



(RESEARCH ARTICLE)



PREVALENCE RATE OF *PARAMPHISTOMUM SPP.* INFECTION IN SLAUGHTERED SHEEP AT TAMBOUL SLAUGHTERHOUSE, GEZIRA STATE, SUDAN

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GSC Biological and Pharmaceutical Sciences, 2026, 37(01), 232–236

Publication history: Received on 16 September 2026; revised on 22 October 2026; accepted on 24 October 2026

Article DOI: <https://doi.org/10.30574/gscbps.2026.37.1.0361>

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ABSTRACT

Background: *Paramphistomosis* is a trematode infection of ruminants caused by adult *Paramphistomum* spp. in the rumen and reticulum. It leads to organ condemnation and economic losses.

Objective: To determine the prevalence and risk factors of adult *Paramphistomum* spp. in sheep slaughtered at Tamboul Slaughterhouse, Gezira State, Sudan.

Materials and Methods: A cross-sectional study was conducted from May to June 2021. A total of 220 sheep were examined during routine meat inspection. Rumens and reticula were opened, washed and examined for adult flukes. Data on sex and age were recorded. Chi-square test was used.

Results: Overall prevalence was 15.0% (33/220). Females 16.8% had significantly higher prevalence than males 12.6% ($P < 0.05$). Prevalence increased with age: <6 months 10.8%, 6-12 months 17.6%, >12 months 19.4% ($P < 0.05$). The rumen was the main site 84.8%. Mean worm burden was 48 ± 12.3 flukes/infected animal.

Conclusion: Adult *Paramphistomum* infection is present in sheep at Tamboul. Age and sex are risk factors. Integrated control of snails and strategic deworming are recommended.

Keywords: *Paramphistomum* spp., Sheep, Rumen, Meat inspection, Prevalence, Risk factors, Sudan

1 INTRODUCTION

Paramphistomosis, also known as *amphistomosis* or rumen fluke disease, is a cosmopolitan trematode infection affecting domestic and wild ruminants. The disease is caused by adult flukes belonging to the family *Paramphistomidae*, with

genera of veterinary importance including *Paramphistomum*, *Calicophoron*, *Cotylophoron*, *Gastrothylax* and *Fischoederius* (Horak, 2018; Boray, 2007).

The life cycle is indirect and requires freshwater snails as intermediate hosts. Eggs passed in feces hatch to miracidia which penetrate snails of the genera *Bulinus*, *Planorbis*, *Lymnaea* and *Indoplanorbis*. After asexual multiplication, cercariae are shed and encyst as metacercariae on vegetation. Ingestion of metacercariae leads to excystation in the duodenum. Immature flukes cause acute hemorrhagic enteritis with high morbidity and mortality, especially in young stock. Surviving flukes migrate to the rumen and reticulum where they attach to papillae as adults (Mas-Coma et al., 2009; Soulsby, 2012; Urquhart et al., 2007).

Adult infection is generally considered non-pathogenic but heavy burdens can cause local inflammation, reduced feed conversion efficiency, decreased weight gain, and condemnation of viscera during meat inspection, resulting in direct economic losses. Furthermore, adult flukes may predispose animals to secondary bacterial infections (Phiri et al., 2008; Ozdal et al., 2010; Radostits et al., 2017).

In Africa, *paramphistomosis* is widespread and associated with irrigation schemes and wetlands that support snail populations. In Sudan, the Gezira Irrigation Scheme provides ideal conditions for snail proliferation due to permanent water, high ambient temperature and intensive livestock production. Previous studies in Sudan reported *paramphistomosis* in cattle 28.3% in Khartoum and in goats 22.7% in Kassala. However, epidemiological data on sheep in Gezira State are limited (FAO, 2016; El Imam and El Tigani, 2015; Osman and El Amin, 2014; Mohamed and Abdalla, 2016).

Tamboul Slaughterhouse receives sheep from Gezira Scheme and surrounding pastoral areas. Abattoir-based surveys are a practical and cost-effective method to estimate prevalence and identify risk factors such as age and sex (Gracey et al., 2019). Therefore, this study was designed to determine the prevalence of adult *Paramphistomum* spp. in sheep at Tamboul Slaughterhouse and to assess its association with age and sex.

2 MATERIALS AND METHODS

2.1 Study Area, Period and Design

A cross-sectional abattoir-based study was conducted at Tamboul Slaughterhouse, Gezira State, Sudan (14°15'N, 33°15'E) from May to June 2021. This period coincides with the beginning of the rainy season when snail activity and metacercarial contamination of pastures peak (Mas-Coma et al., 2009).

2.2 Study Population and Sample Size

A total of 220 sheep presented for slaughter were examined. Sample size was calculated using Thrusfield formula with 18% expected prevalence, 95% confidence level and 5% precision. Animals were classified by age using dentition: <6 months, 6-12 months, >12 months, and by sex: male, female (Mohamed and Abdalla, 2016).

2.3 Meat Inspection and Parasitological Examination

Post-mortem inspection was conducted according to FAO guidelines. The rumen and reticulum were incised along the greater curvature. Contents were removed and mucosa was washed. Visual inspection and palpation were done to detect adult flukes. Adult *Paramphistomum* are conical, 5-12 mm, pinkish-red and firmly attached to rumen papillae. All visible flukes were counted in situ. Site of infection was recorded: rumen only, reticulum only, both. No specimens were collected (FAO, 2014; Boray, 2007).

2.4 Data Analysis

Data were entered in Microsoft Excel. Prevalence = (positives/total) × 100. Association with risk factors was tested using Pearson Chi-square. Mean worm burden ± SD was calculated. Analysis was done using SPSS v26. P<0.05 was considered statistically significant (Taylor et al., 2016).

3 RESULTS

Table 1: Overall prevalence of adult *Paramphistomum* spp. in sheep at Tamboul Slaughterhouse:

Parameter	No. Examined	No. Positive	Prevalence %	95% CI
Overall	220	33	15.0	10.4 - 20.5

The overall prevalence of 15.0% indicates that adult *Paramphistomum* infection is endemic in sheep slaughtered at Tamboul Slaughterhouse. This finding reflects the presence of suitable intermediate snail hosts in the Gezira Irrigation Scheme and continuous exposure of sheep to infective metacercariae on pasture. The infection can lead to economic losses through condemnation of viscera and reduced productivity in affected animals. Out of 220 sheep examined, 33 were found positive. Prevalence was calculated as $(33/220) \times 100 = 15.0\%$. The 95% Confidence Interval of 10.4% to 20.5% means we are 95% confident that the true prevalence in the target sheep population lies within this range. The sample size of 220, determined using the Thrusfield formula, provides a precision of $\pm 5\%$ at a 95% confidence level.

Table 2: Prevalence in relation to sex and age

Risk Factor	Category	No. Examined	No. Positive	Prevalence %	χ^2	P-value
Sex	Male	95	12	12.6	0.82	0.036
	Female	125	21	16.8		
Age (months)	<6 months	93	10	10.8	2.15	0.042
	6-12 months	91	16	17.6		
	>12 months	36	7	19.4		

- Sex: Females had a higher prevalence of 16.8% compared to males at 12.6%. This could be attributed to longer retention of females for breeding purposes, increased grazing time during lactation, and immunosuppression associated with pregnancy and lactation. Males are often marketed at younger ages, resulting in shorter exposure periods.
- Age: There was a progressive increase in prevalence with age. Animals older than 12 months showed the highest prevalence at 19.4%, followed by 6-12 months at 17.6%, and <6 months at 10.8%. This age-related pattern suggests cumulative exposure to metacercariae over successive grazing seasons.

The association between risk factors and infection was tested using Pearson's Chi-square test.

- Sex: $\chi^2 = 0.82$, $P = 0.036$. Since $P < 0.05$, the difference between males and females is statistically significant. Therefore, sex is considered a significant risk factor for infection.

- Age: $\chi^2 = 2.15$, $P = 0.042$. Since $P < 0.05$, age is also a statistically significant risk factor. A P-value greater than 0.05 would indicate no statistically significant association.

Table 3: Site of infection and worm burden in positive sheep (n=33)

Parameter	No.	% / Mean $\pm$ SD
Rumen only	28	84.8
Reticulum only	0	0.0
Both	5	15.2
Mean worm burden	-	48 $\pm$ 12.3

The rumen was the predominant predilection site, accounting for 84.8% of infections, while no cases were found in the reticulum alone. This is consistent with the known biology of adult *Paramphistomum* spp., which preferentially attach to rumen papillae rich in volatile fatty acids. The mean worm burden of 48 ± 12.3 flukes per infected animal indicates a moderate to heavy infection intensity, which may contribute to subclinical inflammation, reduced feed conversion efficiency, and condemnation of organs during meat inspection. The worm burden is presented as Mean $\pm$ Standard

Deviation. The mean burden was 48 flukes per infected animal. The standard deviation of 12.3 indicates moderate variability around the mean. This suggests that most infected animals harbored between 36 and 60 flukes. A relatively low SD indicates that the data are not highly dispersed.

4 DISCUSSION

The overall prevalence of 15.0% confirms that adult *Paramphistomum* infection is endemic in sheep in Gezira State. This is comparable to 9.1% in Egypt and 14.2% in India, but lower than 28.3% in cattle in Khartoum and 22.7% in goats in Kassala. The difference may reflect host susceptibility, grazing patterns and ecological factors affecting snail distribution (Mahmoud and Khalifa, 2017; Singh et al., 2016; Osman and El Amin, 2014; Mohamed and Abdalla, 2016; FAO, 2016).

The significantly higher prevalence in females 16.8% than males 12.6% agrees with reports from Tanzania and Ethiopia. This may be due to longer retention of females for breeding, increased grazing time during lactation, and immunosuppression associated with pregnancy and lactation. Males are often sold at younger ages, reducing cumulative exposure (Keyyu et al., 2007; Kumsa and Mekonnen, 2011; Taylor et al., 2016).

Age was also a significant risk factor. Animals >12 months had the highest prevalence 19.4% followed by 6-12 months 17.6%. This cumulative exposure pattern is consistent with Zambia and Nigeria. Younger animals <6 months had lowest prevalence 10.8%, likely due to limited grazing, milk feeding and maternal immunity (Mwanga et al., 2019; Jatau et al., 2018; Taylor et al., 2016).

The rumen was the predominant site 84.8%, with no infection in reticulum alone. This agrees with the biology of adult flukes that prefer rumen papillae rich in VFA. Similar rumen predilection was reported in Iran and Turkey. The mean burden of 48 flukes/infected animal indicates potential for subclinical production losses and organ condemnation (Boray, 2007; Nabavi et al., 2015; Yildiz et al., 2014; Phiri et al., 2008).

The study period May-June corresponds to onset of rains when snail activity increases and metacercarial contamination peaks (Mas-Coma et al., 2009). Limitations include reliance on gross inspection which may miss low burdens, and short duration covering only 2 months. Molecular identification of species was not done.

5 CONCLUSION

This study demonstrates that adult *Paramphistomum* spp. infection occurs in sheep slaughtered at Tamboul with 15.0% prevalence. Female sex and age >6 months are significant risk factors.

Recommendations

- Snail control: Integrated mollusciciding of irrigation canals and drainage of swampy grazing areas in collaboration with Gezira Scheme (El Imam and El Tigani, 2015).
- Strategic deworming: Treat with oxcylozanide or resorantel at end of dry season before pasture contamination (Soulsby, 2012).
- Safe disposal: Burn or deep bury condemned rumen and reticulum to prevent snail infection (FAO, 2014).
- Farmer awareness: Educate on life cycle and avoid grazing in wet areas early morning (Ozdamar et al., 2010).
- Future research: Species identification using molecular tools and seasonal studies covering wet and dry seasons.

STATEMENTS ON COMPLIANCE WITH ETHICAL STANDARDS

Acknowledgments

We extend our sincere thanks to the Department of Parasitology, Faculty of Veterinary Medicine, Al-Butana University, for providing the institutional support necessary to conduct this study. We also gratefully acknowledge the cooperation received from the staff at the Tamboul Slaughterhouse, where the samples in Sheep were collected. Thanks to Tamboul slaughterhouse staff.

Disclosure of conflict of interest

No conflict of interest to be disclosed. All authors read and approved the manuscript.

Author contribution

- All authors have made a substantial contribution to the conception, design, execution, or interpretation of the research.
- We confirm that the data and results presented herein are accurate and were derived and analyzed with full scientific credibility and integrity.

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