based on one round of mass administration of Praziquantel in a 9-months post treatment examinations.*

In 3 month post treatment survey, for males, the mean egg output of 20.60, 36.80 and 12.70 ova/10 ml urine was observed for the age groups of 5-9, 10-14 and 15-19 years old. For females, the mean egg output for age groups 5-9, 10-14 and 15-19 was 16.20, 26.50 and 8.40 0 va /10 ml urine (Figure 1). In a 6 months post treatment survey, for males, the mean egg outputs were 12.0, 18.40 and 8.2 0 ova/10 ml urine for the age groups 5-9, 10-14 and 15-19 years old. However, for females, mean egg outputs of 8.60, 14. 50 and 8.0 ova/ 10 ml urine were observed for age groups 5-9, 10-14 and 15-19 years old as shown in Figure 2. In a 9 months post treatment survey, the mean egg outputs in males for all age groups were higher than that of females. For males, mean egg outputs of 16.10, 20.50 and 12.20 ova/10 ml urine were observed for age groups 5-9, 10-14 and 15-19 years old. But for females, mean egg outputs of 14.0, 20.0 and 10.40 ova/10 ml urine were recorded for age groups 5-9, 10-14 and 15-19 years old (Figure 3).

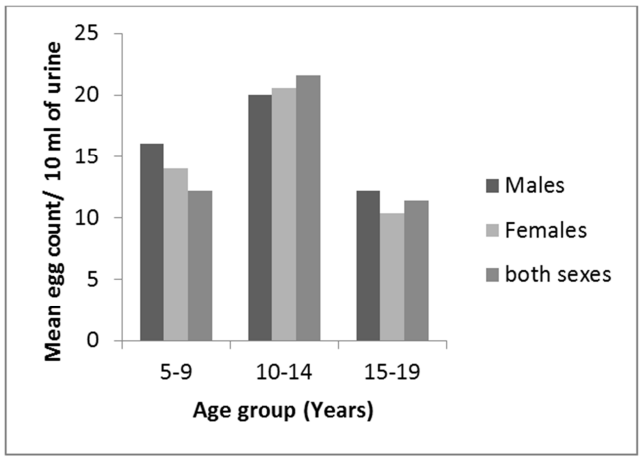

Figure 3. *Mean intensity of urogenital schistosomisis by age and sex of pupils based on one round of mass administration of Praziquantel in a 9-months post treatment examinations.*

3.3. Prevalence and Mean Intensity of Urogenital Schistosomias in Praziquantel Treat Anduntreated Pupils

In 3 months post treatment survey, out of 3,810 pupils that

were examined 2,471 swallowed Praziquantel while 1,339 of them did not. Among the pupils that swallowed the Tablet, the overall prevalence was 3.97% while the mean egg output was 8.20 ova/10 mls urine For the Praziquantel untreated children, the overall prevalence of infection was 27.86% while the mean egg output was 52.00 ova/10 mls urine (Figure 4). There was a significant difference ($P < 0.05$) in prevalence and mean egg count between treated and untreated school pupils.

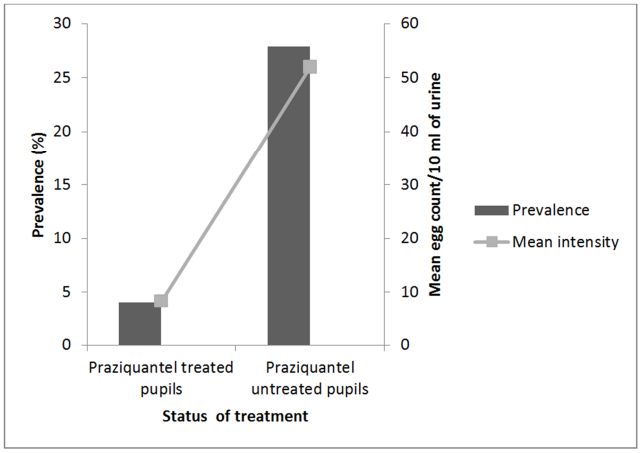

Figure 4. *Prevalence and mean intensity of urogential schistosomiass in Praziquantel treated and untreated pupils after one round of mass administration of Praziquantel in a 3 -months post treatment survey.*

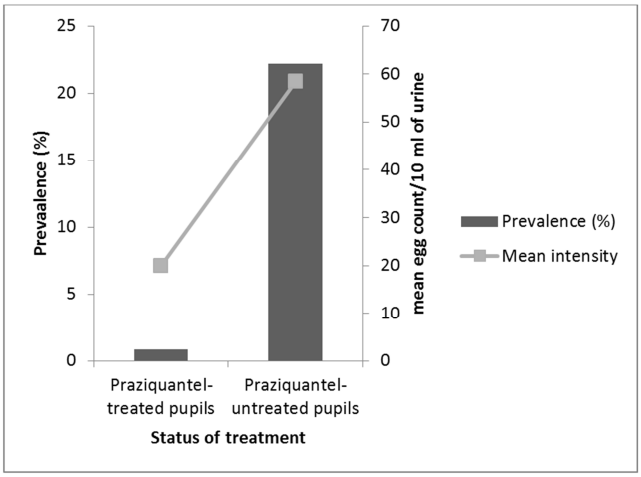

Figure 5. *Prevalence and mean intensity of urogential schistosomiass in Praziquantel treated and untreated pupils after one round of mass administration of Praziquantel in a 6 -months post treatment survey.*

In 6 month post treatment survey, a prevalence of 0.89% and mean intensity 20.00 ova/10 mls urine were observed but among untreated pupils, prevalence and intensity of infection were higher (22.17% and 100.1 ova/10 mls urine) (Figure 5). There was a significant different in prevalence and intensity of treated and untreated children ($P < 0.05$).

Meanwhile in the 9th month post treatment survey, the prevalence of infection was 4.14% while intensity was 22.6 ova/10 mls urine in treated children. But among untreated pupils, prevalence and intensity of infection rose to 19.83% and 58.4 ova/10 mls urine (Figure 6).

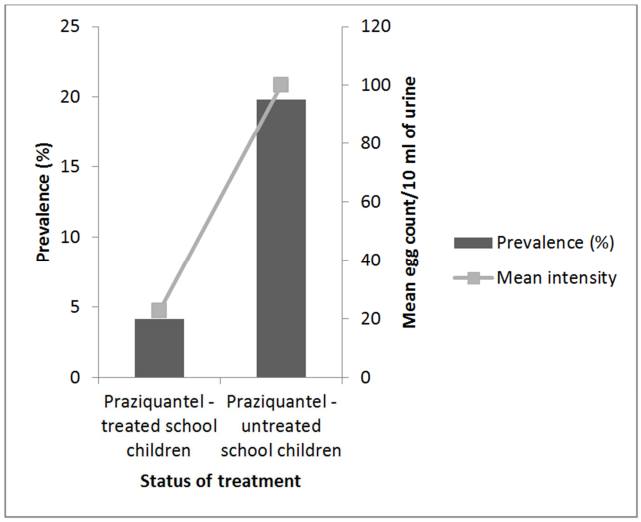

Figure 6. *Prevalence and mean intensity of urogential schistosomiass in Praziquantel and untreated pupils after one round of mass administration of Praziquantel in a 9- months post treatment survey.*

4. Discussion

Prevalence and Intensity of Urogenital Schistosomiasis

The findings of these studies showed that Mbatyula Council Wards was the most endemic areas for urogenital schistosomiasis, with a prevalence of 25.05%, 14.9% and 14.9% in the 3 months, 6 months and 9 months post treatment examinations despite mass administration of Praziquantel. Prevalence of urogenital schistosomiasis have been reported by several researchers in Nigeria: a prevalence of 46.17% have been recorded among people in FCT [8]; in Oju Local Government Area of Benue State, Nigeria a prevalence of 47% have also been recorded [3] while [12] recorded a prevalence of 56.30% in Buruku Local Government of Benue State; report also confirm a prevalence of 70.1% among inhabitants of Odau community in Rivers State [10]. The low prevalence recorded in this present study when compared with the above-mentioned studies may be due to the fact that treatment was administered on the subjects before the commencement of the study. It was also observed that prevalence in the first (3 months post treatment) survey was higher than that of the second (6 months post treatment) survey which in turn was lower than the third (9 months post treatment) survey (Table 1). This may be probably due to re-infection after treatment since contact with schistosome cercaria infected water was not abated by the subjects. This agrees with the reports of [14, 15] who reported that Praziquantel treatment only reduce parasitaemia but does not prevent re-infection.

The study also showed both prevalence and intensity to be gender and age dependent. In relation to gender, the males recorded a higher prevalence than females in all the three post treatment surveys (Tables 2, 3 and 4). This is similar to the reports of [2] in Kwara State, [5, 6] in Abia State who recorded higher prevalence in males than females. Works by other researchers in other part of the world also confirmed to this pattern: in Gambia [23]; in Zimbabwe [21]. This may be

due to the fact that males show more water contact than females. This agrees with the work of [10] who reported a prevalence of 54% in males and 30.0% in females; [7] who reported a prevalence of 73.3% for males and 66,7% for females in Odau community of Rivers State, Nigeria. However, this was in contrast with that of [1] and [4] who found prevalence in females to be higher than males.

The age group 10-14 had the highest prevalence and intensity of infection. This could be as a result of the group constituting a higher proportion of the population and also responsible for the highest relative index of potential contamination of water. [8, 7, 14] also found similarobservations wherethe age group 10-14 years old constituted the most in polluting the environment as they had the highest index of potential contamination.

5. Conclusion

In conclusion, it is unequivocal that the recent mass Praziquantel treatment in Katsina-Ala, Benue State, Nigeria fell short of the goal of resolution 54.19 of WHA. Although chemotherapy is considered as a measure for reduction of human morbidity in Schistosomiasis, it is certainly not the only public health intervention of value. Control of Schistosomiasis requires an integrated approach with the use of health education, portable water supply, sanitation, and focal mollusciciding, which are all important components of Schistosomiasis control.

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