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Gender-based variations in Paramphistomosis in ruminants: A brief review

Narsaiah Shivakoti
Department of Zoology, Govt Degree College, Hayat Nagar, Rangareddy, Telangana, India

Abstract
Paramphistomosis is a parasitic disease caused by *Paramphistomum* species belonging to the phylum Platyhelminthes that affects ruminants such as cattle, buffalo, sheep, and goats. The disease is prevalent worldwide, particularly in regions like Australia, Africa, Asia, Eastern Europe and Russia. Immature parasites inhabit the duodenum, while adult flukes reside in the rumen, with the immature stages being primarily responsible for causing the disease. The symptoms in infected hosts include shooting, diarrhea, anemia, and lethargy, which, if left untreated, can lead to death. These parasites require a primary host (ruminants) and an intermediate host (snails) to complete their life cycle. The author reviewed the infection rate of disease in different host genders between 2000 and 2024 in the present study. The findings revealed mixed results. In some cases, males were more susceptible to the disease than females and vice versa, while in others, gender showed no significant impact on infection rates. In conclusion, the infection rate of *Paramphistomum* is not solely dependent on the host's gender. Still, it is influenced by multiple factors, including age, breed, season, grazing practices, farming methods, etc. This comprehensive study provides valuable insights into the host-parasite relationship and is instrumental in developing a strategic schedule to control the disease effectively.

Keywords: Gender, Paramphistomosis, Ruminants

Introduction

Paramhistomosis is a helminthic infectious disease caused by Paramhistomes or amphistomes species of the Paramphistomidae family, order plagiorchida of class trematodes of phylum Platyhelminthes in the livestock like cattle, buffalo, sheep, goat, and other ruminants. The disease is prevalent worldwide, and its infection depends on different variables of a host, such as gender, age, breed, body health status, and environmental factors like season and rearing practices. The symptoms in infected hosts include shooting, diarrhea, anemia, and lethargy, which, if left untreated, can lead to death. It makes a heavy loss to the livestock industry. These parasites require a primary host (ruminants) and an intermediate host (snails) to complete their life cycle. The author attempted to understand the disease infection rate in different genders in this review study.

Literature review

The investigations performed at the slaughterhouse of Limoges (Central France) were performed to determine the prevalence of *Paramphistomum daubneyi* infection in cattle, and it was revealed that the breed and age of cattle were not significantly associated with *P. daubneyi* infection. Still, females were significantly more infected than males. *P. daubneyi* infection was related to Fasciola *hepatica* but not Dicrocoelium *lanceolatum*. The reasons for the difference in infection rates in the two genders are management and slaughtering practices. The young male cattle were kept in cowsheds for extended periods to promote better growth before being sold. In contrast, female cattle were more quickly moved to pastures. Regarding slaughtering practices, Female cattle were selectively culled based on health or production issues. Regardless of their health status, male cattle were routinely eliminated as part of standard production cycles. (Szmidt-Adjidé *et.al* 2000) [21]. The prevalence of paramphistome infection in sheep slaughtered at Maiduguri abattoir, Nigeria, was studied, and it was revealed that there was no significant role in the sex infection rate. The results show no importance of age, sex, or breed in infections. (Biu *et al*. 2004) [3] Based on the findings of the research conducted on the prevalence of Paramphistomosis in buffaloes under various management settings in four districts of Punjab province, Pakistan, it was found that male buffaloes were more frequently affected than female buffaloes. The reason seems to be related to the social practice of keeping females under better management and feeding conditions in comparison to males, which is generally let loose to graze freely in pastures (Javed Khan *et al.*, 2006) [10]

A Survey of the prevalence and fluke burden of Paramphistomum sp. was conducted among the significant ruminant cattle, sheep, and goats slaughtered in Sokoto Central Abattoir between May and October 2007 and found that females were more infected than males. Higher prevalence in cattle may be a result of their usual grazing and watering sites, the streams, rivers, and lakes where Fasciola and Paramphistomum transmission is easy as against sheep (particularly rams and goats), which were usually reared intensively and semi-intensively, respectively. The disease might have caused sudden death to such animals even before they were slaughtered, thus reducing the chances of sheep and goats being positive during examination. However, another hypothetical explanation may be the fact that the stomach surface of cattle is ordinarily larger, thus providing a larger surface area for fluke attachment. The higher prevalence among females may be due to loss of immunity during pregnancy, birth, and lactation. (Bunza *et al*. 2008) [4] An epidemiological study of paramphistomosis in cattle was

conducted across four districts of Punjab province. It revealed that male cattle were more commonly affected by *Paramphistomum* spp. Than females, indicating a potential gender-related predisposition in the region. It seems related to the social practice of keeping females under better management and feeding conditions than males, who are generally let loose to graze freely in pastures (Javed Khan *et al.,* 2008) [11]. The findings from the study on the epidemiology of paramphistomosis in sheep in the northwest temperate Himalayan region of India provide valuable insights into factors that influence the prevalence of Paramphistomum infections in sheep. These results highlight seasonal, age, gender, and breed-specific differences in infection rates. Male sheep are more susceptible than females. However, the observations were not statistically significant. The influence of sex on the susceptibility of animals to infections could be attributed to genetic predisposition and differential susceptibility owing to hormonal effects. (Tariq *et al.* 2008) [22].

Parasitological investigations on ruminal paramphistomosis were conducted in 2,033 cattle over 14 months at three Algerian slaughterhouses. The findings revealed that female cattle were significantly more infected than males. (Titi *et al.* 2010) [25] A study was conducted to investigate the epidemiology of *Paramphistomum* spp. Infection in cattle within the Sirajgonj district, Bangladesh, using fecal samples collected from 360 cattle between March 2009 and April 2010. The findings revealed that females were more susceptible to *Paramphistomum* spp than males. It suggests potential differences in gender-related vulnerability. The higher infection rate in females may result from physiological changes during pregnancy and lactation and insufficient feed supplements for production, which can weaken their immune resistance (Paul *et al.,* 2011) [16]. Studies conducted to determine the status of amphistomosis in cattle in the Joypurhat district of Bangladesh revealed that females were significantly more infected than males, which seems to be the physiological status of the female body during the gestation and lactation period with lowered body resistance. (Azam *et al*., 2011) [2] An epidemiological study was conducted in Udaipur and its surrounding areas from July 2012 to June 2013. A total of 435 rumens from slaughtered buffaloes at various slaughterhouses were examined. The study found that male buffaloes were more susceptible to infection than females. (Swarnkar et.al 2021) [20]. The findings from the survey of sheep breeds in Balochistan (Pakistan) showed that the female Babrik and Harnai sheep were more vulnerable to diseases than males. These results coincide with many previous studies with few exemptions. (Tehmina *et al.* 2014) [24] Studies on the prevalence and classification of amphistomes in cattle and buffaloes from the Giza and Garbia governorates of Egypt were conducted by examining fecal samples. The results revealed no significant difference in infection rates between male and female hosts with different Paramhistome spp P.cervi, P.microbothrium, and Carmyerius gregarious. (Halium *et al., 2014)* [8]. Interestingly, the study on the prevalence of Fasciolosis and Paramphistomosis in Hawassa Town showed that male cattle were more susceptible to these infections than females[13]. The disease prevalence rate of Hawasa town is equal to the results of Egypt, but it is very high in other European countries. (Mariam *et al.* 2014) [13] The egg count studies from fecal samples of Bali cattle and cows from the District of Tenayan Raya in Pekanbaru Municipality, Indonesia, indicated that the fecal samples from Bali male cattle contained more eggs than those from buffaloes. (Rozi *et al*. 2014) [19] Weekly studies on the small intestines of slaughtered sheep were conducted in abattoirs in Kermanshah, Sanandaj, Tabriz, and Urmia of Iran. The findings revealed no significant difference in the rate of paramphistomosis between genders [15]. The observed results may be attributed to samples collected from diverse sources and influenced by ecological factors. (Tehrani *et al.* 2015) [23] The investigation focused on the prevalence of Paramphistomum in domestic cows and buffalo in the districts of Swat and Charsadda, Khyber Pakhtunkhwa (KP), Pakistan, and found that male animals had higher infection rates than females, which provides significant insights into the dynamics of parasitic infections in livestock. The variation in infection rates may be due to the social practice of giving females better management and feeding conditions. At the same time, males are typically left to graze freely in pastures. (Kattak *et al.* 2017) [12] Studies conducted to determine the prevalence of paramphistomosis in cattle and goats slaughtered in Uyo, Akwa Ibom State, Nigeria, found that females of both cattle and goats sampled exhibited a higher prevalence rate than their males. However, the infection's prevalence and intensity are breed-specific for cattle and goats. (Opara *et al*. 2017) [15] The study on goats in the Mathura district of Uttar Pradesh, India, to determine the prevalence of caprine amphistomosis, revealed that the female goats were more susceptible to the disease than males[18]. Three species of amphisomes have been identified for infection: Paramhistomum epiclitum, Gastrothylax crummnifer, and Fischoederius sppThe higher infection rate in females may be attributed to physiological changes during pregnancy and lactation, along with inadequate feed supplementation, which can weaken their immune resistance. (Jaiswal *et al*. 2018) [9] A study was conducted to investigate the current status of *Paramphistomum* infection in cattle through a coproscopic examination of slaughtered animals and fecal samples collected from various areas in the Sylhet Division of Bangladesh states that females were more susceptible to *Paramphistomum* spp than males[19].The variation in infection in male and female cattle might be due to variations in sample size, host genetic resistance, stress, and lack of nutrition. The higher percentage of infection in the females may be due to the alteration in the physiological condition of the animals during pregnancy and lactation. Higher infection in animals was found in the rainy season, and this may be due to the high rainfall and lodging of water, which facilitates parasitic survival. (Chowdhury *et al.,* 2019) [5]

A study investigated the prevalence of amphistome parasites in buffaloes slaughtered at various abattoirs in Pakistan's Rawalpindi and Peshawar districts. The findings indicated that male Kundhi buffaloes had a higher infection rate than Azi Khali and Nili Ravi breeds, and females showed lower infection rates overall. (Nazar *et al.,* 2019) [14]. Postmortem

studies on cattle slaughtered at an abattoir in Umuahia, Abia State, Nigeria, to determine the prevalence of fascioliasis and paramphistomosis revealed that adult females with poor body condition had a higher prevalence of *Paramphistomum* infection compared to other groups. (Ec, U., U, A., *et al*. 2019) Coproscopic studies on skinny cattle raised in Aceh Province, Indonesia, and slaughtered at the Banda abattoir revealed that females were more infected than males. This study showed that cattle with poor body condition are more affected by fasciola and paramhistome sps. Interestingly, Fasciola gigantica infection is more common in males than females, but vice versa in the case of paramhistomum sps. (Hambal *et al.*, 2020) [7] It has been reported that paramphistomosis in domestic ruminants like cattle, sheep, and goats is prevalent in the Chittoor district of Andhra Pradesh, India. Sheep are infected more, followed by goats and cattle. There is no statistically significant difference in the prevalence of infection between male and female animals. It suggests that biological or physiological differences between males and females do not significantly influence infection rates. (Preethi, *et al* 2020) [17] A cross-sectional study was conducted from September 2017 to April 2018 at the Gwagwalada abattoir in Nigeria. The findings indicated that the disease's infection rate was higher in males than females. The variation in infection rate in different genders might be due to variations in sample size, stress, genetic resistance of the host, and insufficient/imbalanced feed against higher needs loss of immunity in pregnancy and lactation (O. B. Arowoloa *et al*. 2020). The studies focused on the prevalence of *Paramphistomum* spp infections in sacrificial cows in the Lima Puluh Kota District of West Sumatra, Indonesia. The finding is that female cows are more susceptible to disease than males (Zelpina *et al.*, 2023) [26]. The epidemiological study aimed to compare the climatic conditions of four districts in Pakistan, Mardan, Nowshera, Swabi, and Charsadda, and their effects on buffaloes and cows. The results indicated that the prevalence of the amphistome infection was higher in male cows and buffaloes than in their counterparts. (Rafiq *et al.* 2023) [18]

Conclusion

The reviewed studies on the prevalence of Paramphistomosis in various ruminant species across different regions reveal significant insights into gender-related susceptibility patterns and management practices influencing infection rates. A recurring theme emerges from the research: female animals are generally more prone to Paramphistomum infections than males. This higher prevalence among females is often attributed to physiological stressors such as pregnancy, lactation, and weakened immunity (Paul *et al*., 2011 [16]; Azam *et al*., 2011 [2]; Jaiswal *et al*., 2018 [9]; Chowdhury *et al*., 2019 [5]; Zelpina *et al*., 2023) [26]. Additionally, selective culling practices and prolonged pasture exposure increase female infection rates (Szmidt-Adjidé *et al*., 2000 [21]; Bunza *et al*., 2008 [4]; Titi *et al*., 2010) [25].

However, several studies highlight cases where males exhibited higher infection rates, primarily due to differences in management practices where male animals are often allowed to graze freely without proper nutrition and care, making them more vulnerable to infection (Javed Khan *et al*., 2006 [10]; Javed Khan *et al*., 2008 [11]; Kattak *et al*., 2017 [12]; Rafiq *et al*., 2023) [18]. These findings emphasize the influence of social and ecological factors on infection patterns.

Moreover, some research indicates no significant gender-based differences, suggesting that factors such as breed, genetic predisposition, and local ecological conditions play essential roles in infection prevalence (Biu *et al*., 2004 [3]; Halium *et al*., 2014 [8]; Tehrani *et al*., 2015 [23]; Preethi *et al*., 2020) [17].

In conclusion, while gender appears to be a significant factor in many studies, the variation in results highlights the complex interplay of physiological, environmental, and management factors in Paramphistomum infections. Further comprehensive and region-specific research is necessary to understand these dynamics fully and develop targeted strategies for controlling paramphistomosis in ruminants.

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