Received: 10 July 2023, Accepted: 30 August 2023

Original Research

Journal of Advanced Veterinary Research
(2023) Volume 13, Issue 8, 1588-1592

Infection Rate and Risk Factor of Buffalo *Paramphistomum* sp. Infection in Solo Raya Region, Central Java, Indonesia

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Abstract

Paramphistomum sp. infection in buffalo of Solo Raya region has not been reported previously. This study aims to estimate the infection rate of *Paramphistomum* sp. infection in buffalo in Solo Raya and identify the risk factor using prospective approach and cross-sectional pilot study. A total of 59 buffalo faecal samples from 44 small scale farms in Solo Raya were subjected for sedimentation examination. The result was interpreted descriptively, and the risk factors variable were analysed using bivariate and multivariate analysis in R software ver.4.3.1. *Paramphistomum* sp. egg was found in 20.34% of buffalo faecal samples in Solo Raya Region. Bivariate analysis showed grass feeding and farmers knowledge related to helminthiasis clinical sign and treatment have significant association to *Paramphistomum* sp. infection. Based on final logistic regression model, *Paramphistomum* sp. infection was increased by additional grass in feed (OR 5.9, [95% CI: 1.05-32.98] (OR 0.16, [95% CI: 0.04-0.68]) but the risk was decreased by a good farmer knowledge in helminthiasis treatment OR 0.16, [95% CI: 0.04-0.68]. The results indicate that feed management and farmer knowledge should be improved. Further study to explore the parasitic disease in buffalo in Solo Raya Region is suggested.

KEYWORDS
Buffaloes, Infection rate, *Paramphistomum* sp., Risk factor.

INTRODUCTION

Buffalo is considered as a multi-purposed animal that has been utilized for its meat and milk, and as working ruminant. In addition, in Indonesia, buffalo also has a special purpose in the traditional and religion ritual of some local tribes which increase its value in the society (Matondang and Talib, 2015). Considering its potency as meat producer, buffalo farming development has become one of the strategies in the meat self-sufficiency program in Indonesia along with cattle (Talib *et al*., 2014). However, according to the Central Statistical Bureau of Indonesia (2023), the population of buffalo in 2010-2022 is declining from 1,999,604 to 1,170,209. Similarly, in Central Java, buffalo population has been a declining from 111,097 in 2010 into 61,156 in 2020 (Badan Pusat Statistik, 2023). The reducing buffalo population is affected by several factors, including feed quality, decreasing grazing land, lack of support from the government, and disease (Hilmawan *et al*., 2020).

One of the common parasitic diseases in ruminant is *Paramphistomum* sp. infection, an *Amphistomes* parasite under the superfamily *Paramphistomoidea*. Its infection in ruminant is related to economic loss because of the treatment cost, production impairment, management adjustment, and sometimes death in severe cases (Matebesi-Ranthimo *et al*., 2014). In most infection, *Paramphistomum* sp. infection cause a mild sign, but some severe cases sometimes appear with clinical signs such as anorexia, polydipsia, diarrhoea due to enteritis, necrosis, and haemorrhage during immature worm migration (Sanabria andand Romero, 2008). Although severe cases are uncommon, the possibility of negative effect should not be underestimate.

Paramphistomum sp. infection in buffalo has been reported in ruminant of different parts of Indonesia with prevalence higher than 30% (Nurhidayah *et al*., 2019; Susilo *et al*., 2020; Ridwan *et al*., 2022). However, to the best of our knowledge, the infection of *Paramphistomum* in buffalo has not been reported in Solo Raya Region, Central Java of Indonesia. The tropical climate along with the agro-ecology of this region is favourable for the development of the vectors for *Paramphistomum* sp., the snail from family *Planorbidae* and *Lymnea* (Ridwan *et al*., 2022). The present study aimed to estimate *Paramphistomum* sp. infection and the risk factor in buffalo surrounding Solo Raya Region.

MATERIALS AND METHODS

Study area

The samples were collected in five district of Solo Raya region surrounding Surakarta: Karanganyar, Sukoharjo, Boyolali, Sragen, and Klaten covering 5,677 km^2 (Figure 1). This region located in latitude: -7° 33′ 22.00″ S and longitude: 110° 49′ 54.01″ E, the altitude range between 75-600 mbsl with average temperature 22.2°–36,67° C, average humidity 74% and average annual rainfall 11.6 inches. The buffaloes were managed under a small-scale farm with less than 10 buffaloes per farm. Buffalo farm is consid-

ISSN: 2090-6277/2090-6269/

ered as the secondary income for most farmer and managed by family member.

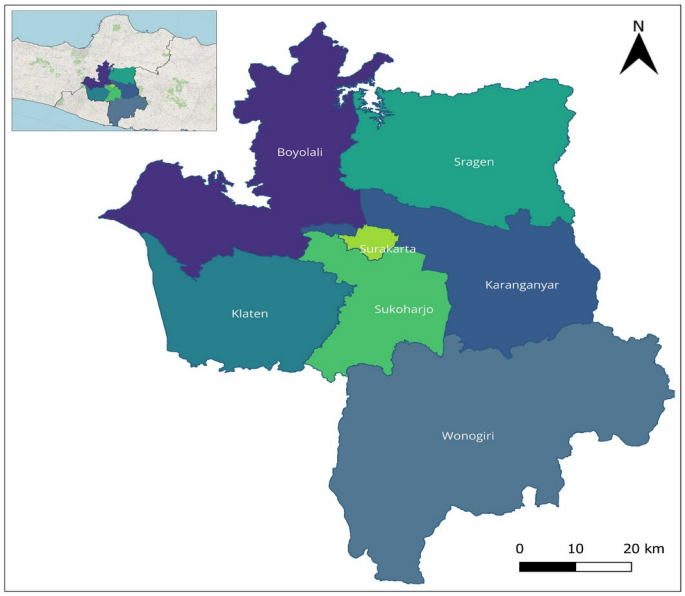


Fig 1. Solo Raya region map visualized by QGIS software version 3.32.0 using base map from Indonesia Geospatial portal (https://tanahair.indonesia.go.id)

Faecal parasite egg detection

The current study was designed using prospective and cross-sectional pilot study. In this study, 59 samples from 44 different farms were collected and used for the analysis. Faecal samples were collected with a minimum contamination in May to July 2021. Each sample was transferred to a pot and fixed with 10% formalin. The faecal samples were subjected for sedimentation examinations technique to detect and identify *Paramphistomum* sp. egg (Happich and Boray,1969). Briefly, a total of 6 grams of faecal sample was mixed with 30 ml water. The mixture was filtered through a 32 meshes/cm filter and kept for 3 minutes to produce sediment and then was stained with 2-3 drops of methylene blue. After staining, the mixture was then poured on a petri dish and was observed under stereomicroscope (Happich and Boray, 1969). The process was conducted in the Veterinary Test Centre, Wates, Yogyakarta.

Determination of risk factor

Questionnaires were distributed to 44 buffalo farmers to collect relevant information related to the study including; farmer's socio-demographic data, intrinsic factor: buffalo's sex and age; and extrinsic factor: livestock management system (housing, feeding and sanitation), farmer understanding on helminthiasis clinical sign and regular veterinary visit (Karim *et al.*, 2016). The data from the questionnaires were used to analyse the associated risk factors to the parasitic infection.

Data Analysis

The infection rate was measured by calculating the number of positive cases within samples and presented in percentage. The risk factor was determined by two steps analysis: bivariate and multivariate analysis. Bivariate analysis was performed using Pearson Chi-square (X2) test and the Fisher's exact test. Variables with p-value ≤0.20 were further analysed using multivariate analysis by logistic regression. Logistic regressions were analysed using backward method that followed with selection of the best model based on Akaike Information Criterion (AIC). Hosmer and Lemeshow tests were performed to test the quality of fit model. This study was performed using R software ver.4.3.1.

RESULTS

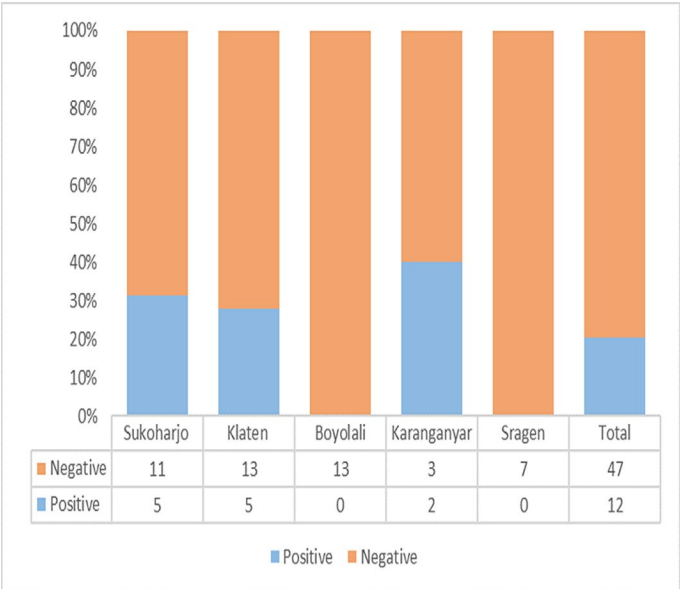
Faecal parasite egg detection

A total of 12 samples (12/59; 20.34%) contained *Paramphistomum* sp. eggs (Figure 2). Based on the districts, the highest infection rate was in Karanganyar (40.00%), followed by Sukoharjo (31.25%) and Klaten (27.78%) while none of the samples were positive in Boyolali and Sragen.

Determination of risk factor

Based on bivariate analysis, three extrinsic factors had significant association to *Paramphistomum* sp. infection, which were: feed type, farmers knowledge of helminthiasis clinical sign, and farmers knowledge in treats helminthiasis ($p < 0.05$) (Table 1). Buffalo that were fed by straw and grass had significant higher risk of *Paramphistomum* sp. infection compared to those fed on straw only [OR: 4.79; p = 0.04; 95% CI: 0.95-24.27]. Furthermore, farmers with good knowledge of helminthiasis clinical signs and treatment showed significant lower risk in *Paramphistomum* sp. infection compared to those with lack of knowledge (OR: 0.22; p = 0.03; 95% CI: 0.06-0.83 and OR: 0.19; p = 0.02; 95% CI: 0.05-0.74, respectively). Other extrinsic factors such as housing management and veterinarian visit were not significantly associated to *Paramphistomum* sp. infection. In addition, the results showed no significant association of intrinsic factor analysis although higher infection rate was observed from the female buffaloes and those who aged more than 2.5 years.

Four factors with p-value ≤0.20 from the bivariate analysis were further analysed using multivariate analysis including feed type; has been dewormed; farmer know clinical sign of helminthiasis; and farmer know how to treat helminthiasis. Based on selection and fit model, only feed type and farmer knowledge in treating helminthiasis factors that fit in final logistic regression model ($p<0.05$) (Table 2). Straw and grass fed shows positive association and significant level to infection rate up to 5.9 times high, but it is reduced with a good farmer knowledge of helminthiasis treatment (OR: 0.16; p = 0.02; 95% CI: 0.04-0.68).



	Sukoharjo	Klaten	Boyolali	Karanganyar	Sragen	Total
Negative	11	13	13	3	7	47
Positive	5	5	0	2	0	12

Fig 2. *Paramphistomum* sp. infection rate of buffalo in each district of Solo Raya Region.

DISCUSSION

The results showed that 20.34% of samples contained *Paramphistomum* sp. egg. However, all infected buffaloes did not show any visual clinical symptoms which is a common observation in *Paramphistomum* sp., clinical signs mainly occur during the migration of immature worms to the rumen (Sanabria and Romero, 2008). It indicated that the infected buffalo in our study may lack in immature worms that are in migration stage. *Paramphistomum* sp. infection has been widely reported in Indonesia's buffalo, including in Banten, West Java and in Lampung Selatan with higher infection rate, between 31.43% up to 71.76% which is higher than our result (Nurhidayah *et al*., 2019; Barkah *et al*., 2021; Ridwan *et al*., 2022). *Paramphistomum* sp. infections are related to intrinsic (buffalo characteristic) and extrinsic factors such as the environmental, ecology, and the presence of snail on the area (Karim *et al*., 2016). *Lymnea* snail, the intermediate host, lives in slow-current water environment and often found in rice field and grazing

Table 1. Risk factor of *Paramphistomum* sp. infection in Buffalo of Solo Raya

Variable	Negative	Positive	OR	95% CI	*P*-value
Intrinsic factors					
Age					
< 2.5 year	19	4	1.36	[0.35-5.15]	0.75[a]
≥ 2.5 year	28	8			
Sex					
Female	36	11	0.3	[0.04-2.57]	0.43[a]
Male	11	1			
Extrinsic factors					
Housing management					
Intensive	20	7	0.53	[0.15-1.91]	0.33
Semi-intensive	27	5			
House cleaned daily					
No	13	2	1.91	[0.37-9.93]	0.71[a]
Yes	34	10			
Housed with other livestock					
No	33	8	1.18	[0.20-4.56]	1.00[a]
Yes	14	4			
Feed type					
Straw only	23	2	4.79	[0.95-24.27]	0.04
Straw and grass	24	10			
Regular veterinarian visit					
No	33	10	0.47	[0.09-2.43]	0.48[a]
Yes	14	2			
Has been dewormed					
No	26	10	0.25	[0.05-1.26]	0.10[a]
Yes	21	2			
Farmer know clinical sign of helminthiasis					
No					
Yes	11	7	0.22	[0.06-0.83]	0.03[a]
	36	5			
Farmer know how to treat helminthiasis					
No					
Yes	13	8	0.19	[0.05-0.74]	0.02[a]
	34	4			
Farmer know how to prevent helminthiasis					
No					
Yes	29	8	0.81	[0.21-3.07]	1.00[a]
	18	4			

[a] Fisher exact test; OR: odds ratio; CI: confidence interval.

Table 2. Final logistic regression model for risk factor analysis of *Paramphistomum* sp. infection in Buffalo of Solo Raya

Variable	Estimate (SE)	OR	95% CI	P-value
Intercept	-1.61 [0.79]	-	-	0.04
Feed – Straw and grass	1.77 [0.88]	5.9	[1.05-32.98]	0.04
Treat worms	-1.83 [0.74]	0.16	[0.04-0.68]	0.01

SE: Standard Error; OR: odds ratio; CI: confidence interval

area surrounding buffalo farms in Solo Raya (Ridwan *et al*., 2022). This snail population becomes high in rainy season following the increasing wet land in Solo Raya. Our study took the sample in May-July which is the dry season in Indonesia and the population of *Lymnea* snail is usually low. The low number of *Lymnea* snail may one of the reasons of lower *Paramphistomum* sp. infection in this study compared to previous reports (Nurhidayah *et al*., 2019; Barkah *et al*., 2021; Ridwan *et al*., 2022).

Risk factor analysis shows no intrinsic factors that are associated to the *Paramphistomum* sp. infection in the present study. This result is similar to other studies that reporting no significant difference of parasitic infection in different age and sex of buffalo and cattle but female buffalo and those that older than 2 years had higher incidence rate (Marskole *et al*., 2016; Kalkal *et al*., 2020; Ridwan *et al*., 2022). On the contrary, some of the extrinsic factors showed significant association to the infection of *Paramphistomum* sp. including feeding straw and grass and farmer knowledge on helminthiasis clinical signs and treatment. In Indonesia buffalo farming, the grass collection is often done in the morning when the morning dew or water content on the grass is still high. Grass is often transport medium for *Paramphistomum* sp. metacercaria (Ridwan *et al*., 2022). In the snail, miracidia are developed into cercaria and released in the water where the snail lives which then move in the water to the grass and become metacercaria. Thus, the number of metacercaria is higher in the grass that submerged in the puddle and in the morning dew (Morley, 2018). Feed management should be improved to reduce the fluke infection. Some alternatives such as ensiling grass and reduce snails' population in the grazing area have been suggested to manage fluke infection (Gupta, 1987; John *et al*., 2019).

Another important factor in the *Paramphistomum* sp. infection is farmer knowledge of the diseases (Nampanya *et al*., 2012). Our analysis showed that the knowledge of farmer on clinical signs and treatment of helminthiasis reduce the risk of *Paramphistomum*, sp. infection even though being fed with grass. However, in some developing countries, many farmers have lack understanding in parasitic diseases (Jenjezwa and Seethal, 2014; Jansen *et al*., 2022). The low perception of farmer to parasitic disease has been reported to cause loss of young animal due to parasitic infection (Slayi *et al*., 2014). Thus, it is important to increase farmer capacity in animal disease to manage parasitic disease. Socialization and intensive training has proved to provide better knowledge, biosecurity practice, and reduce risk behaviour of farmer, especially for small scale farmer (Nampanya *et al*., 2012; Nuraini *et al*., 2022). Thus, support from related stakeholder would be beneficial for the improvement of buffalo farmer capacity in buffalo management which will improve the buffalo farming development.

The current investigation representing a pilot study of parasitic disease of buffalo in Solo Raya region, Central Java, Indonesia. However, some limitations are present in this study. The sample of our study is 59 which were purposively sampled from 44 different farms. The information related to the buffalo farming in Solo Raya is limited, thus sampling calculation is made based on pre-survey study on buffalo population. In addition, there may be some area that are not covered in our study. We suggest a further study in Solo Raya with bigger sample to improve the understanding of parasitic disease in buffalo.

CONCLUSION

The infection rate of *Paramphistomum* sp. infection in Buffalo housed in Solo Raya is 20.34%. The associated risk factors to the *Paramphistomum* sp. infection include feeding type and farmer knowledge on clinical signs and treatment of helminthiasis. Farmer knowledge reduce the risk of *Paramphistomum* sp. infection. A better feeding management and building farmer capacity are suggested to reduce the parasitic infection in buffalo.

ACKNOWLEDGMENTS

Authors acknowledge the support of Department of Animal Science, Faculty od Animal Science, Universitas Sebelas Maret for the facility for our research.

CONFLICT OF INTEREST

The Authors declare that there is no conflict of interest.

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