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Knowledge, Attitudes and Practices Regarding Schistosomiasis among Rural School Children in Upper Sassandra Region, Côte d'Ivoire: A Cross-Sectional Survey

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Abstract

Schistosomiasis is a neglected tropical disease (NTD) widespread in sub-Saharan Africa and mostly affects school going children. Côte d'Ivoire is one of the most vulnerable countries to schistosomiasis, and its prevalence varies by region. This cross-sectional survey was conducted in schools in the Upper Sassandra region to determine the knowledge, attitude, and practices of school children regarding schistosomiasis. In total, 354 students participated in the survey. Our results showed that, compared to the girls, the boys had a higher level of knowledge about schistosomiasis OR = 1.605 and p = 0.05. Regarding the signs, symptoms, and modes of transmission and prevention of schistosomiasis, the participants reported a low level of knowledge $p > 0.05$ and $OR < 1$. The results further showed that infected students had a higher level of knowledge than those not infected $p < 0.05$, $OR > 1$. In conclusion, it is important to target health messages in schools to reach the most vulnerable students effectively. This initiative aims to provide children with basic knowledge and skills in the transmission of schistosomiasis.

Keywords

Schistosomiasis, Knowledge, Practice, Attitude, Schoolchildren, Côte d'Ivoire, Haut Sassandra

1. Introduction

Schistosomiasis is a prevalent neglected tropical disease which still remains a significant public health issue in numerous underdeveloped nations located in the tropics and subtropics, particularly in Africa [1] [2]. Despite the implementation of several initiatives to address worldwide occurrence, the rates of infection continue to be elevated, especially in sub-Saharan Africa. This region is responsible for more than 85% of those affected with schistosomiasis despite comprising only 13% of the global population [2]. Worldwide, six species of schistosome have a global impact on humans. According to studies, several types of schistosomes have been identified, such as *Schistosoma intercalatum*, *Schistosoma mekongi*, *Schistosoma japonicum*, *Schistosoma guineensis*, *Schistosoma haematobium* and *Schistosoma mansoni* that impact human health; among those cited, *Schistosoma haematobium* and *Schistosoma mansoni* are the most widespread in sub-Saharan Africa [3] [4]. Women and children engaged in routine domestic tasks in contaminated waters and anyone of all ages who works in or around contaminated waters, such as farmers, fishermen, children and irrigators, face a significant likelihood of developing the disease [5] [6]. The primary objective of the World Health Organization (WHO) schistosomiasis control plan is to minimize the incidence and impact of the illness [7]. Therefore, other interventions such as water, sanitation and hygiene (WASH), snail control, and health education are essential to sustain schistosomiasis [8]. The World Health Organization recommends that children aged 10 - 14 years should be the target group in the control of schistosomiasis because of their water contact behaviours, and that they should normally be the study population for the baseline survey and for monitoring and the evaluation of intervention strategies because of the epidemiological importance of this group with regard to schistosomiasis [9].

Additionally, community participation to combat disease can provide a platform for implementing various interventions [10]. Hence, it is essential to ensure that the targeted communities have a thorough understanding of the disease and its implications [11]. This is because successfully controlling and ultimately eradicating the disease can be extremely challenging if the affected populations do not recognize the disease as a significant public health issue [12].

In Côte d'Ivoire, schistosomiasis remains a major, potentially fatal, public health problem [13]. Two species of schistosome, *S. haematobium* and *S. mansoni*, have been reported in Côte d'Ivoire [14]. According to the WHO report [15], deaths linked to schistosomiasis in Côte d'Ivoire reached 376 or 0.22% and it is ranked 8th world country with the mortality rate according to age as a result, the Upper Sassandra region does not remain on the margins with a prevalence rate varying from 1.52% to 60% depending on the departments (Daloa, Issia, and Vavoua) according to PDNLMTN [16]. The national schistosomiasis control program in Côte d'Ivoire has reduced morbidity due to schistosomiasis in different governorates of the country. However, today most populations did not consider schistosomiasis as a fatal disease and a problem for public health; most of the affected population don't go to hospitals for treatment [17]. Schoolchildren, in rural

areas, constitute the populations most vulnerable to schistosomiasis infection, due to activity in the river, *i.e.* swimming, fishing and domestic work in the river. Most schistosomiasis educational programs target schoolchildren because they are easy to reach and more likely to become infected [18]. The positive influence of in-depth knowledge, positive attitudes, and practices on effectively preventing and controlling parasitic infections could be an especially important prevention tool. Accordingly, this study assessed the Knowledge, Attitudes and Practices (KAP) level regarding schistosomiasis among schoolchildren residing in rural regions of Upper Sassandra, Côte d'Ivoire.

2. Method

2.1. Study Design and Study Aera

2.1.1. Study Aera

A cross-sectional study design was used to determine the Knowledge, Attitudes, and Practices level regarding schistosomiasis among school children residing in rural regions of Upper Sassandra, Côte d'Ivoire. The Upper-Sassandra region is in the west-central part of Côte d'Ivoire between 6˚12 and 7˚49 North latitude and 5˚55 and 7˚10 longitude. This region is drained by the Sassandra River, from which it takes the name "Upper-Sassandra," and it covers an area of 15,200 km^2 with an estimated population of 1,739,697 inhabitants Figure 1. It is also home to

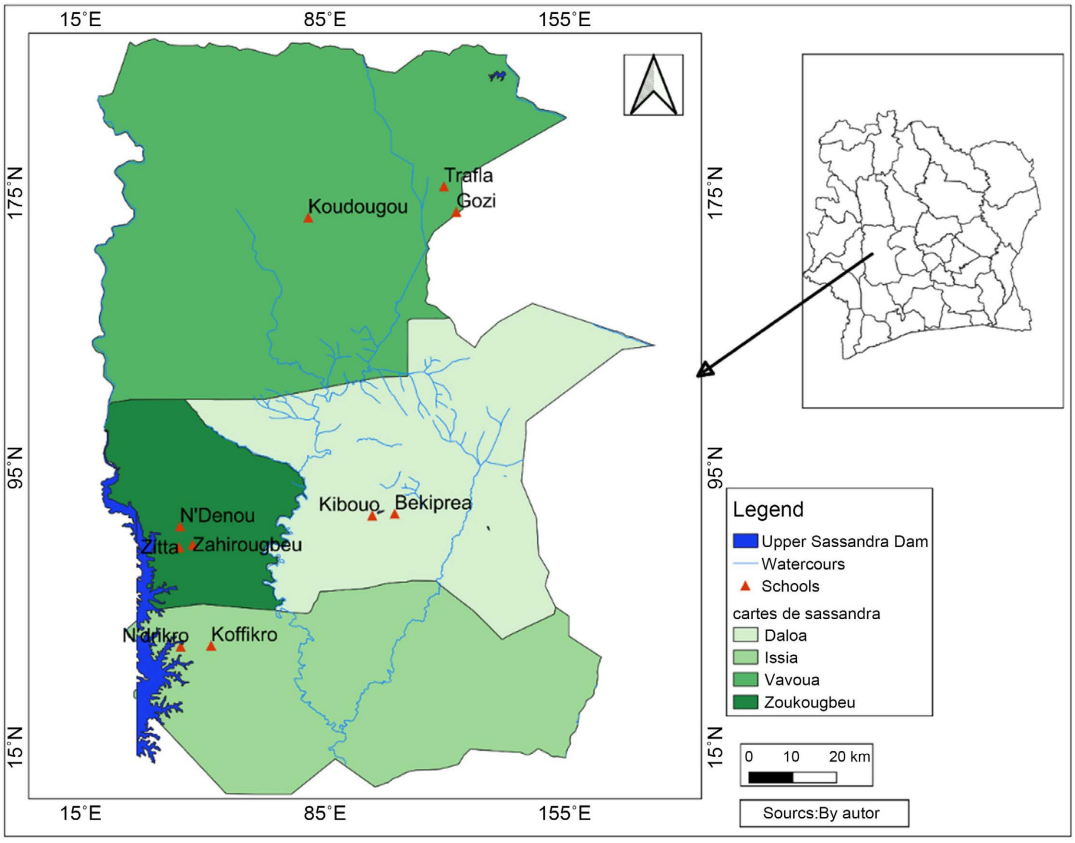

Figure 1. Presentation of the study area and the survey schools.

the third largest city in Côte d'Ivoire, namely Daloa, due to its human potential, food distribution, rice cultivation, and food crops (Giscard *et al.* 2022). This region is part of the third-largest city in Côte d'Ivoire and the second-largest cocoa and coffee production zone. Concerning the climate, this area has a humid tropical climate with rainfall ranging from 1200 to 1600 millimetres of rainfall per year. According to DODEXAM, the annual temperature of the region 2023 [19] was 26 degrees Celsius, and it has two types of vegetation: a forest zone and a pre-forest zone [20].

2.1.2. Study Design

A cross-sectional survey was conducted from January 20 to March 31, 2023, among schoolchildren in rural areas of Haut Sassandra. Ten primary schools were selected based on the following criteria: Being enrolled in Grades 4 and 5, having an age between 9 and 15 years, having a letter of recommendation from parents and schools should be located 150 m from watercourses. All these choices were made with the help of the regional Pedagogical Inspector. According to WHO [21], children aged 9 to 16 in primary schools in rural areas practice swimming in watercourses. Informed consent from schools and parents as well as children was sought before the start of the study. Therefore, participation was voluntary. Probability sampling was used to select participants. Fishbowl sampling technique was used to select schools, and systematic sampling was used to select children from each class in each school.

2.2. Sampling and Participants

We calculated the sample size using the formula below in this study. This study was conducted based on the students' knowledge about KAP. We assumed that about 50% of the students had good knowledge about KAP, so 354 students were selected from the four regions, and within 34 students in each class in the 10 schools in the region.

A cross-sectional sampling design was applied using the following formula:

$$n = \frac{\left(Z^2 * p(1-p) * C\right)}{I^2} \quad [22]$$

where $Z = 1.96$, $p = 36\%$ is the prevalence expected based on a previous study, i is the precision or margin of the error (5%), and C is the correction coefficient ($C = 2$).

2.3. Data Collection

Data were collected through face-to-face interviews using a structured standardized questionnaire which was developed based on a previous study [23]. The questionnaire included 23 questions and was divided into four categories: 1) sociodemographic characteristics; 2) knowledge of schistosomiasis, symptoms, origin, and mode of transmission; 3) attitude toward schistosomiasis prevention; and 4) practices concerning prevention. Data collectors were three who had received 30-

minute training to understand key areas of the structured questionnaire, comprehend the interpretation of key variables and how to collect the same information from all participants consistently. On average, it took 15 minutes to administer questionnaires to participants. Data were collected using Epi info software version 7.2.5.

2.4. Data Analysis

All data analyses were performed using IBM SPSS V.26.0. Participants' sociodemographic characteristics (gender, grade level, age, and school) between practical knowledge level and altitude were compared using Pearson's χ^2 test or Fisher's exact test. A multivariable logistic regression model in which adjusted odd ratio (OR), and their 95% CIs were computed was used to investigate factors associated with schistosomiasis infection. Variables with a $p \leq 0.05$ were considered statistically significant in the final model.

3. Result

A total of 345 schoolchildren aged 9 to 16 years, with an average age of 12 years, attending ten schools in the Haut Sassandra region, in the west-central part of Côte d'Ivoire, participated in this study. Table 1 shows the typical characteristics of these children. Of the 345 participating schoolchildren, (155/345) or 43.8% were girls and (199/345) or 56.2%. Regarding the grade level, 54%, or most of the participants, are in Grade 5 and 46.2% are in Grade 4 see Table 1.

Table 1. Socio-demographic characteristics of school children.

Variable		N	
Class level	CM1	163	46%
	CM2	191	54%
Gender	Boy	199	56.20%
	Girl	155	43.80%
Age (years)	[9 - 10]	155	43.80%
	[11 - 12]	144	40.70%
	[13 - 14]	34	9.60%
	[15 - 16]	21	5.90%

Table 2, in our analysis, it appears that out of 119/354 girls, or 56% were aware of schistosomiasis against 92/354, or 43.9% of boys. However, there is a significant difference between girls and boys with a $p = 0.030$. In addition, regarding the class levels of schoolchildren and the schools in the region on the level of knowledge of schistosomiasis, there is a significant difference with a $p = 0.012$, $p = 0.001$ regarding the age of schoolchildren, there is no significant difference on the levels of knowledge of schistosomiasis with a $p > 0.851$.

Table 3 indicates that out of the total participants, 212/354 or 59% of the sample had knowledge of schistosomiasis. In addition, 210/354 participants or 60.5% of

the sample reported having been infected with schistosomiasis and some claimed to be infected as well. The table shows the results regarding the knowledge of schoolchildren on the causes, signs and symptoms, transmission, and prevention of schistosomiasis. A total of 260 participants (74.3%) mentioned having no idea about the causes, while 91 (25.7%) mentioned that worms were the cause of schistosomiasis. Then, some signs or symptoms were mentioned by the participants 136 (38.4%) abdominal pain, 64 (13.6%) malaise and 48 (18) diarrhoeas, while 24 (6.8%) mentioned having no idea about the signs. Interestingly, only 6.2% and 16.9% of the respondents indicated the classic signs of schistosomiasis, namely fever and itchy skin with black spots. The results also showed that there was a low level of knowledge about the transmission of schistosomiasis in children; Only 82 (23.2%) of them mentioned swimming in contaminated water as a means of transmission of the disease, the others cited respectively 32 (9%) worm, 17 (4.8) doing laundry, dishes in contaminated water, while 218 (61%) had no idea of the mode of transmission. Regarding the participants' knowledge of prevention, about 150/354, or 42.4%, mentioned avoiding swimming in contaminated river water or stagnant water. 42/354 (11.9%), avoiding washing clothes and fishing in dirty water. 47/354, or a rate of 13.3% avoid defecation at the edge of rivers, and 2.9 (8.2%) wash hands with soap before and after eating, while 67/354 (18.9%) could not cite any preventive measure.

Table 2. Cross table analysis on the level of knowledge of schistosomiasis according to sociodemographic factors.

	Variable	Frequency (%)	Chi-square	p value
Sexe	Boy	92 (43.9)	4.713	0.03
	girl	119 (56.1)		
Class	CM1	89 (42)		
	CM2	123 (58)	6.357	0.012
Age	[9 - 10]	94 (44.3)		
	[11 - 12]	83 (39.2)		
	[13 - 14]	21 (9.9)	0.792	0.851
	[15 - 16]	14 (6.6)		
Schools	Bekiprea	18 (8.5)		
	N'denou	26 (12.5)		
	Kibou	31 (14.6)		
	Zitta	24 (11.3)		
	Gozi	28 (13.2)		
	Zahi	12 (5.7)	39.79	0.001
	Trafla	23 (10.8)		
	Koudoukou	14 (6.6)		
	N'drikro	16 (7.5)		
	Koffikro	20 (9.4)		

Table 3. School children's knowledge about la schistosomiases.

Variable		N	(%)
Ever heard about schistosomiasis	Yes	212	59
	No	142	40.1
Ever been infected with schistosomiasis	Yes	210	60.5
	No	140	39.5
Know the causes of schistosomiasis?	Yes	91	25.7
	No	260	74.3
Aware of signs or symptoms of schistosomiasis?	Abdominal pain	136	38.4
	Diarrhoea	48	18
	Malaise	64	13.6
	fever	22	6.2
	itching	60	16.9
	I don't Know	24	6.8
Know the modes of transmission of schistosomiasis?	worm	32	9
	Swimming in rivers	82	23.2
	mosquito bite	5	1.4
	dirty water	17	4.8
	I don't know	218	61.8
Preventive measures you know to avoid schistosomiasis?	Avoid washing clothes in open water sources	2.9	8.2
	Avoid defects in the river	47	13.3
	Washing hands before eating and after using toilets	42	11.9
	Avoid swimming in contamination water	150	42.4
	I don't Know	67	18.9

Table 4, the results of the table regarding the association of participants' knowledge about schistosomiasis with their gender and infection status (N = 354) highlight several significant points, including the causes of infection, symptoms, transmission, and prevention methods. According to the results, boys were more likely to have heard of schistosomiasis (OR = 1.605, CI = [1.046 - 2.462], p value = 0.03). Similarly, the result shows an unexpected association between mosquito bite and schistosomiasis infection in boys. This anomaly may result from confusion among respondents between schistosomiasis and other vector-borne diseases such as malaria (OR = 6.49, CI = [1.12 - 38.12], p value = 0.04). Avoidance of swimming in contaminated waters is associated with a significant reduction in the risk of infection (OR = 0.349, CI = [1.004 - 0.121], p value = 0.051); (OR: 4.65; CI: [0.955 - 22.65], p value = 0.057). Regarding infection status, students who were infected with the disease were twice as likely to have heard of schistosomiasis than those who were not infected (OR = 2.17, [1.402 - 3.374], p value = 0.001). Similarly, the proportions of infected participants were aware of the causes of

schistosomiasis, which clearly demonstrates that certain behaviours are key risk factors in the transmission of schistosomiasis. The association between knowledge of symptoms and infection status is highly significant (OR = 4.28, CI = [1.303 - 1.094], p value = 0.017). Transmission by worms is strongly associated with infection, with an OR of 5.9 and a significant p-value (0.006). This confirms the key role of parasites in the transmission of schistosomiasis. Preventive measures show a strong tendency to reduce the risk of infection with an OR of 349, close to statistical significance (p = 0.051).

Table 4. Multivariate analysis of factors associated with knowledge about schistosomiasis among the schoolchildren.

Variable	Sex			Infection status		
	OR	p value	95% CI	OR	p value	95% CI
Heard about schistosomiasis?	1.605	0.03*	[1.046 - 2.462]	2.17	0.001*	[1.402 - 3.374]
Cause N = 354						
Rice growing	0.518	0.18	[0.198 - 1.355]	1.26	0.005*	[0.859 - 31.1841]
Swimming	0.717	0.255	[0.404 - 1.272]	1.77	0	[2.913 - 10.838]
Laundry, dishes	1.242	0.633	[0.511 - 3.015]	1.24	0.001*	[2.018 - 18.422]
Signs and symptoms N = 354						
Abdominal pain	2.151	0.142	[0.774 - 5.982]	2.92	0.14	[0.703 - 1.263]
Blood in stool or urine	1.011	0.978	[0.45 - 2.275]	4.28	0.017*	[1.094 - 1.303]
Fever	1.349	0.409	[0.662 - 2.751]	9.84	0.227	[0.531 - 2.774]
Itching	0.788	0.133	[0.303 - 2.047]	3.77	0.133	[0.666 - 21.379]
Transmission N = 354						
Worm	1.252	0.619	[0.516 - 3.042]	5.9	0.006*	[1.682 - 20.691]
Swimming in rivers	0.93	0.833	[0.475 - 1.8230]	5.81	0.835	[2.385 - 14.172]
Mosquito bite	6.49	0.04*	[1.12 - 38.12]	0.44	0.075	[0.933 - 7.144]
Dirty water	2.295	0.173	[0.695 - 7.579]	3.7	0.097	[0.79 - 17.422]
Prevention N = 354						
washing clothes in the watercourse	0.669	0.298	[0.313 - 1.427]	0.89	0.834	[0.332- 2.432]
Avoid defects in the river	0.642	0.17	[0.34 - 1.209]	1.21	0.627	[0.556 - 2.646]
hands before/after eating	0.634	0.217	[0.308 - 1.306]	0.55	0.186	[0.232 -1.328]
Avoid drinking from lake	0.9	0.813	[0.378 - 2.144]	2.97	0.101	[0.809 - 10.974]
Avoid swimming	3.49	0.051*	[0.121 - 1.004]	4.65	0.057*	[0.955 - 22.653]

Table 5 shows us the relationships that exist between the altitudes and the practice of the participants concerning the factors influencing schistosomiasis infection in schools. Indeed, the analysis indicates that there are no significant differences between gender and class levels concerning domestic work, fishing and swimming among schoolchildren, so the $p > 0.05$, while girls and boys do not present significant differences concerning the threshold of 5% with the $p > 0.05$

on the questions of the period of work in the fields, sources of water, presence of any source of water in schools or in villages and the place of defecation. On the other hand, the class levels present significant differences among CM1 and CM2 pupils with a significant threshold lower than 5%. Indeed, 75.4% of CM2 schoolchildren go to work in the fields during rainy periods than CM1 students. In addition, the majority of CM2 students (76.4%) say they do not drink water in schools as CM1 students (54.6%). Among those who do not drink water from schools, most say that the water comes from various sources: backwater, rivers, etc.

Table 5. Association of participant's attitude and practices concerning schistosomiasis with sex and class level.

Variable	Girl	Boy	p value	CM1	CM2	p value
Do you often work (laundry, fish) in the river?						
Yes	153 (76.9%)	46 (23.1 %)	0.393	128 (78.5%)	150 (78.5%)	0.099
No	125 (80.6%)	30 (19.4%)		35 (21.5%)	41 (21.5%)	
Do you go swimming in the river often?						
Yes	124 (62.3%)	75 (37.7%)	0.194	98 (60.1%)	112 (58.6%)	0.777
No	86 (55.5%)	69 (44.5%)		65 (39.9%)	79 (41.4)	
At what period of year will you work in the fields or by the riverside?						
when it rains	139 (69.8%)	109 (70.3 %)	0.923	104 (63.8%)	144 (75.4%)	0.018
when it is not raining	60 (30.2%)	46 (29. 7%)		59 (36.2%)	47 (24.6)	
Do you have drinking water in the schoolyard or at home?						
Yes	61 (30.7%)	58 (37.4 %)	0.181	74 (45.4%)	45 (23.6%)	0.001
No	138 (69.3%)	97 (62.6%)		89 (54.6%)	146 (76.4%)	
What sources of drinking water do you have at school or at home?						
Well water	22 (11.1%)	14 (9)		23 (14.1%)	13 (6.8%)	
drilling water	38 (19.1%)	31 (20%)		39 (23.9)	30 (15.7%)	
tap	13 (6.5%)	18 (11.6%)		18 (11%)	13 (6.8%)	0.001
river	45 (22.6%)	25 (16.1%)	0.293	35 (21.5%)	35 (18%)	
backwater	81 (40.7%)	67 (43.2 %)		48 (29.4%)	52 (14.8%)	
Where do you take your stool when you are in school?						
bush	112 (56.3%)	74 (47.7%)	0.11	97 (59.5%)	89 (46.6%)	0.015
school	87 (43.7%)	81 (53.3%)		66 (40.5%)		

4. Discussion

Our study, conducted in a rural area of Upper Sassandra where schistosomiasis in endemic demonstrated the value of using the Kap method to analyses data and identify vulnerabilities related to public knowledge, attitudes, and practices regarding this long-standing public health threat in Côte d'Ivoire.

The analyses showed that socio-demographic factors play a key role in knowledge about schistosomiasis. Factors such as gender, class, and school significantly

influence the level of knowledge. These associations could be explained by factors such as the natural progression of knowledge, the competence of teachers or the school curriculum, as well as gender differences in the educational programmed. Our results are in line with studies carried out in Senegal in schools [24].

The results highlight significant gaps in schoolchildren's knowledge of the causes, signs, modes of transmission and preventive measures for schistosomiasis, despite a considerable proportion (59%) having some knowledge of the disease and 60.5% having reported experience of infection. Most participants (74.3%) had no idea of the causes of schistosomiasis while only 25.7% associated the disease with worms. This lack of understanding of the underlying biological cause may contribute to the perpetuation of risky behaviour, particularly in contexts where health awareness is limited [25]. The low level of knowledge about the causes may reflect a lack of health education in schools or communities [26].

This highlights the importance of specific information campaigns to bridge this gap. In addition, ignorance of the classic signs and symptoms can delay diagnosis and treatment. Educational efforts must include clear and accessible information on symptoms to encourage early recognition [27]. This lack of knowledge is a cause for concern, as it prevents preventive behaviour. The lack of knowledge regarding the connection between bathing and transmission suggests that educational initiatives should be intensified, especially in rural regions where water contamination is prevalent. Although some participants are aware of prevention measures, this knowledge remains fragmentary and insufficient to ensure effective protection. The diversity of responses reveals gaps in the dissemination of prevention messages [28].

The results highlight significant associations between schoolchildren's knowledge of schistosomiasis and their gender and infection status. These observations provide important insights into the dynamics of schistosomiasis awareness and prevention. Boys were significantly more likely to have heard of schistosomiasis than girls (OR = 1.605, CI = [1.046 - 2.462] p = 0.03). However, a notable confounding between schistosomiasis and other vector borne diseases such as malaria was observed in boys, with an association between mosquito bites and schistosomiasis infection (OR = 6.49, p = 0.04). This result suggests greater awareness among boys this confusion could be due to inadequate exposure to clear information, which justifies the need for targeted educational programs to correct these preconceived ideas [29]. Participants who had been infected with schistosomiasis were twice as likely to have heard of the diseases as those who had not (OR = 2.17, p = 0.01). In addition. these results indicate that personal experience with schistosomiasis Favors the acquisition of knowledge about the disease. Transmission via worms was strongly associated with infection (OR = 5.9, p = 0.006), confirming the role of parasites as major vectors of the disease. Furthermore, avoiding bathing contaminated water associated with a significant reduction in the risk of infection (OR = 3.49, p = 0.051). These results underline the importance of adopting preventive behaviours to limit transmission [30]. A highly significant association was observed between knowledge of symptoms and infection status (OR =

4.28, p = 0.017). It indicates that infected schoolchildren are better at appreciating the signs of the disease probably because of their personal experience. Recognition of symptoms in essential to encourage early detection and treatment. Preventive measures such as avoiding swimming in contaminated water, chowed a strong tendency to reduce the risk of infection (OR = 3.49; p = 0.051). This reflects the effectiveness of prevention strategies in the fight against schistosomiasis's result indicates that preventive behaviour can reduce the risks [31]. The pupils' attitude towards schistosomiasis was at a moderate level, but what is worrisome is their bad practices. Although most of the students were able to understand their susceptibility to schistosomiasis and could correctly describe the route of schistosomiasis infection, their high-risk behaviours, such as bathing or urinating in fresh water and defecating in the bush still exist. The high relative frequency of unsanitary behaviours may lend to the transmission of schistosomiasis among children. These findings are similar to the research done in Mozambique [32] in Kenya [33] and in Pemba Island, Zanzibar [34]. Interestingly, indicators such as sex, class and school were noticed as another significant predictor of attitude and practice in children's perception of schistosomiasis. The observed results revealed several challenges in raising awareness of schistosomiasis among school-aged children. Although most of them have heard of the disease and a high proportion have already been infected, knowledge of the causes, symptoms, modes of transmission and preventive measures remains insufficient. However, our study had certain limitations, particularly regarding the number of schools that participated in the study due to the accessibility conditions of the different villages and due to the limited budget and study time. In terms of methods, it could be carried out by interviewing pupils to obtain more information about the modes of transmission, prevalence and symptoms of schistosomiasis. In addition, other studies could be carried out on a larger sample in other regions of Côte d'Ivoire with the support of the Ivorian government and national and international organisations.

5. Conclusion

The results of this study reveal several significant gaps in knowledge about schistosomiasis, although direct experience of the disease promotes understanding. Gender disparities and misconceptions about modes of transmission highlight the need for tailored educational interventions, as well as the importance of sociodemographic factors in learning and justify targeted interventions to improve the team in the education system. It is essential to address these gaps through targeted educational programs that promote gender equality in the curriculum and involve teachers, health workers and community leaders in raising awareness.

Ethical Consideration

The Ethics Committee of Social Sciences of the University of Abidjan approved the study protocol. During our preliminary visits to the study areas, we met with household heads and solar inspectors of the region, school directors and the prefect of the region. A letter of informed consent was given to the students for the

parents.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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