Identifying the risk factors of schistosomiasis in Indonesia

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Abstract

In Poso, Central Sulawesi, schistosomiasis prevalence has shown fluctuations, particularly in the Napu Highland, home to around 17,000 people, where there is a 0.15% risk of Schistosomiasis. This study aimed to analyze the risk factors associated with schistosomiasis in the Napu Highland. Conducted from April to June 2022, this case-control study included residents of schistosomiasis-affected villages. The sample consisted of 148 individuals (37 cases and 111 controls). Cases were residents aged over 2 years who had tested positive for schistosomiasis in a 2021 fecal survey conducted by the Poso District Health Office. Controls were selected as the nearest neighbors of the cases. Data on education, knowledge, occupation, sanitation practices, water sources, activities near water bodies, use of protective equipment, and livestock raising were collected through questionnaires. Statistical analysis involved the Chi-square test with α=5%. The results indicated that education (p=0.018; OR=3.147) and knowledge (p=0.056; OR=2.233) were associated with schistosomiasis. Individuals with lower education levels were 3.147 times more likely to contract the disease, while those with limited knowledge were 2.233 times more at risk. In conclusion, improving schistosomiasis prevention in the Napu Highland should involve enhancing knowledge, attitudes, and practices through health promotion initiatives that engage educators and community leaders.

Introduction

Schistosomiasis is an acute and chronic parasitic disease caused by blood flukes (trematode worms) of the genus Schistosoma. It remains a significant public health problem in many countries. According to estimates, as of 2021, at least 251.4 million people required preventive treatments.[1] Schistosomiasis is most prevalent in tropical and subtropical regions, particularly in impoverished communities lacking access to safe drinking water and adequate sanitation. The disease primarily affects poor, rural populations, especially those engaged in agricultural and fishing activities.[2] Children, due to their inadequate hygiene practices and contact with infected water, are particularly vulnerable to infection.[3] The socio-economic impact of Schistosomiasis is substantial, as the disease causes more disability than mortality.[4,5] Human infection occurs through contact with freshwater sources containing live cercariae, which penetrate the skin. However, it is important to note that Schistosomiasis is not transmitted directly from person to person; rather, it requires freshwater bodies where intermediate snail (*Oncomelania hupensis lindoensis*) hosts reside and reproduce.[6]

In Indonesia, Schistosomiasis is found in the Highlands of Bada, Napu, and Lindu, spanning across 28 villages in Poso and Sigi districts, Central Sulawesi.[7] Recent data from the Central Sulawesi Provincial Health Office indicates a significant increase

in Schistosomiasis cases in the Poso District, with a total of 245 cases reported in 2021 compared to the previous 45 cases. Additionally, the Sigi District reported 12 new cases in 2022, bringing the total number of Schistosomiasis cases in Central Sulawesi in 2022 to 257. The prevalence of Schistosomiasis in the two districts has risen to 1.5% of the total population in the 28 treated villages. By early February 2023, the prevalence of Schistosomiasis reached 1.57%, surpassing the previous rate of below 1% recorded in 2019.[8,9] The Napu Highland, particularly with a population of up to 17,000, faces a Schistosomiasis risk of 0.15%, warranting attention and concern.[10]

Schistosomiasis disproportionately affects impoverished rural communities, including agricultural and fishing populations, due to inadequate sanitation and frequent contact with infested water.[3,11] Occupational exposure to infested water, such as in the case of fishermen, farmers, irrigation workers, and women engaged in household duties near infested water, further contributes to the disease's prevalence.[2,6] Studies conducted by Muslimin in Lore Lindu National Park and Rosmini, Jastal, and Ningsi in the Bada Highland of Poso Regency identified various risk factors for Schistosomiasis, such as lack of personal protective equipment, defecating in open areas, and bathing in infested rivers.[12,13]

Furthermore, the public's awareness of the importance of providing stool samples for investigation is an area of concern, particularly in the Napu Highland region. Approximately 12% of the population studied did not collect their stool samples.[14] Knowledge about Schistosomiasis can significantly influence people's attitudes and actions. For instance, research conducted by Sulistin and Widajadnja in Lindu Sigi revealed a link between public awareness and attitudes towards Schistosomiasis.[15] The impact of Schistosomiasis on health cannot be underestimated. Chronic Schistosomiasis can lead to reduced work capacity and, in severe cases, even death. The disease may also cause anemia, malnutrition, and impaired learning abilities in children.[16] In Sub-Saharan African nations alone, Schistosomiasis is estimated to cause over 200,000 fatalities annually.[17] Therefore, this study aimed to analyze the risk factors for Schistosomiasis in the Napu Highland of Indonesia.

Materials and Methods

This analytic observational study with a case-control design was conducted in the Napu Highland, Poso, Central Sulawesi, Indonesia, from April to June 2022. The target population comprised residents of the Napu Highland, with reachable population including residents of villages with Schistosomiasis based on data from the 2021 Schistosomiasis Program Fecal Survey. The villages included were Alitupu, Dodolo, Kaduwaa, Kalimago, Maholo, Mekarsari, Tamadue, Watumaeta, Winowanga, and Wuasa. Data was collected using a questionnaire administered through the KoboCollect application.

The inclusion criteria for sampling were permanent inhabitants who were registered and inspected in the 2021 Schistosomiasis program fecal survey and were over two years old. Exclusion criteria for sampling included those who refused to participate and individuals with specific health issues, such as mental problems. The sample size was estimated using Schlesselman's sample size formula[18] for case-control research, resulting in 37 cases and 111 controls, making a total sample size of 148 individuals. In this study, cases refer to individuals who have tested positive for Schistosomiasis and were experiencing the disease. On the other hand, control were individuals who do not have Schistosomiasis and have tested negative for the disease.

The research-dependent variable was the prevalence of Schistosomiasis, while the independent variables were risk factors related to Schistosomiasis, including education, knowledge about Schistosomiasis, occupation, use of latrines, clean water sources, passing through snail (*Oncomelania hupensis lindoensis*) focus areas, use of personal protective equipment (PPE) in water-related activities, and livestock raising activities. The education variable was categorized as either high (university and high school) or low (junior high school, elementary school, and no school). Knowledge about Schistosomiasis, including knowledge about causes, intermediate animals, habitat, mode of transmission, symptoms, animals that can be infected, prevention and treatment of schistosomiasis, was categorized as good or poor based on a median score of 6. A score of 6 or more was considered good knowledge, while a score below 6 was considered poor knowledge. The habits related to Schistosomiasis exposure, such as passing through snail (*Oncomelania hupensis lindoensis*) focus areas, having activities in rivers, gutters, or rice fields, and using PPE when working near water, were categorized as either 'yes' or 'no'. Occupation was categorized as either 'farmer' or 'others. The use of latrine and raising livestock were categorized into 'yes' or 'no'. The use of water sources was divided into three categories: wells, municipal waterworks, and other sources like rivers and ditches. All variables were measured by interviewing the respondent's using questionnaire through the KoboCollect application.

Chi-square test was used to analyze the data at a significance level of α=5% to determine the relationship between variables.

Results

The research findings on the risk factors for Schistosomiasis in the Napu Highland, Poso Regency, Central Sulawesi, are presented in Tables 1 and 2. Table 1 contains data on the characteristics of respondents related to socio-demographics. The research findings showed that the gender most found with Schistosomiasis was male (56.8%). Schistosomiasis cases were also prevalent in the age group of 20–60 years (78.4%).

Table 2 shows that variables with a p-value of ≤0.05 were education and knowledge about Schistosomiasis. The odds ratio (OR) for education was 3.147, indicating that individuals with lower education levels were 3.147 times more at risk of contracting Schistosomiasis compared to those with higher education. Similarly, the OR for knowledge was 2.23, suggesting that individuals with poor knowledge about Schistosomiasis were 2.233 times

Table 1. Socio-demographic characteristics of respondents (N=148)

Variable	Case (N=37)		Control (N=111)		N
	n	%	n	%	
Gender					
Male	21	56.8	63	56.8	84
Female	16	43.2	48	43.2	64
Age group (years)					
0-10	2	5.4	0	0.0	2
11-19	2	5.4	4	3.6	6
20-60	29	78.4	93	83.8	122
>60	4	10.8	14	12.6	18

more at risk of infection than those with good knowledge. On the other hand, factors such as employment status, latrine use, access to clean water sources, passing through the snail (*Oncomelania hupensis lindoensis*) focus area, use of PPE during water-related activities, use of PPE when passing through the snail (*Oncomelania hupensis lindoensis*) focus area, engaging in activities in rivers or gullies, and raising livestock were not found to be significant risk factors for Schistosomiasis.

Discussion

The proportion of respondents with low education in the case group was higher than in the control group. There was a significant relationship between education and Schistosomiasis. People with low education were more at risk of contracting Schistosomiasis than those with higher education. Education plays a vital role in improving health behavior, especially in cases of environmentally transmitted diseases like Schistosomiasis.[19] Research on Schistosomiasis in Zimbabwe concluded that poor sanitation (unsafe water sources for household needs), related to schistosomiasis infections, was found more in women who had never received an education than those with education.[20] Increased education can lead to better understanding of health messages and promote clean and healthy practices to prevent diseases.

The study found a marginal association between participants' knowledge of Schistosomiasis and its incidence. Lower knowledge increased the risk of infection. Effective community awareness programs can improve knowledge and preventive measures. Similar findings were observed in research from South Africa and the Philippines, persons with a good understanding of Schistosomiasis had favourable attitudes and actions toward Schistosomiasis prevention.[21,22] Government programs in Napu include warning signs in the snail (*Oncomelania hupensis lindoensis*) focus area as an effort to reduce the incidence. Regular awareness programs are vital for infection prevention. Collaborative efforts between education and health sectors are essential for successful prevention initiatives.[23,24]

The most common occupation among the research respondents was farming. While there was no significant relationship between occupation and Schistosomiasis. Similar findings were reported by Rosmini *et al.* in the Bada Highland, Poso District, and Central Sulawesi, where no relationship was found between the type of work (farmers and non-farmers) and the incidence of Schistosomiasis.[13] Study in Sudan even shows that school-age children of parents who work as farmers are at higher risk of being infected with Schistosomiasis than children of parents with other jobs.[25] However, farming should still be a concern in preventing Schistosomiasis infection since farmers often work in areas like rice fields and rivers, which are known to be habitats for the inter-

Table 2. Risk factors for Schistosomiasis

Variable	Case (n=37)		Control (n=111)		p	OR	95% CI
	n	%	n	%			
Education							
Low	30	81.1	64	57.7	0.018*	3.147	1.274-7.778
High	7	18.9	47	42.3			
Occupation							
Farmer	22	59.5	71	64.0	0.768	0.826	0.386-1.771
Other	15	40.5	40	36.0			
Knowledge related to Schistosomiasis							
Poor	22	59.5	44	39.6	0.056*	2.233	1.046-4.768
Good	15	40.5	67	60.4			
Latrine use							
No	5	13.5	13	11.7	0.775	1.778	0.390-3.560
Yes	32	86.5	98	88.3			
Using clean water sources							
Wells/municipal waterworks/pipes	37	100	111	100	-	-	-
Other	-	-	-	-			
Passing snail (Oncomelania hupensis lindoensis) focus areas							
Yes	27	73	70	63.1	0.369	1.178	0.390-3.560
No	10	27	41	36.9			
Having activities in water (rivers, gutter, or rice fields)							
Yes	27	73.0	68	61.3	0.276	1.707	0.752-3.876
No	10	27.0	43	38.7			
Use personal protection equipment (PPE) when having activities in water							
No	13	35.1	30	27.0	0.404	1.463	0.661-3.237
Yes	24	64.9	81	73.0			
Use personal protection equipment (PPE) when passing through snail (*Oncomelania hupensis lindoensis*) focus areas							
No	10	27.0	20	18.0	0.345	1.685	0.704-4.031
Yes	27	73.0	91	82.0			
Raising livestock							
Yes	8	21.6	23	20.7	1.000	1.055	0.426-2.615
No	29	78,4	88	79,3			

*p<0.05.

mediate host snail (*Oncomelania hupensis lindoensis*) of Schistosomiasis.[21,26,27]

The proportion of individuals with Schistosomiasis who did not use latrines for defecation was higher. Open defecation can contaminate water bodies with worm eggs, leading to potential infections.[28,29] To prevent transmission, using clean and proper latrines is essential. Improving sanitary facilities and promoting latrine usage in Schistosomiasis-endemic regions through counseling is crucial.[29,30] All respondents use wells, municipal waterworks, or pipes as clean water sources. Several studies suggest that using unprotected or unsafe water sources can contribute to Schistosomiasis incidence.[29,31–33] People's knowledge and attitudes about Schistosomiasis prevention are good; however, having safe sources of clean water is still necessary to reduce the risk of infection.

The relationship between the habit of passing through the focus area of snails (*Oncomelania hupensis lindoensis*) and the incidence of Schistosomiasis was not statistically significant. Nevertheless, it is important to avoid these areas or use personal protection PPE such as boots to protect against potential exposure to snails (*Oncomelania hupensis lindoensis*).[12,13,32,34] The analysis did not find a significant relationship between having activities in rivers, ditches, or rice fields and the incidence of Schistosomiasis.[12,35,36] Nonetheless, it's essential to be cautious, as these water bodies are potential habitats for snails (*Oncomelania hupensis lindoensis*). Using PPE, such as boots, when working or engaging in activities near water bodies is recommended to prevent Schistosomiasis.[21,37] Several studies have emphasized the importance of PPE in reducing infection risk. Raising livestock did not show a significant relationship with Schistosomiasis.[9,37–39] However, ensuring clean conditions for livestock is important to minimize potential risks.

According to WHO, an integrated Schistosomiasis control strategy that combines large-scale preventive chemotherapy with praziquantel, the provision of potable water, improved sanitation, hygiene, education, snail control, and environmental modification can result in the interruption (elimination) of Schistosomiasis transmission. Praziquantel is effective for the treatment of human schistosomiasis.[40] However, praziquantel treatment does not prevent reinfection and is hence ineffective in interrupting the transmission cycle. Praziquantel is primarily aimed to lowering the occurrence and severity of infection as well as controlling morbidity over time.[41] The occurrence of fluctuations in Schistosomiasis infection despite the continuation of the treatment program implies that there is reinfection due to the continued cycle of transmission in humans, animals, and intermediary snails. Overall, preventing Schistosomiasis requires awareness of the disease transmission pathways and the importance of proper sanitation, using clean water sources, and adopting protective measures when in contact with water in endemic areas.

Conclusions

Our study identified education and knowledge as significant risk factors for Schistosomiasis in the Napu Highland. Lower education levels were associated with a higher likelihood of infection. However, factors such as occupation, latrine use, clean water sources, passing through snail (*Oncomelania hupensis lindoensis*) focus areas, use of PPE near water, use of PPE when passing through (*Oncomelania hupensis lindoensis*) snail focus areas, activities in rivers and ditches, and raising livestock were not found to be risk factors for Schistosomiasis in this region. Health promotion efforts involving teachers, lecturers, researchers, religious leaders, and community leaders can play a key role in enhancing understanding, attitudes, and behaviors related to Schistosomiasis prevention in the Napu Highland.

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