Update on Human Schistosomiasis Prevalence and Schistosomiasis Control Intervention in Poso Regency, Central Sulawesi Province, Indonesia

Anis N. Widayati[1(✉)] and Opyn Mananta[2]

[1] Research Center for Public Health and Nutrition, The National Research and Innovation Agency, Bogor, Indonesia
anisnurw21@gmail.com
[2] Poso Regency Health Office, Poso, Indonesia

Abstract. Schistosomiasis in Indonesia is caused by the trematode worm, *Schistosoma japonicum*, with the snail *Oncomelania hupensis lindoensis* as its intermediate host. In Indonesia, it spreads in three endemic areas only: Napu and Bada Highlands of Poso Regency and Lindu Highland of Sigi Regency, Sulawesi Tengah Province. In Poso Regency, the prevalence of human schistosomiasis fluctuates. When schistosomiasis is intensively controlled, the number of reported cases declines. Inversely, it rises again when control measures are halted, even if the prevalence is less than 1%. This study would provide an update on human schistosomiasis and the effect of interventions including anti-schistosomiasis therapies in Poso Regency. The survey was conducted from February to November 2021 by collecting stool samples from residents of 23 villages in the regency who were at least two years old. The percentage of stool coverage reached 81.64 (16.914 samples). The Kato-Katz method was then used to analyze the stool samples collected from the participants within three consecutive days of each. The prevalence was highest in Dodolo village, according to the results (1.72%). However, the average global human prevalence was 0.28 percent (below 1%). The implemented interventions include treatment, surveillance, clean water and sanitation, environmental engineering interventions, intermediate snail control, livestock cages, and additional interventions, as well as community empowerment initiatives such as "GEMA BERAKSI," "BADA MODEL IMPLEMENTATION," and "GADAR BASIS." The survey results showed that these actions could reduce the prevalence of schistosomiasis in Poso Regency.

Keywords: schistosomiasis · prevalence · human · Poso Regency · intervention · *Schistosoma japonicum*

1 Introduction

Schistosomiasis affects almost 240 million people worldwide, including those over 700 million living in endemic areas. The infection is prevalent in tropical and subtropical regions, especially in poor communities without potable water and adequate sanitation.

I. Nurlaila et al. (Eds.): ICHR 2022, AHSR 56, pp. 938–948, 2023.
https://doi.org/10.2991/978-94-6463-112-8_85

Schistosoma haematobium causes urogenital schistosomiasis, while *S. guineensis*, *S. intercalatum*, *S. mansoni*, *S. japonicum*, or *S. mekongi* causes intestinal schistosomiasis. Several million people all over the world suffer from severe morbidity [1] from this zoonotic disease. It is considered a zoonotic because it attacks mammals, such as cattle, buffaloes, horses, pigs, rats, and others (as hosts) [2].

Schistosomiasis is one of the neglected tropical diseases in Asia, affecting countries such as China, the Philippines, and Indonesia. It is endemic to 28 villages in the Poso and Sigi Regencies of Sulawesi Tengah Province, Indonesia. There are approximately 30,000 people at risk [3]. Schistosomiasis in Indonesia is an intestinal infection caused by *S. japonicum.* The snail *Oncomelania hupensis lindoensis* transmits the parasite through its infective cercariae, which emerge from its body [4].

Both central and regional governments have carried out several efforts to control this disease by involving various cross-sectors and community empowerment. The commitment appears through the Minister of Health Regulation No. 19 of 2018 concerning Schistosomiasis Eradication [5]. Multiple cross-sectors have coordinated their efforts to control schistosomiasis. Human and animal cases of schistosomiasis are treated and monitored by the Ministry of Health, the Ministry of Agriculture, and local governments. In collaboration with the Regional Government, the Ministry of Villages and the Ministry of Public Works and Public Housing provide clean water and sanitation. The Ministry of Agriculture, the Ministry of Public Works and Public Housing, the Ministry of Marine Affairs and Fisheries, the Ministry of Environment and Forestry, and the Regional Government are all responsible for environmental engineering. Together with the Regional Government, the Ministry of Health engages in snail control through community empowerment and environmental modification in snail habitat areas [3, 5, 6].

Despite various control efforts, cases of schistosomiasis still fluctuate, with prevalence below 1%. This number indicates, however, that schistosomiasis can still be transmitted in endemic regions. This article aims to describe the current schistosomiasis situation in Poso Regency and the various control measures that have been implemented.

2 Material and Methods

The data processed in this paper was secondary. The prevalence of schistosomiasis in humans in 2021 had been published in the Schistosomiasis Survey Report of the Poso Regency Health Office, Sulawesi Tengah. A stool survey was conducted by the Schistosomiasis Laboratory in 23 endemic villages of Napu and Bada, Poso Regency, Sulawesi Tengah Province, from February to November 2021. The stool survey was conducted with the target population in endemic areas aged two years and over. The activity of collecting feces was that from each person three stool pots were taken for three consecutive days, each day one pot of feces was taken. The number of pots collected will be calculated as the percentage of collection coverage, i.e. the number of pots collected in each village divided by the total population of the target population of feces collection multiplied by 100%.[7] The number of samples was 16,914, bringing the coverage to reach 81.64%.

Each stool pot were made three preparations, so that the samples from each person examined were nine preparations. Stool examination was performed using the Kato-Katz method. The preparation of feces using the Kato-Katz method is as follows: stool is taken with a stick the size of a thumb, filtered with steel wire, filtered feces are taken to be prepared on glass objects with the help of cardboard that has been perforated (kato cardboard), covered with cellophan tape. Has been soaked with malachite-green glycerin dye, the preparation is leveled, placed upside down on tissue paper so that the excess dye can be absorbed, the preparation is examined under a microscope. The results of the examination are recorded in the stool examination form. A positive result is found if *S. japonicum* eggs are found in the preparation being examined. The prevalence of schistosomiasis in humans was calculated by the formula: the number of positive *S.japonicum* population divided by the number of people examined multiplied by 100% [7].

Data on schistosomiasis control across sectors were collected from various sources, namely the roadmap for schistosomiasis elimination by Bappenas and the achievements of the schistosomiasis control and prevention program by the Directorate of P2PTVZ of the Ministry of Health.

3 Results

3.1 Stoll Collecting Coverage

The minimum target for stool collection coverage in this schistosomiasis survey was set to be 80% to ensure that the resulting survey data could describe the actual data in endemic areas. Based on Fig. 1, the percentage of the population's stool collection coverage in Poso Regency was already over 80%. However, four out of 23 villages had a rate below 70%.

3.2 The Prevalence of Schistosomiasis in Humans

Based on Fig. 2, the prevalence of schistosomiasis in nearly all 23 endemic villages was below 1 percent, with the exception of Dodolo, where it reached 1.72 percent. In five other villages, including Kalemago, Tamadue, Winowanga, Maholo, Mekarsari, and Alitupu, the prevalence was above 0.25 percent. According to the survey conducted in 2021, there were no cases of schistosomiasis in eleven villages.

3.3 Integrated Interventions Against Schistosomiasis

The control of schistosomiasis direly needs cross-sectoral roles and integration. Following the roadmap for schistosomiasis elimination prepared by Bappenas, every cross-sector is responsible in overcoming schistosomiasis. As shown in Table 1, the implemented interventions include treatment, surveillance, clean water and sanitation, environmental engineering interventions, intermediate snail control, and livestock cages, among others. Together with Bappenas, the responsible ministries are the Ministry of Health, the Ministry of Agriculture, the Ministry of Public Works and Public Housing,

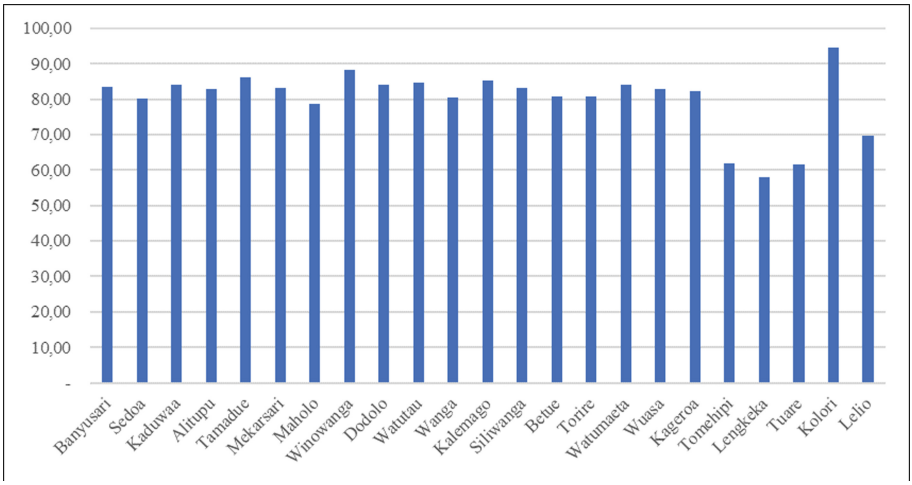

Fig. 1. Coverage of population stool collection (in percentage) (source: Health Office of Poso Regency, 2021)

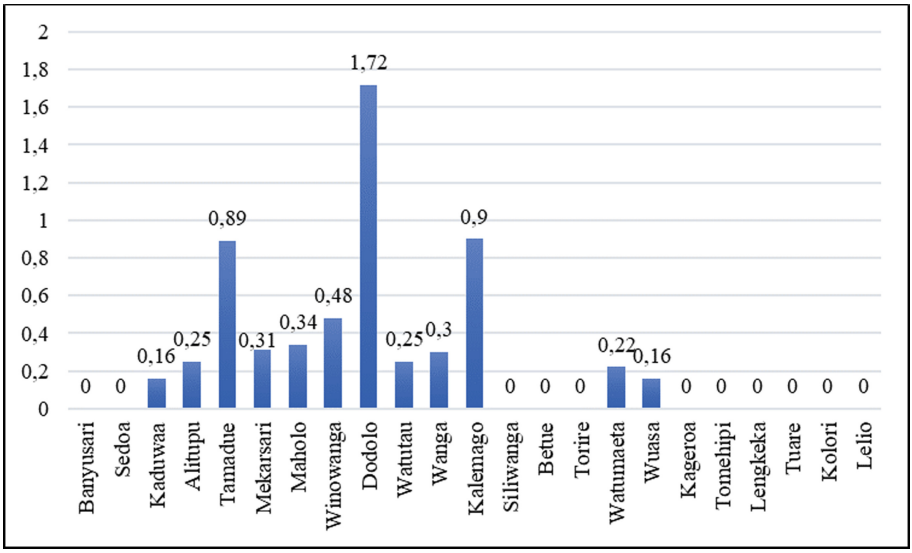

Fig. 2. Prevalence of Schistosomiasis in humans (source: Health Office of Poso Regency, 2021)

the Ministry of Environment and Forestry, the Ministry of Maritime Affairs and Fisheries, the Ministry of Home Affairs, the Ministry of Villages, the Coordinating Ministry for Human Development and Culture. In implementing the interventions determined, the various ministries collaborate and with local governments.

Table 1. Cross-sectoral integration in interventions against schistosomiasis *

Intervention	Responsible cross-sector
Treatment	Ministry of Health, Ministry of Agriculture, Local Government
– Preparation of Praziquantel in humans	
– Access to treatment at health facilities	
– Preparation of Praziquantel in animals	
Surveillance	Ministry of Health, Ministry of Agriculture, Local Government
– Evaluation surveys on human, snails and reservoir animals	
– Capacity building of Puskesmas Staff and Laboratory Schistosomiasis	
Clean water and sanitation	Ministry of Health, Ministry of Public Works and Public Housing, Local Government
– Provision of clean water and worthy sustainable sanitation	
– Access to hygienic latrines through STBM	
Environmental Engineering	Ministry of Environment and Forestry, Ministry of Agriculture, Ministry of Marine Affairs and Fisheries, Ministry Public Works and Public Housing, Local Government
– Land revitalization	
– Irrigation	
– Support for the management of fisheries activities in the management of snail habitat	
Snail Control	Ministry of Health, Local Government
– Community Empowerment	
– Integrated Environmental Modification	
Grazing Cattle	Ministry of Agriculture, Local Government
– Livestock management to reduce transmission	
Integration of Regional Planning and Budgeting	Ministry of Internal Affairs, National Development Planning Agency, Coordinating Ministry for Human Development and Cultural Affairs, Ministry of Village, Development of Disadvantaged Regions and Transmigration

(*continued*)

Table 1. (*continued*)

Intervention	Responsible cross-sector
National Planning and Budgeting Policy Support	
Monitoring Progress Achievements	
Village Fund Policy Support	

* Source: Directorate of P2PTVZ, 2021

Table 2. Efforts by the Ministry of Health to Control Schistosomiasis*

Intervention	Activities
Health Promotion	Health promotion
	Information
	Communication and Education for using personal protective equipment (PPE)
	Increased community participation under the coordination of the Health Office (Bada Model, Gema Beraksi, Gadar Basis)
Risk Factor Control	Tool preparation and materials for snail control
	Using personal protective equipment (PPE) for community
Mass Drug Administration (MDA)	Praziquantel administration (1x year)
	Mass screening for MDA evaluation
Chronic case treatment	According to the case management at the Health Facilities
Schistosomiasis surveillance	Prevalence survey in all populations
	Intermediate snail survey

*Source: Directorate of P2PTVZ, 2021

3.4 Efforts by the Ministry of Health to Control Schistosomiasis

The Ministry of Health, via the Directorate of P2PTVZ, has also carried out various efforts to control schistosomiasis with funding sourced from the State Budget, Local Government Budget, and other sources (Table 2). The activities undertaken include health promotion, risk factor control, schistosomiasis mass treatment, chronic case management, and schistosomiasis surveillance.

4 Discussion

In 2021, the population's stool collection coverage in most schistosomiasis endemic areas in Poso Regency reached over 80%. There were only four villages whose coverage was below 70%. Therefore, more intensive efforts were needed to increase public

awareness in the five villages to participate in schistosomiasis control activities, in line with the Ministry of Health's efforts to carry out health promotion activities to control schistosomiasis.

Human schistosomiasis prevalence in 23 Poso Regency villages ranged from 0 to 1.72%. The highest was in Dodolo, which had a smaller population than the others. Snails in Dodolo Village spread in close proximity to residential areas and places where residents carried out their daily activities, namely cacao gardens and rice fields owned by residents, resulting in a high level of transmission. The number of human cases of schistosomiasis in Dodolo is consistently higher than in other villages in the Napu Highland [8]. Thus, additional efforts are required to prevent transmission, including community health promotion, the use of PPE, and the administration of schistosomiasis drugs.

The prevalence in Kalemago Village was 0.9%. In the village, snails lived on the land where residents engaged in gardening activities. Other villages, including Alitupu, Winowanga, Watumaeta, and Tamadue, had the same problem: snails lived in close proximity to active people, so the risk of infection was high. Even in Tamadue, snails lived close to people's homes, specifically in the water channels used by some residents to wash their clothes. This activity unquestionably increased the frequency of contact with water containing schistosomiasis intermediate snails, thereby increasing the likelihood of infection. A study found that increased activity in contact with water in these snails may increase the risk of schistosomiasis infection [9]. Cases in Mekarsari were found to be quite low, namely 0.31%. In the preceding years, this village consistently had the highest number of cases in the Lore Timur District. Mekarsari is an example of a village that has successfully reduced the number of habitats for intermediate snails through the application of integrated environmental modification techniques. The chosen plant species could reduce the number of habitats for intermediate schistosomiasis snails. The inhabitants of the village transform snail habitats into land for horticultural crops, including cabbage, leeks, tomatoes, and cauliflower. These types of plants necessitate daily land cultivation, such as weeding, insecticide spraying, and other plant maintenance tasks. Habitat for snails can be eradicated by routine and persistent activities. This activity would be excellent if implemented in other villages with endemic diseases. In Sedoa and Watumaeta, the land where snails once flourished was transformed into rice fields or gardens. Numerous people converted snail habitats in Mekarsari into agricultural lands for cabbage, shallots, leeks, and chilies, leading to a decline in the snail population. These results were consistent with efforts to control intermediate snails of schistosomiasis in China, which considered land use to be a determining factor in schistosomiasis transmission. Rotating the plants in snail habitats in China from rice to plants that do not require a great deal of water is one of the measures taken to control snail populations [10].

This agricultural activity was also found in Wuasa, Lore Utara District. The prevalence was also found to be low because many innovations were carried out in the village. In their region, the Wuasa Health Center promoted the Gadar Basis (Schistosomiasis Eradication Awareness Family) activity as an example of an innovative program. The innovation involved health workers, security officers (sector police and military district command), village officials, and the community, particularly landowners in areas where

snails served as schistosomiasis vectors. To reduce the habitats of schistosomiasis intermediate snails, this innovation required landowners to cultivate their land and not allow it to become abandoned.

The community empowerment innovation initiated by the Poso Regency Health Office was Gema Beraksi, in which the community worked together to control schistosomiasis intermediate snails in Napu and Bada. In addition to spraying molluscicides, the activities included the cleaning of waterways and the improvement of water flow. They performed these tasks under the supervision of Schistosomiasis Laboratory personnel. Another community empowerment activity was the implementation of the Bada Model, first implemented in an endemic area of Bada by the Donggala Health Research and Development Center. The community empowerment was successful in increasing stool collection coverage, lowering cases of schistosomiasis in humans, and reducing the habitats of schistosomiasis intermediate snails in Lengkeka Village. In other nations, such as Thailand, the success of community empowerment in reducing the prevalence of a disease was also observed. The prevalence of opisthorchiasis could be reduced if the "Lawa Model" was implemented intensively and continuously for five years in endemic areas of the disease [11].

Various community control activities in schistosomiasis endemic areas in Poso Regency could help reduce its prevalence in humans, besides integrated schistosomiasis interventions by several ministries. In other endemic nations, eradication of schistosomiasis can only be achieved through cross-sectoral cooperation due to the numerous human, animal, and environmental factors involved. In order for integrated schistosomiasis control to be successful, there must be support at the national, regional, and provincial levels. National, regional, and provincial support is required. The district/city level is responsible for controlling snail habitats [12]. Nonetheless, this is insufficient, necessitating village-level regulations to strengthen snail habitat control in order to implement the roadmap in schistosomiasis-endemic villages [13]. In addition, each control activity's annual program must be evaluated to ensure that it runs smoothly. Control of intermediate snails should be a component of an integrated schistosomiasis control program that includes praziquantel treatment, behavioral and educational interventions, and increased availability of clean water and sanitation [12].

In endemic regions, praziquantel treatment may reduce prevalence during treatment, but cannot prevent reinfection. Numerous cases of schistosomiasis involve reinfection [14]. The control of schistosomiasis is complicated by the high population density in areas where active snails reside. The lab personnel in Lengkeka and Sigi are unable to examine stool samples due to their limited capacity. Still, the infection rate among snails and rats is quite high. There are still numerous pets roaming the area of interest. Due to the difficulty of obtaining stool specimens, community participation in stool collection is low. The role of related cross-sectors has not been maximized, as evidenced by research conducted by the Donggala Health Research and Development Center, which revealed that 53.6% of the activities outlined in the roadmap were not carried out in 2018 [15].

Based on the roadmap for schistosomiasis elimination compiled by Bappenas and various ministries, each ministry has an important role in controlling schistosomiasis. However, not all the roles or responsibilities of each ministry have been carried out based on the target. The results of research that evaluated the cross-sectoral activities stated the

activities carried out were only about 58% [15]. It is necessary to strengthen efforts to accelerate the achievement of schistosomiasis elimination targets, namely re-mapping of cross-sectoral roles in the integration of schistosomiasis elimination interventions, Community Empowerment Improvement (Bada Model Replication in other endemic villages, Gema Beraksi, and Gadar Basis), utilization of financing sources (State Budget, Local Government Budget, and Village Budget) to support community empowerment based on the schistosomiasis control program, capacity building for laboratory personnel through training/internships at the Health Research and Development Center, strengthening the role of R&D in the development of research in policy-making with a socio-anthropological approach and procedures for surveillance, monitoring and evaluation of the elimination of schistosomiasis in animals, and mapping of risk factors in other animals, as well as strengthening the role of district governments in planning and financing Schistosomiasis Control (Master Plan, Regent Regulation) [3].

The limitation of the description in this article is that it only shows cases in humans and does not provide a comprehensive picture of both cases in mammals and the level of infection in snails. This is due to the limited information obtained.

In general, the number of schistosomiasis cases in Indonesia is low, because the average is below 1%. Examination of schistosomiasis in low-endemic areas with Kato-Katz actually is less sensitive [16], necessitating innovation to determine the diagnosis using more sensitive methods, such as the serological method with ELISA and molecular analysis to detect nucleic acid (DNA of *S. japonicum* worm) by PCR. With the availability of more precise diagnostic methods or techniques, it is possible to assess the success of schistosomiasis control efforts [17].

5 Conclusion

The implemented interventions include treatment, surveillance, clean water and sanitation, environmental engineering interventions, intermediate snail control, livestock cages, and other interventions, as well as efforts to empower the community. These interventions could reduce the prevalence of schistosomiasis in Poso Regency, according to the survey results.

Acknowledgments. The authors would thank the P2PTVZ Directorate of the Ministry of Health and the Poso Regency Health Office for the data on schistosomiasis cases and efforts to control the disease.

References

1. WHO. Schistosomiasis (Bilharzia) [Internet]. 2022 [cited 2022 Jun 2]. Available from: https://www.who.int/health-topics/schistosomiasis#tab=tab_1
2. Gray DJ, Williams GM, Li Y, McManus DP. Transmission Dynamics of Schistosoma japonicum in the Lakes and Marshlands of China. PLoS One [Internet]. 2008 Dec 30 [cited 2022 Jun 3];3(12):e4058. https://doi.org/10.1371/journal.pone.0004058
3. Direktorat P2PTVZ Kemenkes RI. Capaian Program Pencegahan dan Pengendalian Schistosomiasis. 2021.

4. Hadidjaja P. Schistosomiasis di Indonesia. 1st ed. Jakarta: UI Press; 1985. 11–12 p.
5. Kementerian Kesehatan [Kemenkes]. Permenkes No. 19 Tahun 2018 tentang Penyelenggaraan Eradikasi Demam Keong [JDIH BPK RI] [Internet]. 2018. Available from: https://peraturan.bpk.go.id/Home/Details/139655/permenkes-no-19-tahun-2018
6. Kementerian PPN/Bapennas. Roadmap Eradikasi Penyakit Demam Keong (Schistosomiasis). Bappenas. 2018.
7. Subdit Pengendalian Filariasis dan Kecacingan, Direktorat Pengendalian Penyakit Bersumber Binatang, Ditjen Pengendalian Penyakit dan Penyehatan Lingkungan KR. Petunjuk Pengendaian Schistosomiasis di Indonesia. 1st ed. Jakarta: Subdit Pengendalian Penyakit dan Penyehatan Lingkungan; 2015. 1–124 p.
8. Rosmini, Soeyoko, Sumarni S. Penularan Schistosomiasis di Desa Dodolo dan Mekarsari Dataran Tinggi Napu Sulawesi Tengah. Media Litbang Kesehat. 2010;XX(3):113–7.
9. Engels D, Chitsulo L, Montresor A, Savioli L. The global epidemiological situation of schistosomiasis and new approaches to control and research. Acta Trop [Internet]. 2002 May [cited 2016 Dec 9];82(2):139–46. Available from: http://linkinghub.elsevier.com/retrieve/pii/S0001706X02000451
10. Qiu J, Li R, Xu X, Yu C, Xia X, Hong X, et al. Identifying Determinants of Oncomelania hupensis Habitats and Assessing the Effects of Environmental Control Strategies in the Plain Regions with the Waterway Network of China at the Microscale. Int J Environ Res Public Health [Internet]. 2014 Jun 23 [cited 2016 Nov 3];11(6):6571–85. Available from: http://www.mdpi.com/1660-4601/11/6/6571/
11. Sripa B, Tangkawattana S, Laha T, Kaewkes S, Mallory FF, Smith JF, et al. Toward integrated opisthorchiasis control in northeast Thailand: The Lawa project. Acta Trop [Internet]. 2015;141(Part B):361–7. https://doi.org/10.1016/j.actatropica.2014.07.017
12. WHO. Chemical Methods For The Control Of Vectors and Pests of Public Health Importance. 1997. p. 85–8.
13. Widjaja J, Erlan A, Tolistiawaty I, Srikandi Y, Mustafa H. Penyusunan dan Penerapan Peraturan Desa tentang Pengendalian Schistosomiasis di Daerah Endemis Formulation and Implementation of Village Regulations concerning Schistosomiasis Control in Endemic Areas. J Vektor Penyakit. 2021;15(2):107–12.
14. Wang LL, Wang LL, Chen H, Chen H, Guo J, Guo J, et al. A Strategy to Control Transmission of Schistosoma japonicum in China. Heal (San Fr. 2009;360:121–8.
15. Anastasia H, Widjaja J, Nurwidayati A. Evaluasi Pengendalian Schistosomiasis oleh Lintas Sektor Tahun 2018. Bul Penelit Kesehat. 2019;47(4):2–6.
16. Glinz D, Silué KD, Knopp S, Lohourignon LK, Yao KP, Steinmann P, et al. Comparing Diagnostic Accuracy of Kato-Katz, Koga Agar Plate, Ether-Concentration, and FLOTAC for Schistosoma mansoni and Soil-Transmitted Helminths. PLoS Negl Trop Dis [Internet]. 2010 Jul [cited 2022 Jun 6];4(7). Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2907416/
17. Cai P, Weerakoon KG, Mu Y, Olveda RM, Ross AG, Olveda DU, et al. Comparison of Kato Katz, antibody-based ELISA and droplet digital PCR diagnosis of schistosomiasis japonica: Lessons learnt from a setting of low infection intensity. PLoS Negl Trop Dis [Internet]. 2019 [cited 2022 May 23];13(3):e0007228. https://doi.org/10.1371/journal.pntd.0007228