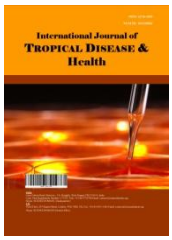

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Determinants of Uptake of Mass Drug Administration for Schistosomiasis Control in Butiaba Sub-county, Uganda

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Introduction: Schistosomiasis is one of the Neglected Tropical Diseases (NTDs) targeted for elimination in Uganda by 2025 through Mass Drug Administration (MDA) using praziquantel. To achieve this, WHO estimates indicate that MDA coverage and uptake of 75% is required. However, coverage remains suboptimal with insufficient knowledge and inadequate drug supply often cited as key reasons. There is a need to add to the body of knowledge in various settings to enable more robust mitigation measures. This study aimed to assess the uptake of praziquantel for MDA and associated factors in Butiaba sub-county along the shores of Lake Albert in Uganda.

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Methods: A cross-sectional study was conducted in five randomly selected villages within Butiaba sub-county between July and September 2021 using quantitative and qualitative approaches. Semi-structured questionnaires were administered to 450 adults, with additional two Focus Group Discussions and Key Informant interviews held with implementation structures from the village to district level.

Results: Self-reported uptake of praziquantel within twelve months of the most recent MDA exercise was 71.56% (95% CI: 67.14 – 75.68). Of all the participants, 5.78% reported have never swallowed praziquantel in their lifetime, and 75% (96/128) of participants who didn't swallow praziquantel in the last twelve months reported having at least swallowed the drug in the last ten years. Respondents were less likely to have swallowed praziquantel if they had no knowledge about schistosomiasis signs (AOR= 0.18, 95% CI: 0.08–0.39) and more likely if they were between the ages 30-39years (AOR= 2.31, 95% CI: 1.35–3.95) or 40 years and above (AOR= 2.86, 95% CI: 1.45 – 4.95). Operational challenges such as the inadequate supply of praziquantel and financial constraints also influence the uptake of praziquantel during MDA in Butiaba sub-county.

Conclusion: The uptake of praziquantel during MDA in Butiaba sub-county was high but still below the WHO target of 75%. People with limited knowledge of schistosomiasis symptoms and those aged 18 – 29 years were less likely to take Praziquantel. Irregular drug supply was also a key challenge.

Recommendation: Rigorous health education and ensuring a continuous supply of Praziquantel are key to improving MDA uptake.

Keywords: Schistosomiasis; mass drug administration; Uganda; Sub-Saharan Africa; uptake; praziquantel.

1. INTRODUCTION

Schistosomiasis, also known as bilharzia, is a neglected tropical parasitic disease transmitted through freshwater snails currently estimated to affect 240 million people worldwide with approximately 800 million people at risk due to poor water, sanitation, and hygiene [1]. Along with geohelminths, schistosome infections have been estimated to account for 40% of the global tropical disease burden excluding malaria [2]. The disease burden is highest in Africa with statistics reporting schistosomiasis as the second most common parasitic disease on the continent putting strain on economies and governments [3]. Furthermore, the 2022 WHO schistosomiasis fact sheet revealed that at least 90% of those requiring treatment for the disease globally were in Africa [4].

In Uganda, *Schistosoma mansoni* is the most common species causing intestinal schistosomiasis [5, 6] which is endemic in 73 districts [7] with a national prevalence of 25.6% and estimates of more than 4 million people infected and 55% of the population at risk [8]. The disease is particularly of great concern among fishing communities [9] such as those along the Lake Albert shores in Butiaba sub-county where the only available data on statistics registered a prevalence as high as 72% in 2004 [6, 10].

In a bid to combat this high prevalence, the chief strategy endorsed by the World Health Organization (WHO) is Preventive Chemotherapy (PC) through Mass Drug Administration (periodic large-scale population treatment) with Praziquantel as the drug of choice [11] aiming at a target coverage of 75%. As of 2016 however, the global coverage rate stood at 14.3% as per the epidemiological report from WHO, department of control of neglected diseases and a compliance rate of less than 50% thus an actual level of reach of about 5% of the intended population [12].

In Uganda, the National Bilharzia and worm Control Programme is implemented at the district level. This is done through the District Health Office (DHO) by the District Vector Control Officer (DVCO) and the District Health Educator (DHE) [13]. Praziquantel distributions are done both in schools and in the community. In the communities, trained volunteer drug distributors administer the drug to registered community members at particular sites and door-to-door visits. Drug distribution is done twice each year in regular intervals to endemic populations because of susceptibility to reinfection.

Despite the use of a variety of avenues to reach out to the endemic communities and the benefits such as reduced schistosomiasis morbidity, MDA uptake is still below target coverage with

statistics revealing fluctuating levels of coverage from 64.7% when the national control program was initially launched in 2003 [14] to percentages as low as 50% in 2012 [15] and 48.8% in 2016 [16]. The uptake of MDA among adults varies across different communities and is tied to local dynamics as demonstrated by 84.5% coverage registered in Bugiri versus 48.8% coverage in Arua in the 2003/2004 drug distribution [17]. Low uptake jeopardizes the achievement of major goals set by the World Health Organization in eliminating schistosomiasis. These findings/statistics demonstrate that if schistosomiasis elimination is to be achieved through Mass Drug Administration, then strategies to increase treatment uptake need to be tailored to the specific community dynamics. Therefore, this study aimed to assess the determinants of uptake of Mass Drug Administration for Schistosomiasis Control in Butiaba sub-county, Uganda. Findings from this study could yield critical insight into strategies to tailor MDA interventions in similar settings.

2. METHODS

2.1 Study Design and Setting

A cross-sectional study was conducted in which quantitative and qualitative data was collected from adults (18 years and above) in Butiaba sub-county in September 2021. Butiaba is a sub-county within Buliisa district in which schistosomiasis is endemic; the most predominant species being *Schistosoma mansoni*. It is located right on the shores of Lake Albert and the predominant economic activity is fishing.

The four parishes that constitute the sub-county have twenty-one villages and an estimated population of 29,181 people as per the 2014 census report from the Uganda Bureau of Statistics [18]. However, as of 2020, 11 villages experienced flooding, leading to the migration of residents.

Buliisa district has a total of eleven functional health units (8 Government owned Health centers and 3 are private not for profit / PNFP health units), of which eight are HC IIs; one is a HC III, one is HC IV and one is district general Hospital.

MDA campaigns for praziquantel in Butiaba sub-county usually occur biannually but occurred once in 2020 because of the COVID pandemic. The most recent MDA campaign in the sub-county happened in October/November 2020 hence this study was conducted one year after the campaign. This study specifically sought to estimate the uptake of PZQ among adults during the most recent MDA exercise, and identify sociodemographic, knowledge, and attitudinal factors associated with this uptake.

2.2 Sample Size Calculation

The sample size required was estimated based on the study's first objective which was to determine adult the uptake of Mass Drug Administration for schistosomiasis control in Butiaba, Uganda. The formula used was that by Kish Leslie [19], $mple\ size\ (n) = \frac{Z^2 p(1-p)q}{d^2}$, where:

n is required sample size for the study.
Z is 1.96 (A confidence interval of 95% or a statistical significance level of (α) of 0.05).
P is expected coverage estimated at 17% ie 0.17 [20]
d is degree of error or desired precision of +/- 5%.
q is a design effect of 2 [21]

As illustrated above, an initial sample size of 434 participants was required to estimate the uptake of Mass Drug Administration for schistosomiasis control in Butiaba, Uganda. However, considering a 4% non-response rate, the appropriate sample size was 450 respondents.

2.3 Sampling and Participant Selection

Five villages were picked by random selection from a list of the 10 sub-county villages using STATA with stratification to ensure equitable representation.

Multistage Probability sampling was used to select households within the identified villages using the sub-county registers. Given the targeted sample size of 450 participants, it was determined that 90 adults needed to be interviewed per village (one adult was interviewed per household to allow equal/wider representation.)

For the selection of households to visit, a sampling interval was selected by dividing the total number of households per village (as reported on village registers provided by the LC1 Chairman) by the intended number of

households/respondents to be interviewed per village (which was 90). Consecutive numbers were generated using the sample interval and these were used to identify households from the register to visit for interviews. Numbers allocated in village registers were used for this exercise.

Eligible respondents were adults who had lived in Butiaba for 12 months or more and consented to participate in the study. At the household level, adults were listed on separate papers and selection was done randomly from a bowl. If a household had no one who met our inclusion criteria, the neighboring household was selected.

Four key informants were however purposively selected with representation from the local leadership, the district vector control office, and the MDA parish supervisors to seek expert opinion on MDA uptake in Butiaba.

2.4 Data Collection Tools

For quantitative data, semi structured, researcher administered questionnaires were used in face-to-face interviews with the respondents. The questionnaire was developed based on the recommendations from the WHO 2016 field guide for implementation of coverage evaluation surveys and was pretested in the target population prior to the start of the study. The questionnaires were translated to Alur (the major local language spoken in the sub county) and administered by the trained local interviewers. The semi structured questionnaires covered sociodemographic characteristics, knowledge and attitudes with respect to schistosomiasis and MDA associated with uptake of Praziquantel in the community.

Regarding qualitative data, interview sessions were recorded using audio devices and structured topic guides were used to run the sessions.

2.5 Quality Control of Study Tools

The local interviewers were trained before the start of the study on the procedures of obtaining the informed consent and administering the interview questionnaire. The trainings also included practice interview sessions and sharing an overview of the research project.

The research questionnaire was pretested prior to the start of the study within the study population to ensure that the questions and translations were relevant and comprehensible. Furthermore, the information sheets and consent forms were translated to Alur (major local language spoken in Butiaba) as well to ensure comprehensive understanding. The Content Validity Index(CVI) obtained during pretesting was 0.81.

The audio recordings were transcribed and translated verbatim with review to ensure that they contained word-by-word transcriptions and translations that retained original meanings and culturally embedded content.

The content of the qualitative data from Key Informant Interviews and Focused Group Discussions (FGDs) was explored on the same day as the interviews. Furthermore, the analysis of qualitative interview data was done in accordance with the approaches suggested by Krefting [22] to ensure credibility, applicability, dependability, and confirmability of the data.

2.6 Variable Measurement

Both qualitative and quantitative data were collected. Quantitative data was collected as illustrated in Table 1 below.

The semi-structured questionnaire (File S1) used was developed based on recommendations from the WHO 2016 field guide for implementation of coverage evaluation and pretested (with a Content Validity Index of 0.81). The questionnaire was modified from related literature [15] with minor changes to fit the study's objectives. It was prepared in English and later translated and administered to the respondents in their local language, Alur by trained local interviewers.

The dependent variable was Mass Drug Administration uptake which was determined using self-reported swallowing of praziquantel distributed in the last October/November 2020 MDA campaign. The percentage uptake represented the fraction of the population sampled that reported having swallowed praziquantel in the most recent October/November 2020 MDA campaign in the sub-county.

The independent variables were knowledge, attitudes, and socio-demographic determinants (age, sex, occupation, tribe, educational level) of MDA uptake. The association of attitudes with MDA uptake was determined using questions with answers measured on a five-point Likert scale with values between 1-3 representing negative attitudes and values 4 and 5 representing positive attitudes. Each question had response categories ranging from (1) strongly disagree to (5) strongly agree.

Table 1. Study variables

Objective	Variable	Indicator	Means of data collection
To determine the uptake of Mass Drug Administration for schistosomiasis control among adults in Butiaba, Uganda	Uptake of Mass drug administration (dependent)	Self-reported swallowing of praziquantel in last Oct/Nov 2020 MDA campaign	Semi-structured questionnaire administered through face-to-face interviews
To assess the association between socio-demographic determinants and uptake of Mass Drug Administration for schistosomiasis control among adults in Butiaba, Uganda.	Sociodemographic determinants for uptake of MDA for schistosomiasis control (independent)	Age Sex Tribe Occupation Level of education	Semi-structured questionnaire administered through face-to-face interviews
To assess the association between knowledge and uptake of Mass Drug Administration for schistosomiasis control among adults in Butiaba, Uganda.	Knowledge of schistosomiasis and MDA (independent)	Schistosomiasis symptoms schistosomiasis control measures Benefits of MDA	Semi-structured questionnaire administered through face-to-face interviews
To assess the association between attitudes and uptake of Mass Drug Administration for schistosomiasis control among adults in Butiaba, Uganda.	Attitudes towards Mass Drug Administration (independent)	Exposure risk Motivation to take praziquantel Agreement with benefits of MDA Outcome expectancy	Semi-structured questionnaire administered through face-to-face interviews

Similarly, the association of MDA uptake with knowledge was assessed using a score with 6 variables. Values between 0 and 3 represented low knowledge and 4-6, high levels of knowledge.

For the qualitative data, Focus Group Discussions and Key Informant Interviews were used to identify further hindering factors.

2.7 Data Management and Statistical Analysis

Quantitative data was entered in Epi Data and analyzed in STATA version 12. Data analysis was done at three stages: univariate, bivariate, and multivariate, and for all statistical analyses, a statistical significance level (α) or p-value of 0.05 was used (95% CI). All the variables considered were informed by our conceptual framework developed based on the modified Anderson model of health service utilization [23] and are shown in the tables of bivariate analysis.

In univariate analysis, descriptive statistics were obtained for all study variables and presented using standard statistical parameters (frequencies, percentages, means, and standard deviations). MDA uptake was computed as the number of respondents who reported swallowing praziquantel in the last October/November 2020 MDA campaign divided by the total number of respondents who answered this question.

In bivariate analysis, the chi-square test was used (as is the case with binary and categorical outcomes) to explore the association of the respondents' sociodemographic characteristics, knowledge, and attitudes to schistosomiasis and MDA uptake/likelihood of swallowing praziquantel. Interaction effects between the sociodemographic and knowledge variables were also analyzed using the Chi-square test.

In Multivariate Analysis, the binary logistic regression model was used to examine the relationship between MDA uptake and the independent variables. This method was used because the dependent variable is binary in nature (yes/no). Stepwise backward regression was used to eliminate factors that are not

significantly associated with swallowing praziquantel (with a cut-off for statistical significance of $P \leq 0.05$) until all independent variables within the model had a p-value less than 0.05. Crude and adjusted odds ratios with their corresponding confidence intervals and p-values were used to determine association.

Qualitative data was analyzed through thematic content analysis. The data from key informant interviews and the focus group discussions collected using audio recordings were transcribed verbatim and translated into English. To this end, transcripts were read back and forth several times and then coded. Key themes and subthemes related to study objectives were organized in a matrix and discussed as a team for appropriate interpretation. Key quotations that epitomized central themes relating to the health system were identified. Furthermore, the analysis of qualitative interview data was done following the approaches suggested by Krefting [22] to ensure the credibility, applicability, dependability, and confirmability of the data.

3. RESULTS

A total of 450 respondents sampled from five villages in Butiaba sub-county were interviewed. Three key informant interviews and two focus group discussions (one per parish) were conducted. The most recent MDA campaign in the sub-county happened in October/November 2020 hence this study was conducted one year after the campain.

3.1 Baseline Characteristics of Study Participants

The socio-demographic characteristics of the respondents that participated in the questionnaire interviews are shown in Table 2. Over half (52.7%) of the respondents were female. Respondents' age ranged from 18 to 80 with a mean age of 34 years (SD = ±11.4). Most respondents (60.89%) had received at least a primary education with the majority (37.56%) being business people and the second most common occupation being fishing.

Table 2. Socio-demographic characteristics of 450 adults from Butiaba Sub-county, Buliisa district surveyed in September 2021

Variable	Number (N=450)	Percentage (%)
Age group(years)		
18-24	106	23.56
25-29	75	16.67
30-39	153	34.00
40+	116	25.78
Total	450	100
Sex		
Male	213	47.33
Female	237	52.67
Total	450	100
Tribe		
Alur	366	81.33
Bagungu	43	9.55
Banyoro	22	4.89
Others	19	4.21
Total	450	100
Duration of residence at current address		
1-10	124	27.56
11-20	131	29.11
>20	195	43.33
Total	450	100
Highest level of education		
None	85	18.89
Primary	274	60.89
Lower Secondary	75	16.67
Upper Secondary	13	2.89
University	3	0.67
Total	450	100

As shown in Table 3, most of the respondents (96%) reported using latrines as the place of ease with these being majorly shared/neighborhood latrines (47.98%). The most common source of water reported was the lake at 82.44%.

3.2 Uptake of Praziquantel During MDA for Schistosomiasis Control

In all five sampled villages, the distribution of praziquantel was conducted in the 2020 MDA exercise. Of the 450 respondents, 322 respondents i.e., 71.56% (95% CI: 67.14 – 75.68) reported that they had swallowed the drug in the 2020 MDA exercise. 5.78 % (26/450) of the participants reported having never swallowed praziquantel in their lifetime and 21.3% (96/450) of the participants hadn't swallowed praziquantel within the last 10 years. Overall, 84.73% of respondents reported that they were willing to swallow praziquantel in the next MDA exercise with the majority (34.65%) citing schistosomiasis prevention as the reason.

Factors associated with the reported uptake of praziquantel in the bivariate analysis are shown in Tables 4, 5, and 6. Female respondents were less likely to swallow Praziquantel (OR=0.52, 95% CI: 0.34–0.79), and being 30 years and above had a positive association with the uptake of mass treatment: 30-39 years (OR= 2.31, 95% CI: 1.35-3.95), 40+ years (OR= 2.86, 95% CI: 1.58-5.22). Being in the fishing occupation also had a positive association with the uptake of praziquantel during MDA (OR =2.72, 95% CI: 1.41-5.24).

As shown in Table 5, knowledge about Bilharzia was positively associated with the uptake of MDA. Respondents who were not knowledgeable about bilharzia cause (OR= 0.19, 95% CI: 0.09-0.41), signs (OR= 0.18, 95% CI: 0.08-0.39), and control measures (OR= 0.27, 95% CI: 0.08-0.86), were less likely to swallow Praziquantel during MDA exercise.

Regarding attitude-related factors (Table 6), the bivariate analysis revealed that respondents who perceived a high personal risk of catching Bilharzia (OR=2.02, 95% CI:1.21-3.38) & agreed that MDA improves one's health (OR=2.51, 95% CI:0.99–6.36) were more likely to swallow PZQ.

In the multivariate analysis using the Logistic regression model, variables that were considered included age, sex, length of stay, occupation, knowledge of bilharzia signs, causes, control measures, perceived bilharzia risk, the effectiveness of MDA in controlling Bilharzia & improving health, the taste of praziquantel and sufficiency of praziquantel during MDA campaigns (as indicated in the tables of bivariate analysis below).

Table 3. Sanitation characteristics of 450 adults from Butiaba Sub-county, Buliisa District surveyed in September 2021

Variable	Number (N=450)	Percentage (%)
Place of ease		
Latrine	432	96.00
Bush	15	3.33
Lake	3	0.67
Total	450	100
Location of toilet used		
Household	209	46.44
Shared	216	47.98
Public	11	2.44
Total	450	100
Main source of water		
Lake	371	82.44
Tap	73	16.22
Rainfall	2	0.44
Borehole	2	0.44
Other	2	0.44
Total	450	100

Table 4. Bivariate association between Socio-demographic characteristics and uptake of praziquantel in 450 participants from Butiaba sub-county, Buliisa district

Variable	Uptake of MDA		Unadjusted OR	P-value
	Yes (n=322) N(%)	No (n=128) N(%)	95% CI	
Age group(years)				
18-24	62(13.8)	44(9.8)	1.00	
25-29	50(11.1)	25(5.6)	1.42(0.77-2.63)	0.265
30-39	117(26)	36(8)	2.31(1.35-3.95)	0.002
40+	93(20.7)	23(5.1)	2.86(1.58-5.22)	0.001
Total	322(71.56)	128(28.4)		
Sex				
Male	167(37.1)	46(10.2)	1.00	
Female	155(34.4)	82(18.2)	0.52(0.34-0.79)	0.002
Total	322(71.56)	128(28.4)		
Length of stay in Butiaba				
1-10	75(16.7)	49(10.9)	1.00	
11-20	90(20)	41(9.9)	1.43(0.86-2.4)	0.17
>20	157(34.9)	38(8.4)	2.69(1.63-4.47)	0.00
Total	322(71.56)	128(28.4)		
Highest level of				
education	61(13.6)	24(5.3)	1.00	
None	200(44.4)	74(16.4)	1.06(0.62-1.83)	0.82
Primary	50(11.1)	25(5.5)	0.79(0.40-1.54)	0.49
Lower Secondary	10(2.2)	3(0.7)	1.31(0.33-5.18)	0.70
Upper Secondary	1(0.2)	2(0.4)	0.20(0.02-2.27)	0.19
University	322(71.56)	128(28.4)		
Total				
Major occupation				
Unemployed	35(7.8)	24(5.3)	1.00	
Fishing	119(26.4)	30(7.1)	2.72(1.41-5.24)	0.003
Office	4(0.9)	1(0.2)	2.74(0.29-26.08)	0.38
Business	119(26.4)	50(11.1)	1.63(0.88-3.02)	0.12
Farming	15(3.75)	4(0.9)	2.57(0.76-8.7)	0.13
Other	30(6.7)	19(4.2)	1.08(0.49-2.35)	0.84
Total	322(71.56)	128(28.4)		

Of those (Table 7), only age and knowledge about schistosomiasis symptoms were found to be significant predictors for the uptake of Praziquantel during MDA. Belonging to the age group 30 years & above and having knowledge about signs of schistosomiasis were positively associated with the uptake of praziquantel during MDA.

3.3 Hindering Factors Associated with the Uptake of Praziquantel

Hindering factors were further highlighted through the Focus group discussions and Key Informant Interviews. All the participants of the Focus Group discussions from the two parishes had been residents of Butiaba for at least 2 years and all the 3 key informants had participated in conducting MDA exercises within Butiaba sub-county.

The major themes cited in both Focus Group Discussions included: matters relating to drug acceptability (such as side effects, size & smell), poor sensitization, poor mobilization, irregular supply, and inadequacy of tablets during the MDA exercises. "*From my experience, the side effects of the drug are too severe moreover the tablets smell so bad and require one to eat heavily before swallowing. Another reason is the inadequacy of tablets for example I missed the drug in the last MDA exercise. It demoralizes me to participate because I know that they always come in small quantities so I may miss them again. It makes me lose interest in taking the tablet."* (Bugoigo FGD participant).

Table 5. Bivariate association between knowledge-related factors and uptake of praziquantel of 450 adults from Butiaba Sub-county, Buliisa district surveyed in September 2021

Variable	Uptake of MDA		Unadjusted OR	P-value
	Yes(n=322) N(%)	No(n=128) N(%)	95% CI	
Knowledge of cause				
Ways one can get Bilharzia	310(68.9)	107(23.8)	1.00	
Knowledgeable	12(2.7)	21(4.7)	0.19(0.09-0.41)	0.00
Not knowledgeable	322(71.56)	128(28.4)		
Total				
Knowledge of signs				
Bilharzia signs				
Knowledgeable	311(69.1)	107(23.8)	1.00	
Not knowledgeable	11(2.4)	21(4.7)	0.18(0.08-0.39)	0.00
Total	322(71.56)	128(28.4)		
Knowledge of control measures				
Bilharzia control measures	317(70.4)	121(26.9)	1.00	
Knowledgeable	5(1.1)	7(1.6)	0.27(0.08-0.86)	0.029
Not knowledgeable	322(71.56)	128(28.4)		
Total				
Drug control of Bilharzia				
Swallowing MDA				
PZQ controls	245(54.4)	93(20.7)	1.00	
Bilharzia	77(17.1)	35(7.8)	0.83(0.52-1.33)	0.45
Knowledgeable	322(71.56)	128(28.4)		
Not knowledgeable				
Total				

Table 6. Bivariate association between attitudinal factors and uptake of praziquantel in 450 adults from Butiaba Sub-county, Buliisa district surveyed in September 2021

Variable	Uptake of MDA		Unadjusted OR	P-value
	Yes (n=322) N(%)	No (n=128) N(%)	95% CI	
Attitude towards risk				
Personal risk of catching Bilharzia				
Low	44(9.8)	31(6.9)	1.00	
High	278(61.8)	97(21.5)	2.02(1.21-3.38)	0.007
Total	322(71.56)	128(28.4)		
Attitude towards severity				
Bilharzia can cause death				
Disagree	4(0.9)	1(0.2)	1.00	
I don't know	9(2)	8(1.8)	0.28(0.02-3.07)	0.298
Agree	309(68.7)	119(26.4)	0.65(0.07-5.87)	0.7
Total	322(71.56)	128(28.4)		
Attitude toward MDA need				
Everyone should take PZQ in MDA	2(0.4)	1(0.2)	1.00	
Disagree	16(3.6)	12(2.7)	0.67(0.05-8.23)	0.75
I don't know	304(67.6)	115(25.6)	1.32(0.12-4.71)	0.82
Agree	322(71.56)	128(28.4)		

Variable	Uptake of MDA		Unadjusted OR	P-value
	Yes (n=322) N(%)	No (n=128) N(%)	95% CI	
Total				
Perceived benefits				
MDA controls Bilharzia effectively				
Disagree	32(7.1)	7(1.6)	1.00	
I don't know	11(2.4)	13(2.9)	0.19(0.05-0.58)	0.004
Agree	279(62)	108(24)	0.57(0.24-1.31)	0.187
Total	322(71.56)	128(28.4)		
MDA improves one's health				
Disagree	10(2.2)	9(2)	1.00	
I don't know	13(2.9)	12(2.7)	0.98(0.29-3.22)	0.97
Agree	299(66.4)	107(23.8)	2.51(0.99-6.36)	0.05
Total	322(71.56)	128(28.4)		
Perceived barriers				
PZQ tastes bad				
Disagree	139(30.9)	61(13.5)	1.00	
I don't know	16(3.6)	13(2.9)	0.54(0.24-1.19)	0.13
Agree	167(37.1)	54(12)	1.36(0.88-2.08)	0.17
MDA can cause death or bad				
effects	197(43.8)	80(17.8)	1.00	
Disagree	13(2.9)	8(1.8)	0.66(0.26-1.66)	0.38
I don't know	112(24.9)	40(8.9)	1.14(0.73-1.77)	0.57
Agree				
Medicine isn't enough during MDA	80(17.8	35(7.8)	1.00	
Disagree	42(9.3)	33(7.3)	0.56(0.3-1.01)	0.06
I don't know	200(44.4)	60(13.3)	(1.46(0.89-2.38)	0.13
Agree	322(71.56)	128(28.4)		
Total				

Table 7. Significant factors associated with uptake of praziquantel in 450 adults from Butiaba Sub-county, Buliisa district surveyed in September 2021

Variable	Uptake of MDA		Unadjusted OR 95% CI	Adjusted OR 95% CI	P-value AOR
	Yes (n=322) N(%)	No (n=128) N(%)			
Age group(years)					
18-24	62(13.8)	44(9.8)	1.00		
30-39	117(26)	36(8)	2.31(1.35-3.95)	2.35(1.34-4.09)	0.003
40+	93(20.7)	23(5.1)	2.86(1.58-5.22)	2.68(1.45-4.95)	0.002
Total	322(71.56)	128(28.4)			
Knowledge of signs					
Bilharzia signs					
Knowledgeable	311(69.1)	107(23.8)	1.00		
Not knowledgeable	11(2.4)	21(4.7)	0.18(0.08-0.39)	0.00	0.00
Total	322(71.56)	128(28.4)			

Of the three key informants, two cited financial constraints as a major challenge in delivering MDA for Bilharzia in the sub-county. One key informant said:

"*There's a lot of resistance from the Village Health Teams (VHTs) because of lack of facilitation vis-a-vis the large amount of work. We pull ropes with them and keep on persuading with a few incentives, but the major issue is lack of facilitation to do the work."* (KI: district vector control office).

Another challenge that was cited was the inadequacy of drugs. "The *amount of medicine brought to the community is low compared to the*

data that we present on the population." (KI: parish supervisor). This was highlighted as a demoralizer to participate in Bilharzia MDA within the community.

Additionally, infective sensitization was cited as a major problem in the delivery of MDA for Bilharzia services. "*The community lacks knowledge on MDA. Local Leaders and elders need to be utilized as well to deliver the right message to the community*." (KI: local leader).

Another challenge identified was constant migration. *"The community at the landing site is mostly a moving community: today someone is in Sonsio, tomorrow Runga. People are registered for praziquantel in one area and are not in the same place when the MDA exercise starts. This hinders uptake of Praziquantel."* (KI: parish supervisor).

As illustrated above, 5 major themes were cited in the qualitative interviews including financial constraint, poor sensitization & mobilization, irregular and inadequate drug supply, constant migration, and matters relating to drug acceptability (such as side effects, size & smell).

4. DISCUSSION

4.1 Uptake of MDA

Although the uptake of praziquantel during MDA in Butiaba sub-county was high at 71.56%, it was still below the WHO target of 75% [1]. According to the World Health Organization, it is important to attain at least the target of 75% coverage to avoid the high rate of infection and eliminate schistosomiasis as a public health threat by 2025 [1]. With uptake below the target, this cannot be achieved. Lower than recommended drug uptake rates have in the past been reported in different parts of Uganda including Koomes Island [15] and Mayuge [16]. Such low drug uptake as reported could considerably prolong the time needed to reach the goal of schistosomiasis transmission elimination. It is thus important to identify barriers to optimal drug uptake rates to improve them and to identify enabling factors that could further be strengthened to ensure successful schistosomiasis elimination.

Analysis of data in this study also revealed that 5.78% of the participants reported that they have never swallowed praziquantel in their lifetime and 21.3% of participants reported that they have not swallowed the drug in the last 10 years. A number of studies have in the past focused on recent treatment coverage [15,24,25], but have not looked at lifetime treatment data and the important issue of systematic non-treatment rates [26,27]. It is good to note that a greater percentage of participants in this study had been treated at least once in 18 years of MDA. Using such data to develop models could have a significant effect on the predicted duration that repeated MDA is needed to control morbidity. Using this study's noncompliance rate of 21.3% within the last 10 years, the sensitivity analyses by Turner and colleagues [26] indicate that MDA is needed for 6–9 years with a 20% systematic non-compliance [26]. If these lower-than-target annual treatment rates and high lifetime MDA non-treatment rates continue, MDA programs in districts such as this may potentially never attain the goals of schistosomiasis elimination. The closeness of percentages obtained in this study to the set targets is however encouraging that once efforts are geared in the right direction, goals could be achieved.

4.2 Socio-demographic Factors Associated with Uptake of Praziquantel During MDA

There was a strong association between age and uptake of praziquantel during MDA. This is in agreement with other studies that young adults are less likely to swallow praziquantel during MDA exercises [15,16,28-30]. In a fishing community like Butiaba, this is possible because younger adults spend more time at the lake shores and outdoors and are therefore more likely to miss out on door-to-door and even centralized drug distributions. This similarity suggests a need for further research to understand the reasons behind this trend revealed by the different studies. Additionally, if younger adults are more likely to reject free treatment than their older counterparts, then there is a need to tailor MDA exercises targeted at involving them more.

This study did not find a significant association between occupation and uptake of praziquantel during MDA as demonstrated by some studies [15]. A study done on Lake Victoria Island linked being a fisher folk to a greater likelihood to swallow praziquantel but that wasn't the case in this study. Trends may differ along different lake shores.

4.3 Knowledge-related Factors Associated with the Uptake of Praziquantel

In line with knowledge, the results show that study participants who were knowledgeable

about signs of schistosomiasis were more likely to swallow praziquantel. This observation correlates with other studies [31-33] that had similar findings. Knowledge of schistosomiasis symptoms possibly implies that the residents have had prior experience with the disease in their community and are hence more aware of their exposure risk and more willing to swallow the drug to protect themselves. However, it should be noted that knowledge collectively doesn't always positively correlate with increased uptake of the drug as shown by some studies [29,34] because of barriers like fear of praziquantel side effects.

Most of the participants had heard about schistosomiasis as is expected in highly endemic areas that have been treated repeatedly for several years. Similarly, in studies done in endemic parts of Africa, more than 90% of the study populations have been observed to have an awareness of schistosomiasis [35-37]. However, awareness is often limited to just being familiar with the disease's name. In this study, a strong correlation was found between knowledge of symptoms and uptake of the drug. Poor awareness of signs and symptoms was also observed to impact praziquantel uptake in other studies [38,39] which could in turn deter the elimination of schistosomiasis.

Furthermore, although greater than 50% of the respondents were knowledgeable about the cause, signs, and control measures of schistosomiasis, the remaining unknowledgeable population shows that there is need for intensive health education about schistosomiasis and its control. Health education is a major control strategy acting as a founding block on which other strategies can flourish. If health education is inadequate, this may result in the rejection of free drugs during mass drug administration [40-42]. Health education on both schistosomiasis and the importance of praziquantel during MDAs is beneficial in enabling community participation and changing perceptions & beliefs of the community toward given control measures [43].

4.4 Attitudinal Factors Associated with Uptake of Praziquantel

There was no significant association between attitude toward personal risk of exposure to schistosomiasis or its severity and the uptake of praziquantel. This contradicts the health belief model which suggests that when a person perceives themselves to be at risk of acquiring the disease and the benefits of the health intervention are known, the intervention will be complied with [44]. Furthermore, the perception that MDA improves health and controls schistosomiasis effectively did not significantly impact the uptake of praziquantel during MDA. This could be due to the absence of a major spiritual belief in the community that could drive negative attitudes toward the disease and MDA exercise.

Despite the bad taste and severe side effects of praziquantel, personal attitudes towards this were not negatively associated with people swallowing the drug. Our results, similar to other studies [25,45], show that the personal perceptions and fear of side effects or taste of praziquantel may not necessarily influence the uptake of the drug. This could be because the negative barriers of taste and side effects are negligible in comparison with the drug benefits [46]. In conflict with these findings, other studies [47-49] show that awareness of side effects and bad taste is negatively associated with the uptake of drugs during MDA exercise. However, given that this was a cross-sectional study, it is possible that this finding was because people who had swallowed the drugs had potentially experienced the side effects and the bad taste and hence were more knowledgeable about them. It is beneficial to work towards alleviating praziquantel side effects when possible.

4.5 Hindering Factors Associated with the Uptake of Praziquantel

Additional hindering factors included operational and service delivery challenges highlighted through the qualitative interviews such as financial constraints hence low Village Health Team (VHT) motivation, poor sensitization & mobilization, irregular, and inadequate drug supply that in turn affected uptake of praziquantel during MDA in this study.

VHTs and local leaders participated in the MDA exercises within the sampled Butiaba villages which illustrates positive community involvement. This is very vital in ensuring that the larger community supports the MDA exercise and hence positively impacts drug uptake [50,51]. However, as shown in the results, uptake was lower than recommended by WHO perhaps because of low motivation amongst the VHTs in the absence of facilitation. Furthermore, VHTs lacked training and adequate supplies to execute their duties.

VHTs that are not facilitated to execute their duties may lack the motivation to accomplish their tasks. Additionally, the absence of training results into the lack of the knowledge and skills to adequately sensitize the community. Together, these can result in failure to achieve set goals with drug uptake during MDA [15,52]. Therefore, there is a need to train VHTs and provide adequate facilitation and supplies for them to execute their duties as per the Uganda Health Sector Strategic Plan.

Other challenges highlighted included poor sensitization, and irregular and inadequate drug supply. These need to be solved to enable the Uganda national bilharzia control program (UNBCP) to achieve the objective of creating local demand for mass treatment [53]. The irregular and inadequate drug supply have been shown to negatively impact the uptake of MDA programs [54,55] by demoralizing people from participating in the MDA exercises hence effort needs to be geared towards availing a constant and adequate supply.

Conclusively, the results show that sociodemographic factors like age and enabling factors like knowledge about schistosomiasis increase the likelihood of praziquantel uptake during MDA in Butiaba. This information could be used to improve the national bilharzia control program in implementing effective mass drug administration [56-58].

4.6 Limitations of the study

Two major limitations were incurred in this study. Firstly, there is the inability to generalize findings since the study only looked at participants from one area (sub-county) along Lake Albert shores.

Secondly, this was a cross-sectional study hence is not able to determine causality between identified factors and uptake of praziquantel.

5. CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

The uptake of praziquantel during MDA in Butiaba was high but still below the target rate of 75% set by WHO. Limited knowledge about schistosomiasis symptoms, being in a young adult age group (18-29), and irregular and/or inadequate drug supply are some of the factors associated with uptake being below target.

5.2 Recommendations

Rigorous health education supervised by local leaders and the Ministry of Health needs to be done to share information on schistosomiasis and MDA.

Adequate and regular praziquantel supply by the Ministry of Health as the inadequacy of the drug was cited as a major demoralizer to participate in the MDA exercise**.**

A strategic approach to drug distribution involving the distribution of praziquantel at youth hot spots (such as lake shores and dancing halls) with prior mobilization done by fellow youth leaders to target the young adults**.** In addition, the proposed strategy should constantly monitor the program performance and make the required changes as guided by the Quality of Care model [59] developed by the World Health Organization. This model provides a simple framework for engaging the various stakeholders, including representatives from different parts of the community, in the planning and implementation of an intervention whilst ensuring a predefined level of quality. By using such systematic approach and by involving local decision-makers, program planners, drug distributors, and community members, the MDA programs targeting schistosomiasis in Butiaba should be able to increase praziquantel uptake rates and hence attain the target of elimination of the disease as a public health problem.

Further research is needed to understand why young adults are less likely to swallow praziquantel during MDA exercise.

ETHICAL APPROVAL AND CONSENT

Approval for the study was sought and granted by the Institutional Review Board of Clarke International University- Research Ethics Committee (Approval Number: CLARKE-2021-115). Permission to conduct the study was sought from Uganda National Council for Science and Technology (Approval Number: SS1083ES).

Written informed consent was sought from each person before the questionnaire or interview was administered. The study involved people 18 years (the age of consent in Uganda) and above with the ability to exercise free will and no personal identifiers were collected.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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