Schistosomiasis Outbreak Driven by River Water Contact Among Children in Petauke District, Eastern Province, Zambia, May 2026

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ABSTRACT

Background: Schistosomiasis (bilharzia) is a water-borne parasitic disease that remains endemic in Petauke District, Eastern Province, Zambia. In 2025, Petauke Urban Health Centre recorded 98 suspected and 50 laboratory-confirmed cases, compared with 38 suspected and one confirmed case in 2024, exceeding the epidemic threshold of 53.2 cases (mean + 2 SD, 2021–2024) by 84.2%. We investigated to determine the magnitude of the outbreak, describe cases by person, place and time, identify independent risk factors and recommend control measures.

Methods: We conducted a descriptive analysis of surveillance data and an unmatched case-control study (1:2) in the Petauke Urban Health Centre catchment area. Cases were residents with schistosome eggs detected on urine microscopy between September 2025 and January 2026; controls were residents aged five years and above from the same catchment who tested negative on urine microscopy. Data were collected using structured KoboToolbox questionnaires and analysed in R (version 4.5.3) using univariable and multivariable logistic regression, with sex included a priori in the adjusted model.

Results: We enrolled 117 participants (39 cases, 78 controls). Median age of cases was 13 years (IQR 11.0–14.5); 97.4% of cases were male and 59.5% were aged 10–14 years. Haematuria was universal (100%), followed by dysuria (76.9%). Chimate (n=12) and Stambuli (n=11) villages accounted for 59.0% of cases. River water contact was reported by 89.7% of cases versus 10.3% of controls. In multivariable analysis adjusted for sex, river water contact (aOR 43.71; 95% CI 8.80–217.20) and children swimming and urinating in water bodies (aOR 6.24; 95% CI 1.42–27.43) were independently associated with infection. No participant had received praziquantel through mass drug administration (MDA), median care-seeking delay was 44 days, and 23.1% of confirmed cases had not been treated.

Conclusion: This was a true outbreak of urogenital schistosomiasis, consistent with S. haematobium infection on urine microscopy, associated with recreational river contact among school-age boys in a setting with no preventive chemotherapy coverage. Emergency praziquantel MDA, treatment of all untreated cases, malacological surveys to guide any focal snail control at implicated river sites, targeted risk communication and improved access to safe water are recommended.

Keywords: Schistosomiasis, bilharzia, Schistosoma haematobium, outbreak investigation, case-control study, water contact, Petauke District, Zambia.

INTRODUCTION

1.1 Background

Schistosomiasis (bilharzia) is a parasitic disease caused by blood flukes of the genus Schistosoma. Two principal forms affect humans in sub-Saharan Africa: urogenital schistosomiasis caused by S. haematobium and intestinal schistosomiasis caused by S. mansoni. Transmission occurs when human skin comes into contact with fresh water containing cercariae shed by infected intermediate-host snails, Bulinus species in the case of S. haematobium (Colley et al., 2014). Infection presents with haematuria and dysuria and, if untreated, can progress to chronic urogenital morbidity (World Health Organization, 2023).

Schistosomiasis remains one of the most prevalent neglected tropical diseases, with the great majority of the global burden concentrated in sub-Saharan Africa (Chitsulo et al., 2000). School-age children carry the highest burden because of frequent recreational contact with open water bodies, and preventive chemotherapy with praziquantel is the cornerstone of control (World Health Organization, 2022). In Zambia, transmission is concentrated in districts with rivers, dams and seasonal water bodies that support snail populations (Ministry of Health, 2019).

Petauke District, located 179 km from Chipata, the provincial capital of Eastern Province, is endemic for schistosomiasis. Routine surveillance at Petauke Urban Health Centre documented 98 suspected and 50 confirmed cases in 2025, compared with 38 suspected and one confirmed case in 2024. Of the 50 confirmed cases in 2025, 35 had onset between September and December. Laboratory positivity remained high, with 13 of 21 suspected cases (62%) confirmed in November 2025 and 9 of 12 (75%) in December 2025. The 2025 total of suspected cases exceeded the calculated epidemic threshold of 53.2 cases by 84.2%, and a preliminary assessment found that no residents had received praziquantel through mass drug administration (MDA).

The magnitude and persistence of this increase, together with high laboratory confirmation rates, were inconsistent with a surveillance artefact and confirmed a true outbreak. However, the transmission sites, high-risk behaviours and drivers of the outbreak were uncharacterised, delaying a targeted response. We conducted this investigation to quantify the outbreak, describe cases by person, place and time and characterise their clinical and parasitological presentation, determine behavioural and environmental risk factors independently associated with infection, and recommend evidence-based control and prevention measures.

METHODS

2.1 Study design

We combined descriptive epidemiology with an unmatched case-control study using a 1:2 case-to-control ratio. Descriptive analysis of surveillance and laboratory data was used to confirm the outbreak and characterise cases by person, place and time. The case-control component was chosen because the number of confirmed cases was sufficient to support analytical testing of hypothesised exposures, and because a 1:2 ratio maximised statistical power within district-level operational constraints. An unmatched design was used so that age and sex, both of which are closely linked to water-contact behaviour, could be examined as characteristics of the outbreak and controlled analytically, rather than removed from analysis through matching.

2.2 Study site and setting

The investigation was conducted in the catchment area of Petauke Urban Health Centre (UHC), Petauke District, Eastern Province, Zambia. The catchment has an estimated population of 68,704 persons in peri-urban and rural communities, including Chimate, Stambuli, Garden and the Tasala settlements. The area is characterised by rivers and seasonal dams that support snail intermediate-host populations, and many residents depend on freshwater bodies for domestic, livelihood and recreational activities.

2.3 Study population

The study population comprised residents of the Petauke UHC catchment area. High-risk subgroups included school-age children, fishermen, traders and individuals regularly engaging in water-contact activities. Cases were all residents of the catchment area laboratory-confirmed between September 2025 and January 2026, irrespective of age. Controls were residents aged five years and above from the same catchment who tested negative by urine microscopy and had no schistosomiasis symptoms or diagnosis in the preceding three months. Controls were recruited from available households in the same villages as cases during the field investigation, rather than through formal random sampling from a sampling frame. Individuals with known non-infectious causes of haematuria or abdominal symptoms were excluded (Table 1).

Because cases were enrolled irrespective of age, the control age range was set to cover the same population at risk, rather than restricting controls to children while cases included adolescents and adults. The resulting age distributions were similar (median 13 years in both groups; Table 3). Controls were not matched on sex. The near-exclusive male predominance among cases was itself a feature of the outbreak to be described, and sex is closely related to the main exposure of interest (river swimming); matching on a variable so strongly linked to exposure risks overmatching and loss of efficiency. Sex was instead addressed analytically by including it a priori in the multivariable model, and the age distributions of cases and controls were compared (Table 3).

Case category	Definition
Suspected case	Any resident of the catchment area presenting with one or more of: visible blood in urine (haematuria), painful urination (dysuria), bloody stool (haematochezia), diarrhoea, or abdominal pain.
Confirmed case	A suspected case with laboratory confirmation of schistosomiasis by detection of one or more Schistosoma haematobium eggs per 10 ml of urine, or S. mansoni eggs in stool, on microscopic examination.
Control	A community resident aged ≥5 years living in the same catchment area, negative on urine microscopy, with no schistosomiasis symptoms or diagnosis in the preceding three months.

Table 1. Case and control definitions applied in the schistosomiasis outbreak investigation.

2.4 Sample size and enrolment

Sample size was calculated using the formula for unmatched case-control studies, $n = (Z\alpha/2 + Z\beta)^2 \times [p_1(1 - p_1) + p_2(1 - p_2)] / (p_1 - p_2)^2$, assuming 95% confidence ($Z\alpha/2 = 1.96$), 80% power ($Z\beta = 0.84$), a control exposure prevalence of 30% and an odds ratio of 3.0. This gave a minimum of 35 cases and 70 controls; allowing 10% non-response, the target was 39 cases and 78 controls. The target was achieved in full, with all 117 participants completing the interview.

2.5 Data collection

Primary data were collected through structured questionnaires administered by trained interviewers on encrypted devices using KoboToolbox. Variables included demographics, symptom history, dates of symptom onset and facility visit, water-contact behaviours, sanitation and hygiene indicators, health-seeking delay, method of diagnosis, treatment and prior MDA. Secondary data were abstracted from Petauke UHC outpatient registers, laboratory results and surveillance records for 2021–2025. Laboratory confirmation relied on urine microscopy performed at the Petauke UHC laboratory. Stool examination (e.g. Kato-Katz), egg-intensity quantification and molecular species identification were not performed, and no malacological survey of water bodies was undertaken during the investigation.

2.6 Data analysis

The epidemic threshold was calculated as the mean plus two standard deviations of annual suspected cases for 2021–2024. Descriptive statistics were used to summarise characteristics by case-control status, with frequencies and proportions for categorical variables and medians with interquartile ranges (IQR) for continuous variables.

Fisher's exact test and the Mann-Whitney U test were used for group comparisons. Univariable and multivariable logistic regression were used to estimate crude (OR) and adjusted odds ratios (aOR) with 95% confidence intervals (CI), with statistical significance set at $p < 0.05$. Variables with $p < 0.20$ in univariable analysis, together with a priori confounders, were considered for the multivariable model. Sex was included in the multivariable model a priori because of the marked imbalance between cases and controls and its established relationship with water-contact behaviour.

River water contact was coded as a binary variable (river reported as the primary water body versus dam or no regular contact). Two composite variables were constructed a priori to represent defined transmission pathways rather than isolated behaviours: children swimming and urinating near water (children in the household swimming in, and urinating or defaecating near, a water body), which combines exposure to cercariae through immersion with contamination of the same water with eggs; and sanitation risk (urinating near water and no handwashing facility). Composites were used because the individual water-contact items were highly correlated with one another, and because the small number of events (39 cases) limited the number of parameters that could be estimated reliably. A composite was never entered in the same model as its own component variables.

Age was missing for three participants (two cases, one control); apart from age, the variables summarised in Table 3 were complete for all participants. Analyses were conducted on complete cases. All analyses were conducted in R, version 4.5.3.

2.7 Ethical considerations

Approval for this outbreak investigation was obtained from the Eastern Provincial Health Office and Petauke District Health Office in accordance with national guidelines for public health emergency response. Verbal informed consent was obtained from all participants, and from parents or guardians for participants under 18 years of age. Personal identifiers were replaced with unique study codes, and data will be retained securely for five years in accordance with Zambian data protection guidelines. All confirmed cases were linked to treatment services irrespective of participation.

RESULTS

Of 98 suspected bilharzia cases recorded at Petauke UHC in 2025, 91 (92.9%) had urine samples sent for laboratory testing and 50 were confirmed. A total of 117 participants were enrolled in the case-control study: 39 confirmed cases (33.3%) and 78 community controls (66.7%), with no non-response (Figure 1).

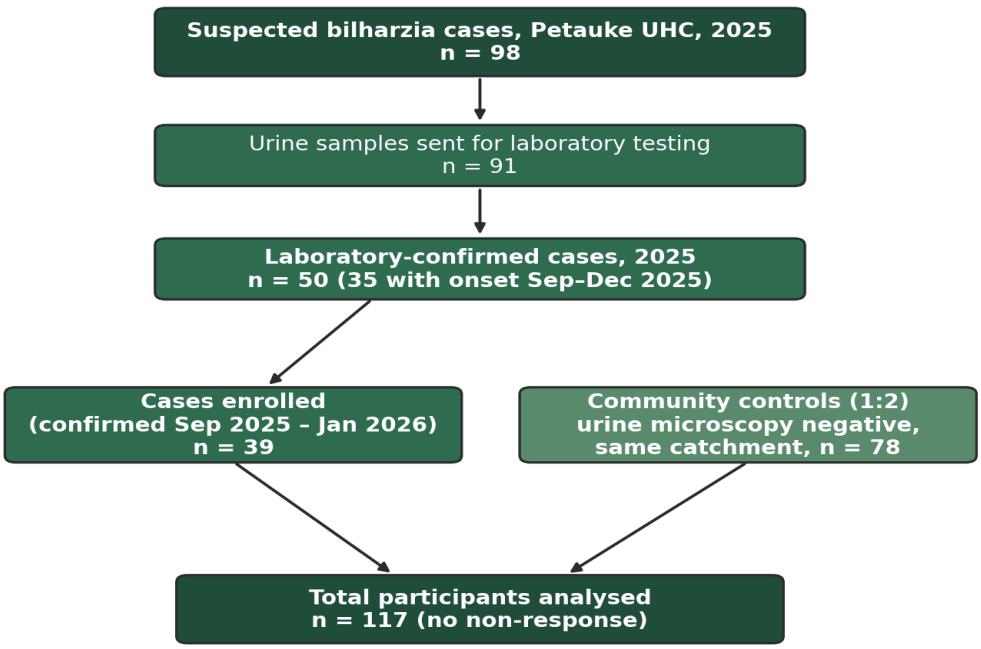


Figure 1. Case ascertainment and participant enrolment flow diagram, Petauke District schistosomiasis investigation.

3.1 Magnitude of the outbreak (Objective 1)

Annual suspected cases at Petauke UHC varied between 2021 and 2024 (8, 35, 18 and 38, respectively), giving a baseline mean of 24.8 cases per year (SD 14.2) and an epidemic threshold of 53.2 cases. The 2025 count of 98 suspected cases exceeded this threshold by 84.2%, and confirmed cases rose from one in 2024 to 50 in 2025 (Table 2).

Year	Suspected	Tested	Confirmed
2021	8	4	3
2022	35	16	9
2023	18	8	8
2024	38	9	1
2025	**98**	**91**	**50**

Table 2. Annual bilharzia cases at Petauke Urban Health Centre, 2021–2025 (epidemic threshold 53.2 suspected cases).

Based on the catchment population of 68,704, the 2025 attack rate for confirmed schistosomiasis was 0.7 per 1,000 population. Laboratory positivity among tested suspected cases in 2025 was 54.9% (50/91).

3.2 Descriptive analysis – Person (Objective 2)

The median age was 13 years among both cases (IQR 11.0–14.5) and controls (IQR 11.0–16.0), with no significant difference (p=0.293). The 10–14-year age group contributed the largest share of cases (59.5%, n=22), followed by 15–19 years (21.6%, n=8) and 5–9 years (16.2%, n=6). A striking sex disparity was observed: 97.4% of cases (n=38) were male compared with 53.8% of controls (p<0.001). Most cases had primary-level education (82.1%). River water contact was reported by 89.7% of cases versus 10.3% of controls (p<0.001), and children swimming in water bodies was reported in 82.1% of case households versus 16.7% of control households (p<0.001) (Table 3).

Characteristic	Overall (N=117)	Cases (n=39)	Controls (n=78)
Age (years), median [IQR]	13.0 [11.0–15.0]	13.0 [11.0–14.5]	13.0 [11.0–16.0]
Sex			
Male	80 (68.4%)	38 (97.4%)	42 (53.8%)
Female	37 (31.6%)	1 (2.6%)	36 (46.2%)
Age group (years)†			
5–9	18 (15.8%)	6 (16.2%)	12 (15.6%)
10–14	61 (53.5%)	22 (59.5%)	39 (50.6%)
15–19	22 (19.3%)	8 (21.6%)	14 (18.2%)
20–34	8 (7.0%)	1 (2.7%)	7 (9.1%)
35–49	3 (2.6%)	0 (0.0%)	3 (3.9%)
50+	2 (1.8%)	0 (0.0%)	2 (2.6%)
Education			
Primary	87 (74.4%)	32 (82.1%)	55 (70.5%)
No education	18 (15.4%)	5 (12.8%)	13 (16.7%)
Secondary	12 (10.3%)	2 (5.1%)	10 (12.8%)
Occupation (as recorded)			

Characteristic	Overall (N=117)	Cases (n=39)	Controls (n=78)
Trader	105 (89.7%)	33 (84.6%)	72 (92.3%)
Fisherman	12 (10.3%)	6 (15.4%)	6 (7.7%)
Primary water body contacted			
River	43 (36.8%)	35 (89.7%)	8 (10.3%)
Dam	4 (3.4%)	1 (2.6%)	3 (3.8%)
None	70 (59.8%)	3 (7.7%)	67 (85.9%)
Distance to water body			
< 5 km	80 (68.4%)	37 (94.9%)	43 (55.1%)
5–10 km	19 (16.2%)	0 (0.0%)	19 (24.4%)
> 10 km	18 (15.4%)	2 (5.1%)	16 (20.5%)
Children in household swim in water bodies	45 (38.5%)	32 (82.1%)	13 (16.7%)
Urinates near water bodies	42 (35.9%)	22 (56.4%)	20 (25.6%)
Toilet facility			
Pit latrine	114 (97.4%)	38 (97.4%)	76 (97.4%)
None/open defaecation	3 (2.6%)	1 (2.6%)	2 (2.6%)
Received praziquantel through MDA	0 (0.0%)	0 (0.0%)	0 (0.0%)

Table 3. Characteristics of cases and controls, Petauke District schistosomiasis outbreak, 2025–2026. Categorical variables: n (%); continuous: median [IQR]. †Age group missing for 3 participants (2 cases, 1 control).

Among the 39 confirmed cases, haematuria was universally present (100%) and was the defining clinical feature, followed by dysuria (76.9%), frequent urination (30.8%) and abdominal pain (25.6%). No case reported diarrhoea, blood in stool or fatigue (Table 4). Detection of eggs in urine together with an exclusively urogenital symptom profile is consistent with S. haematobium infection; however, because stool was not examined, concurrent S. mansoni infection cannot be excluded. Among the 25 cases (64.1%) who sought treatment, the median delay from symptom onset to first health facility visit was 44 days (IQR 16–104).

Symptom	n	%
Haematuria	39	100.0
Dysuria	30	76.9
Frequent urination	12	30.8
Abdominal pain	10	25.6
Other	4	10.3
Blood in stool	0	0.0
Diarrhoea	0	0.0
Fatigue	0	0.0

Table 4. Frequency of clinical symptoms among confirmed cases (n=39).

3.3 Descriptive analysis – Place

Cases were distributed across ten villages within the catchment area. Chimate (30.8%, n=12) and Stambuli

(28.2%, n=11) together accounted for 59.0% of cases and were the villages nearest to the implicated river sources, followed by Garden (12.8%, n=5) and Tasala 8 (10.3%, n=4). No cases were recorded in Riverside or Showgrounds (Table 5). Nearly all cases (94.9%) lived within 5 km of the water body they used, compared with 55.1% of controls.

Village	n	%
Chimate	12	30.8
Stambuli	11	28.2
Garden	5	12.8
Tasala 8	4	10.3
Tasala 9	2	5.1
Tasala 6	1	2.6
Tasala 10	1	2.6
Kalela	1	2.6
Donald Compound	1	2.6
Chilembwe Village	1	2.6
Riverside	0	0.0
Showgrounds	0	0.0

Table 5. Confirmed schistosomiasis cases by village of residence (n=39).

3.4 Descriptive analysis – Time

Suspected cases fluctuated below the epidemic threshold between 2021 and 2024 before rising sharply to 98 in 2025, with a parallel increase in confirmed cases from one to 50 (Figure 2). Within the investigation period, symptom onsets clustered between September and December 2025, which accounted for 35 of the 50 confirmed cases in 2025. This period coincides with the hot season and the onset of the rains, when river swimming and other water-contact activities are most frequent. Cases continued to be confirmed in December 2025 (9 of 12 tested, 75%) and January 2026, indicating ongoing transmission at the time of the investigation.

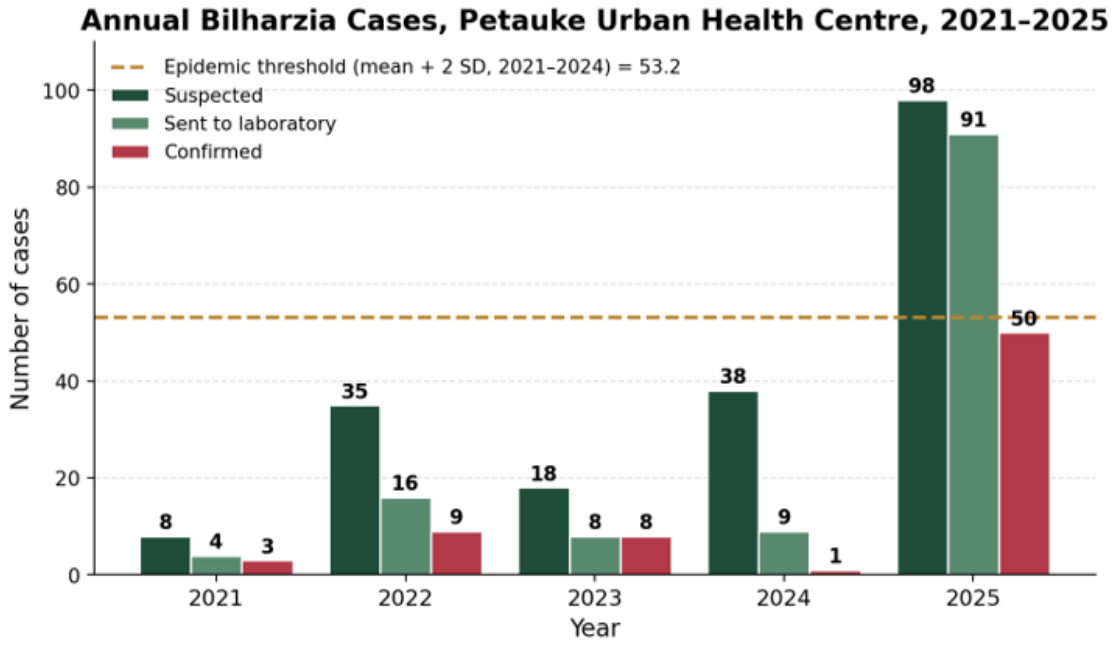


Figure 2. Annual suspected, tested and confirmed bilharzia cases against the epidemic threshold, Petauke Urban Health Centre, 2021–2025.

3.5 Risk factors for infection

Water-contact exposures showed the strongest differences between cases and controls. River water contact was reported by 89.7% of cases and 10.3% of controls, while 85.9% of controls reported no regular contact with any water body. Children swimming in water bodies (82.1% vs 16.7%) and urinating near water (56.4% vs 25.6%; p=0.002) were both more common among cases. Pit latrines were the main toilet facility in both groups (97.4%), and open defaecation was uncommon (2.6% in each group).

In univariable analysis, compared with river users, participants with no regular water-body contact (OR 0.01; 95% CI 0.00–0.04) or using dams (OR 0.08; 95% CI 0.01–0.83) had markedly lower odds of infection, as did those living more than 10 km from a water body (OR 0.15; 95% CI 0.03–0.67). Female participants had markedly lower odds of infection than males (OR 0.03; 95% CI 0.00–0.23). Education, toilet type and handwashing facility were not associated with infection (Table 6).

The multivariable model included river water contact, children swimming and urinating in water bodies, having heard of bilharzia and sex. After adjustment, river water contact (aOR 43.71; 95% CI 8.80–217.20; p<0.001) and children swimming and urinating in water bodies (aOR 6.24; 95% CI 1.42–27.43; p=0.015) remained independently associated with infection. Male sex was also associated with infection (aOR 13.06; 95% CI 1.09–157.06; p=0.043), although the estimate was imprecise because only one case was female. Having heard of bilharzia was not significant (aOR 6.62; 95% CI 0.89–49.50; p=0.065) (Table 7).

Variable	Category	OR	95% CI	p-value
Education	Primary (ref)	1.00	—	
	No education	0.66	0.22–2.03	0.592
	Secondary	0.34	0.07–1.67	0.210
Sex	Male (ref)	1.00	—	
	Female	**0.03**	0.00–0.23	**<0.001**
Primary water body	River (ref)	1.00	—	
	Dam	**0.08**	0.01–0.83	**0.035**
	None	**0.01**	0.00–0.04	**<0.001**
Distance to water body	< 5 km (ref)	1.00	—	
	5–10 km	NE‡	—	
	> 10 km	**0.15**	0.03–0.67	**0.007**
Toilet facility	Pit latrine (ref)	1.00	—	
	None/open defaecation	1.00	0.09–11.38	1.000
Handwashing facility	Yes (ref)	1.00	—	
	No	1.06	0.46–2.43	1.000

Table 6. Univariable logistic regression of factors associated with schistosomiasis, Petauke District, 2025–2026. OR = odds ratio; CI = confidence interval; bold = p < 0.05. ‡NE = not estimable (no cases in category).

Variable	aOR	95% CI	p-value
River water contact (vs other/none)	**43.71**	8.80–217.20	**<0.001**
Children swimming and urinating in water bodies (yes vs no)	**6.24**	1.42–27.43	**0.015**
Male sex (vs female)	**13.06**	1.09–157.06	**0.043**
Heard of bilharzia (yes vs no)	6.62	0.89–49.50	0.065

Table 7. Multivariable logistic regression of factors independently associated with schistosomiasis, Petauke District, 2025–2026. aOR = adjusted odds ratio; model includes all variables shown; bold = $p < 0.05$.

3.6 Diagnosis, treatment and MDA coverage

Of the 39 confirmed cases, 38 (97.4%) were diagnosed by urine microscopy and one (2.6%) clinically. Only 25 cases (64.1%) actively sought care, the remainder being identified through case-finding. Thirty cases (76.9%) received praziquantel, leaving nine confirmed cases untreated at the time of the investigation. Coverage of preventive chemotherapy was zero: no case and none of the 78 controls had ever received praziquantel through MDA (Table 8).

Indicator	n	%
Diagnosed by urine microscopy	38	97.4
Diagnosed clinically only	1	2.6
Actively sought care	25	64.1
Received praziquantel	30	76.9
Not treated	9	23.1
Prior MDA – cases	0	0.0
Prior MDA – controls (n=78)	0	0.0

Table 8. Diagnosis, treatment and preventive chemotherapy coverage among confirmed cases (n=39).

DISCUSSION

This investigation confirms a true outbreak of urogenital schistosomiasis in the Petauke UHC catchment area, concentrated among school-age boys living close to rivers in Chimate and Stambuli villages. Direct river water contact and children swimming and urinating in open water bodies were strongly and independently associated with infection after adjustment for sex. This is consistent with findings from Colley et al. (2014) and the World Health Organization (2023), which describe transmission of S. haematobium through penetration of the skin by cercariae shed from infected Bulinus snails during freshwater immersion. The detection of eggs in urine, the universal presence of haematuria and the absence of intestinal symptoms are consistent with S. haematobium as the causative species. However, species identification was not confirmed by stool examination or molecular methods, and the intermediate host was not confirmed by malacological survey, so this conclusion should be regarded as presumptive.

The near-exclusive male predominance among cases (97.4%) most plausibly reflects gendered patterns of water use. Controls of both sexes reported some water contact, predominantly for washing clothes and bathing, but intense and prolonged exposure through river swimming was concentrated among boys. Male sex remained associated with infection after adjustment (aOR 13.06), but the estimate was very imprecise (95% CI 1.09–157.06) because only one case was female. Because the questionnaire did not measure the frequency, duration or body immersion of water contact, sex is likely to be acting partly as a proxy for these unmeasured dimensions of exposure rather than as an independent biological risk factor. Importantly, the associations with river contact and with children swimming and urinating in water bodies persisted after adjustment for sex. This is consistent with findings from Ayabina et al. (2021), whose systematic review of African studies reported higher S. haematobium prevalence in males, largely attributed to occupational and recreational water-contact patterns.

The adjusted odds ratio for river water contact (aOR 43.71) is very large and its confidence interval wide (8.80–217.20), reflecting near-complete separation of this exposure between groups: 89.7% of cases but only 10.3% of controls reported river contact. The point estimate should therefore be interpreted with caution and not as a precise measure of effect, although the direction and strength of the association support river contact as the principal exposure. The independent effect of children swimming and urinating in water bodies (aOR 6.24) captures a self-sustaining transmission cycle in which the most exposed children are also the main source of egg

contamination of the water. This is consistent with findings from Sidibé et al. (2024), who showed in Mali that human-water contact patterns and the timing of cercarial emergence jointly shape urinary schistosomiasis transmission, and from Grimes et al. (2015), who highlighted the role of safe water and sanitation in reducing contact with and contamination of infested water.

The median care-seeking delay of 44 days, and the fact that only 64.1% of cases sought care themselves, suggest community normalisation of haematuria in young boys, which prolongs untreated infection and environmental contamination. This is consistent with findings from Danso-Appiah et al. (2010), who found in Ghana that only about one in five schistosomiasis-related symptoms were reported to a health facility and that perceived severity was the main determinant of seeking care. The treatment gap, with 23.1% of confirmed cases untreated despite laboratory diagnosis, represents a further break in the care cascade that sustains community transmission.

The complete absence of MDA coverage in both cases and controls is the single most actionable programmatic finding of this investigation. WHO recommends annual preventive chemotherapy with praziquantel, reaching at least 75% of people aged two years and above, in communities where prevalence is 10% or higher (World Health Organization, 2022). This is consistent with findings from Kokaliaris et al. (2022), who estimated that the scale-up of preventive chemotherapy was associated with a 58.3% reduction in schistosomiasis prevalence among school-aged children in sub-Saharan Africa between 2000–2010 and 2015–2019. The concentration of cases in Chimate and Stambuli, the villages nearest to the implicated river sources, indicates focal transmission and supports combining village-level MDA with gender-targeted behavioural interventions. Snail control is a recognised complement to preventive chemotherapy (World Health Organization, 2022), but in this setting it should follow malacological confirmation of infected Bulinus populations at the implicated sites and the environmental and regulatory safeguards required for molluscicide use (World Health Organization, 2017).

LIMITATIONS

As a case-control study, this investigation is subject to recall bias in self-reported water-contact behaviours. Controls were recruited from available households rather than by random sampling, which may introduce selection bias if those at home during data collection differed in water-contact behaviour from other residents. Controls were not matched on age or sex; although both were addressed analytically, residual confounding by sex is possible, and the sex-adjusted estimates are imprecise because only one case was female. Near-complete separation of some exposures resulted in very wide confidence intervals, so the magnitude of the river-contact odds ratio is uncertain. The composite exposure variables overlap conceptually, which may complicate interpretation of individual behaviours. Cases were identified through a single health facility, which may under-represent infected individuals who did not seek care, and controls were classified on a single urine microscopy examination, which may misclassify light infections and bias odds ratios towards the null. Species confirmation was presumptive: stool examination, egg-intensity quantification and molecular methods were not performed, so S. mansoni co-infection cannot be excluded. The association between having heard of bilharzia and case status may reflect knowledge gained after diagnosis rather than a true risk factor. No malacological survey was conducted to confirm the presence of infected snails at the implicated river sites.

CONCLUSION

This investigation confirms an active outbreak of urogenital schistosomiasis, consistent with S. haematobium infection, in the Petauke Urban Health Centre catchment area, Petauke District, Eastern Province, exceeding the epidemic threshold by 84.2% in 2025. Infection was strongly associated with river water contact and with children swimming and urinating in open water bodies, independently of sex, with boys aged 10–14 years in Chimate and Stambuli most affected. The complete absence of MDA coverage, a 44-day median care-seeking delay and untreated confirmed cases are likely to have contributed to both the intensity and the silent propagation of the outbreak and require urgent, coordinated intervention.

RECOMMENDATIONS

7.1 Immediate

1. Conduct emergency praziquantel MDA targeting all school-age children (5–15 years) and high-risk

adults in river-adjacent villages, prioritising Chimate, Stambuli, Garden, Tasala 8 and Tasala 9, in liaison with the National NTD Programme for drug procurement.

2. Trace and treat all nine confirmed cases who did not receive praziquantel.

3. Conduct a malacological survey of river sites near Chimate and Stambuli to identify Bulinus species and test for cercarial shedding. Where infected snails are confirmed, consider focal niclosamide application in line with WHO operational guidance, only after an environmental assessment and authorisation by the Zambia Environmental Management Agency (ZEMA), consultation with the Department of Fisheries and affected communities (because niclosamide is toxic to fish and other aquatic organisms), and with post-application monitoring. Erect warning signage at high-risk river entry points in the meantime.

4. Deploy community health workers and health promotion teams to challenge the normalisation of haematuria in boys, discourage river swimming, promote not urinating or defaecating near water, and publicise free praziquantel treatment.

5. Conduct school-based active case-finding in high-burden villages using urine dipstick screening for haematuria, with referral for confirmatory microscopy and treatment.

7.2 Long-term

1. Integrate annual schistosomiasis screening and MDA into the School Health and Nutrition Programme, with specific targeting of the 10–14-year age group.

2. Prioritise boreholes and improved latrines in communities where river use and open-water urination are common, through coordination with the Ministry of Water Development and Sanitation.

3. Train health facility staff on the case definition, urine microscopy, treatment protocol and mandatory notification to close the treatment gap identified in this outbreak.

4. Strengthen schistosomiasis surveillance at Petauke UHC through monthly DHIS2 reporting with a formal alert threshold (53.2 suspected cases per year), and include Petauke District in national praziquantel procurement for at least three consecutive annual MDA cycles.

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