



Occurrence of *Trichostrongylid-Type* Eggs in Sheep at an Urban Livestock Market in Kabul, Afghanistan

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Abstract:

Objectives: Trichostrongyliasis is a zoonotic parasitic nematode infecting sheep intestines, causing weight loss and digestive issues; this cross-sectional study was conducted from March to August 2024 at the Eid Livestock Market in the Company region of Kabul, Afghanistan, which aims to assess the proportion of sheep positive for morphologically compatible eggs in sheep and identify associated risk factors.

Methods: A total of 160 sheep showing clinical signs suggestive of parasitic infection were sampled, and fecal samples were examined using the flotation technique. Descriptive statistics estimated animal prevalence and farmer awareness, while Chi-Square and Fisher's Exact tests assessed associations between sex, age, breed, and *Trichostrongylus* spp. infection.

Results: The overall proportion was 6.3% (10/160), with no statistically significant association observed between infection and sex ($p = 0.178$) or breed ($p = 0.335$). However, a significant association was found with age ($p < 0.001$), as older sheep had a higher proportion. Farmer interviews revealed limited awareness of the impact of gastrointestinal parasites and seasonal deworming practices.

Conclusion: The findings highlight the need for targeted parasite control strategies, improved grazing management, and increased farmer education to reduce the burden of infection and improve livestock productivity in Afghanistan.

Keywords: Flotation technique; Gastrointestinal parasite; *Trichostrongylid*; Risk factor.

1 Introduction

Small ruminants independently provide essential resources to 300 million smallholders globally, primarily using rangelands unsuitable for crop production (FAO, 2018). Sheep play a significant role in Afghanistan's food production, providing meat, milk, and wool. Their skins are also important export items that help generate foreign currency for developing countries (Haleem et al., 2023). According to a comprehensive nationwide livestock survey (CNLS) in Afghanistan by the Food and Agriculture Organization of the United Nations (FAO), livestock accounts for 15% of Afghanistan's agricultural gross domestic product (GDP), around USD 680 million, and supports more than 1.1 million jobs. Key exports include carpets, wool, and cashmere. However, over the past 40 years, the livestock population has fluctuated significantly due to various factors, including disease outbreaks. Presently, the country has an estimated 3.7 million cattle and 16 million sheep and goats, a sharp decline from over 30 million animals two decades ago (FAO, 2024).

Helminths in livestock, along with zoonotic viruses, bacteria, and other infections, pose significant health risks to humans and livestock (Libera et al., 2022). Helminth parasites that infect livestock can severely impact their overall health and reproductive performance (Rehman & Abidi, 2022).

Trichostrongyliasis is a zoonotic infection resulting from intestinal nematode parasites (Ghanbarzadeh et al., 2019). These parasites are commonly found in herbivores such as cattle and small ruminants (Abbas & Hildreth, 2022). Trichostrongyliasis has been shown to significantly impact sheep performance, leading to a 40% decrease in weight and 6-30% decreases in food intake in lambs. Infected sheep have also experienced a 40% reduction in wool production and a 15% decrease in milk yield (Krecek & Waller, 2006; Molan et al., 2000). To limit economic losses, controlling the disease involves deworming, managing pastures, and using drugs such as benzimidazole, levamisole, closantel, and ivermectin. However, their widespread use has contributed to increasing drug resistance in livestock globally (Qamar & Alkheraije, 2023).

A study conducted in Tabriz, Iran, identified three species of *Trichostrongylus*: *T. probolurus*, *T. vitrinus*, and *T. colubriformis*, all of which were successfully isolated and identified from slaughtered sheep using morphological identification (Shahbazi et al., 2012). A case study

from India found that a camel was infected with *Trichostrongylus* spp eggs, leading to severe diarrhea (Mohanapriya et al., 2020). In addition, a study conducted in Zhob, Balochistan, Pakistan, examined the gastrointestinal tracts of 120 sheep and found that younger sheep were more frequently affected by *Trichostrongylus* spp. infections. It was also found that warm and wet weather creates favorable conditions for the development of eggs into larvae. In contrast, regions with harsh winters and dry summers experience a reduced parasitic burden, as observed in this study (Lateef et al., 2021). Epidemiological research in Iran has revealed that multiple *Trichostrongylus* spp. are widespread among both domestic animals and humans (Shahbazi et al., 2012).

The infection in humans is most prevalent in regions with poor sanitation, particularly where human and animal feces are used as fertilizer, leading to contamination of vegetables and water sources (Wattanakulpanich et al., 2013). Human trichostrongyliasis occurs worldwide, but it is most prevalent in regions such as the Middle East, Africa, and Southeast Asia (Phosuk et al., 2015).

As mentioned, trichostrongyliasis has been reported in livestock and humans from Afghanistan's neighboring countries (Lateef et al., 2021; Shahbazi et al., 2012). A recent study has also reported a high prevalence of GIP (gastrointestinal parasites) (62.3%), including *Trichostrongylus* spp., in cattle of Kandahar province (Shah et al., 2023). Moreover, another study illustrated that camels imported from Afghanistan to Iran were infected with various *Trichostrongylus* spp, including *T. probolurus* and *T. colubriformis* (Borji et al., 2010). These reports indicate the presence of *Trichostrongylus* spp. in livestock; however, there is a lack of reports on their presence in small ruminants. Therefore, this study aimed to investigate the presence of *Trichostrongylid*-type eggs in sheep at the Company Eid Livestock Market in Kabul City. The Company Eid Livestock Market receives sheep from multiple sources (Ghazni, Kandahar, Zabul, and Maidan Wardak); therefore, it is a practical and epidemiologically relevant site, representing sheep presented at this market for detecting *Trichostrongylus* spp.

Furthermore, the study examined the association between animal attributes (such as age, sex, and breed) and the presence of *Trichostrongylus* spp. Finally, farmers were surveyed to assess their knowledge and awareness of the adverse effects of

gastrointestinal parasites (GIPs). This study contributes to a better understanding of and associated animal factors, while highlighting gaps in farmer awareness that can inform future educational efforts.

2 Materials and Methods

2.1 Ethical Approval and Information Collection

The members of the Paraclinic department of the Faculty of Veterinary Science, Kabul University, Afghanistan, approved the ethical guidelines for this study (ethics approval number: R49/01/2024). Consent from the farmers was obtained before collecting any animal samples. Information on the sampled animals was obtained from the farmers, including age, sex, and breed; gastrointestinal problems; and physical examination, through a brief structured interview with each farmer. In addition, the discussion included farmers' information on the impact of parasites on sheep weight.

Trichostrongylus spp. proportion of sheep positive for morphologically compatible eggs

2.2 Study Area

The study was conducted at the Eid Livestock Market in the Company region, located in the 5th District of Kabul. Geographically, Kabul is located at 34°31'31" North latitude and 69°10'42" East longitude. Serving as the country's political, economic, and cultural hub, Kabul has a dry-to-semi-arid climate. Summers (June to August) are hot, with temperatures reaching up to 40°C, while winters (December to February) are cold, with land surface temperatures dropping below -10°C (Figure 1) (Sahak et al., 2023). This market was chosen because it is an important hub connecting Kabul to other provinces, including Ghazni, Kandahar, Zabul, and Maidan Wardak. Livestock is brought to this market throughout the year by people from various provinces for sale.

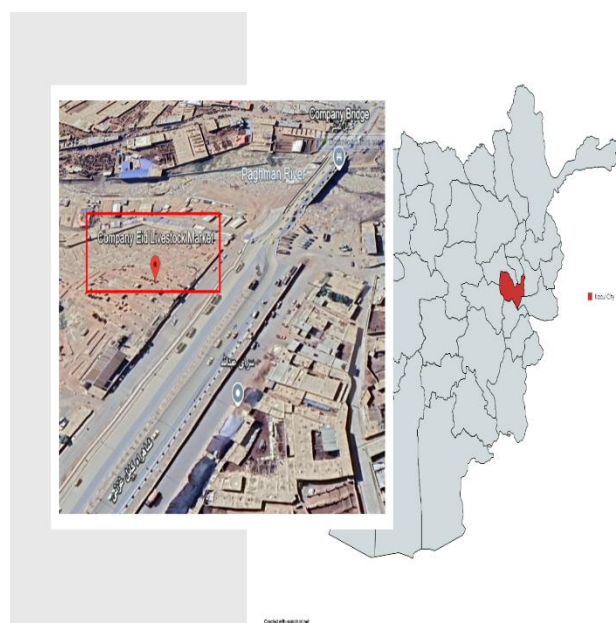


Figure 1: Illustrates the sampling site in Kabul City, Afghanistan.

2.3 Inclusion Criteria

A cross-sectional survey was conducted among sheep presented at the Company Eid Livestock Market in Kabul City. A total of 160 sheep were included in the study based on the number of eligible animals available for sampling at the Company Eid Livestock Market during the study period from March to August 2024. The study was conducted as a preliminary cross-sectional investigation of *Trichostrongylus* spp infection in sheep presented at the market. Sheep older than six months, showing clinical signs suggestive of

parasitic infection, and with no reported deworming history during the preceding 90 days were eligible for inclusion. Eligible animals available at the market during the sampling period were selected according to these predefined criteria. To minimize preferential selection, animals were not intentionally selected based on breed, sex, age, or apparent severity of clinical signs. The age of the animals was determined by dental anatomy as: milk teeth (< 12 months), two permanent teeth (12 to 18 months), four permanent teeth (18 to 24

months) six teeth (24 to 36 months), and full mouth (36 to 48 months); however, if the exact age was provided, it was recorded based on the farmer's report. A total of 160 sheep (100 castrated males and 60 females) brought to the market from March to August 2024 (spring and summer seasons) were included in the study.

2.4 Sampling

Approximately 10 grams of fecal samples were taken directly from the rectum of the sheep by using gloves lubricated with liquid mineral oil. The samples were labeled, placed in sealed envelopes, and stored in an isothermal icebox with gel ice packs, then transported to the Parasitology Laboratory of the Faculty of Veterinary Science, Kabul University, Afghanistan, where they were stored at 4 °C in a refrigerator until further processing.

2.5 Flotation Technique

The fecal flotation technique with saturated sodium chloride was used to identify eggs (Navarro Serra, 2017; Palomino-Guerrera et al., 2024; Urquhart et al., 1996). Eggs with morphological features consistent with the trichostrongylid group were recorded as *Trichostrongylid*-type eggs. Fecal egg counts (EPG) were not performed. Briefly, 5 grams of the fecal sample were mixed with 100 mL of water, then thoroughly crushed in a pestle and mortar. The suspension was then filtered using a strainer in a new jar. The sample from the second beaker was transferred into a test tube and allowed to stand for 10 minutes. The excess water was removed from the sample, leaving only the settled portion in the test tube. A saturated NaCl solution was added to the test tube, filling it to the top. A cover slip was placed on top of the test tube for 15 minutes, allowing the eggs to adhere to it. The cover slip was then placed onto a slide. Finally, the sample was examined under a light microscope

(Olympus CX43), starting with a lower magnification (4x) and then increasing the magnification (10x) (Ballweber et al., 2014; Hendrix & Robinson, 2022).

2.6 Statistical Analysis

Statistical analysis was performed using SPSS 27 (IBM Inc., Chicago). Descriptive statistics were used to calculate the proportion of sheep positive for morphologically compatible eggs among the sampled animals and farmers' awareness. Chi-Square and Fisher's Exact tests were used to determine the association between sex, age, breed, and the carriage of *Trichostrongylus* spp. in the selected sample population. A *p*-value less than 0.05 was considered statistically significant. Univariate analyses were used because of the exploratory nature of the study, the relatively small sample size ($n = 160$), and the limited number of positive observations and/or sparse observations within some categories of the investigated variables. These characteristics limited the reliability of fitting a multivariable logistic regression model with multiple predictors simultaneously.

3 Results

In this study, conducted in the fifth district of Kabul's Livestock Market, located in the Company region (Figure 2), out of the 160 collected samples, eggs of *Trichostrongylus* spp. Eggs were found in 10 (4 positive samples from male (2.5% [4/160]; CI: 0.742-3.451) and 6 positive samples from female sheep (3.8% [6/160]; CI: 0.346-1.039)) of the samples (Table 1). Finally, when asked about the impact of parasites on animal weight, only 80 (50% [80/160]) farmers believed that it has a negative impact on the animals' weight; in addition, 120 (75% [120/160]) farmers had no idea about the deworming schedule of the sheep.

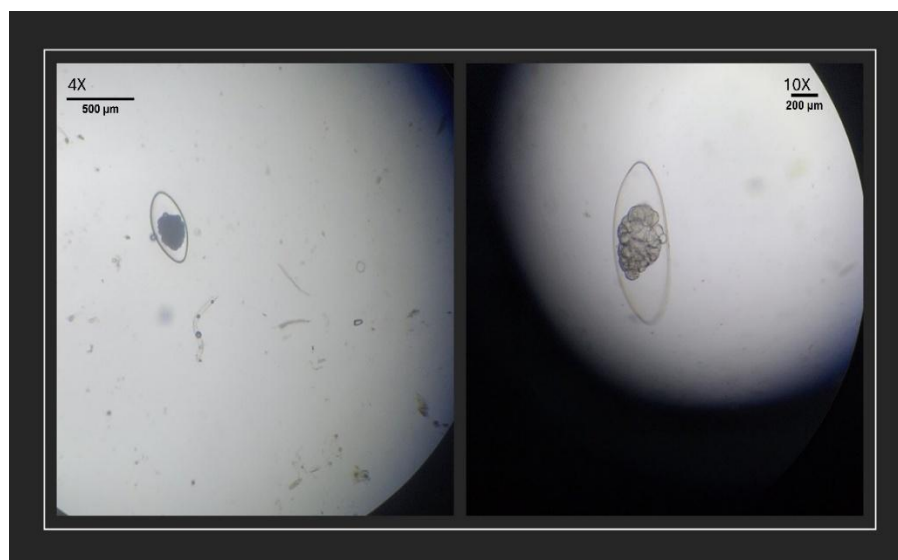


Figure 2: Photomicrograph of *Trichostrongylus* eggs identified by fecal flotation under the light microscope. The eggs are oval, thin-shelled, and typically contain a morula (a cluster of blastomeres), as shown in the photo.

Table 1: Distribution of *Trichostrongylus* infection among sheep according to sex, age group, and breed in Eid Livestock Market of Kabul City.

No.	Risk Factors	Category No.	Proportion N (%)	Confidence interval (95%)	<i>p</i> -value	
1.	sex	Male	100	4 (2.5)	0.742-3.451	0.178
2.		Female	60	6 (3.8)	0.346-1.039	
3.	Age	≤1year old	68	0 (0.0)	-	<0.001*
4.		2-3 years old	70	4 (2.5)		
5.		> 3 years old	22	6 (3.8)		
6.	Breed	Hazaragi	70	6 (3.8)	0.415-1.219	0.335
7.		Mix	90	4 (2.5)	0.663-3.100	

*Statistically significant.

4 Discussion

Gastrointestinal parasites cause significant economic losses for farmers through reduced productivity, increased treatment costs, and decreased reproductive capacity in small ruminants. Nowadays, resistance to many anthelmintics such as benzimidazole and ivermectin has been reported worldwide. For effective treatment measurement, it is very important to evaluate the prevalence of these parasites.

The result of the current study illustrated that, within the selected samples (sheep with clinical signs suggestive of parasitic infection), the age of the sheep showed a significant association with the proportion of the parasite, sheep older than 3 years of age had a proportion of 3.8% (6/160), and 2-3 years of age sheep had a proportion of 2.5% (4/160). The relatively small number of positive animals represents an important limitation of the present study. Only 10 of the 160 examined sheep (6.3% [10/160]) were positive for eggs morphologically

consistent with *Trichostrongylus* spp. This limited number of positive observations reduces the statistical power to detect associations between infection status and animal characteristics and increases the uncertainty of estimates, particularly within small subgroups. Consequently, statistically significant or non-significant findings from the univariable analyses should be interpreted cautiously and should not be considered definitive evidence of or against associations with age, sex, or breed. The sheep under one year of age showed no positive samples. These findings were consistent with those of Vohra et al. (2020), who reported a higher prevalence of adult sheep (83.34%) in Haryana, India, than in younger animals (76.67%). Similarly, Rahman et al. (2017), Bui et al. (2009), Uddin et al. (2006), and Soulsby et al. (1982) reported that small ruminants older than 2 years were more prevalent with endoparasites. Hassan et al. (2011) found that older small ruminants (>24 months) are more susceptible to gastrointestinal parasites than younger ones (<24 months),

supporting the study's findings. In the Philippines, goats older than 1 year had a parasite burden 4 times higher than that of those less than 6 months old (Rupa & Portugaliza, 2016). Similarly, Githigia et al. (2005) in Kenya found a higher prevalence in younger animals than in older ones, but only during the dry season. Lower grazing exposure is reported to be the major factor reducing risk in younger goats (Urquhart et al., 1996). However, age-related differences in infection should not be attributed solely to grazing duration. Sheep can develop acquired immunity to gastrointestinal nematodes following repeated exposure, which may reduce the establishment of adult parasites and egg shedding in older animals (Hou et al., 2025). Consequently, the relationship between age and parasite detection may depend on the balance between cumulative exposure and the development of protective immunity.

Grazing management may also influence this relationship. Continuous grazing, high stocking density, and grazing on contaminated pasture can increase exposure to infective larvae, whereas pasture rotation and appropriate grazing management may reduce larval accumulation. In addition, management practices such as the frequency and timing of anthelmintic treatment, previous deworming practices, movement of animals between grazing areas, nutritional status, and flock management may contribute to differences in parasite burden between age groups (Giulioti et al., 2026). Because these factors were not comprehensively assessed in the present study, grazing exposure should be considered a possible explanation rather than a demonstrated cause of the higher detection observed in older sheep. Further studies incorporating detailed grazing history, pasture management, anthelmintic use, nutritional status, and longitudinal sampling would help clarify the relationship between age and *Trichostrongylus* spp. infection.

The findings of the current study indicate that gender is not significantly associated with the proportion of sheep positive for morphologically compatible eggs ($p = 0.178$) in the selected samples. This observation aligns with the results reported by Rahman et al. (2017), in which the prevalence was higher in females (65.7%) than in males (60.1%) in Bangladesh. These findings were contrary to those of Vohra et al. (2020), in which prevalence was higher in male sheep (89.79%) than in females (82.59%). The observed prevalence may be influenced by stress, host genetic resistance, inadequate or unbalanced feed relative to higher needs (Raza et al., 2010), and a temporary loss of

acquired immunity in female animals near parturition (Garcia et al., 2007).

The Hazaragi sheep breed showed a higher proportion than the mixed breed, but the difference was not statistically significant ($p = 0.335$). This shows that breed is not the only factor directly involved in the infection in the sampled sheep in this study. A similar finding was reported in Pakistan, where local breeds did not differ significantly in the prevalence of *Trichostrongylus* spp. (Saeed et al., 2010). This further supports the argument that environmental exposure is the major factor, rather than the breed, of small ruminants.

The significant association between the age of the sheep and the proportion of sheep positive for morphologically compatible eggs in the selected samples with signs of parasitic infection suggests that management should be improved, especially for older sheep with greater grazing exposure. Reducing the parasite load could be helped by adequate pasture management, selective deworming, and rotational grazing (Papadopoulos et al., 2012). Although gender and breed were not statistically significant, further control initiatives might still benefit from targeted monitoring and treatment.

Trichostrongyliasis can significantly affect animal health and weight, and most farmers are unaware of this. Only half of the survey respondents (50% [80/160]) understood its significance, while 75% (120/160) were unaware of the importance of seasonal deworming. This underscores the critical need for improved parasite control education to protect livestock health and productivity. The findings of the current study emphasize the need for large-scale epidemiological studies to improve understanding of infection patterns in Afghan sheep herds. Using integrated parasite management strategies, including environmental management and genetic selection for resistance, could help reduce prevalence even further and improve overall herd health. Increased understanding and farmer education, when successful, may also help enhance long-term parasite management (Besier, 2012).

Although the sample size allowed estimation of infection occurrence and assessment of associations with the investigated animal-level characteristics, the relatively small sample size, single-market setting, and unequal distribution of some characteristics may have limited the statistical power to detect modest associations, particularly within small subgroups. Therefore, the results of risk-factor analyses were interpreted cautiously and should be considered exploratory rather than

definitive. Lack of ability of molecular detection of *Trichostrongylus* spp. to the species level was also among the limitations of this study, which were due to limited access to laboratory equipment and funding; therefore, to establish the association of risk factors, we recommend selection of sheep should be carried out with higher sample size (at least 384 samples) to reflect the true predictors of trichostrongyliasis in sheep in the selected area. We also recommend the inclusion of molecular detection of *Trichostrongylus* spp. to the species level to ensure a highly valid result is reported. However, the proportion of sheep positive for morphologically compatible eggs in the sampled population from the 5th District of Kabul, Afghanistan, underscores the urgent need for more effective, long-lasting control measures. Prioritizing resistance characteristics in breeding programs can improve herd adaptability and reduce dependency on pharmacological measures, ultimately leading to more effective long-term parasite control.

5 Conclusions

The present study highlights a significant association between age and the proportion of sheep positive for morphologically compatible eggs, with older animals showing higher proportions, likely due to increased grazing exposure. In contrast, gender and breed were not statistically significant factors among. These findings underscore the importance of improved management practices, particularly for older sheep, including targeted deworming, rotational grazing, and pasture control. Because data collection was restricted to spring and summer, seasonal shifts could significantly alter gastrointestinal parasite prevalence, preventing these results from representing a full annual cycle. The limited awareness among farmers regarding parasite impacts and seasonal deworming further emphasizes the need for education and outreach.

5.1 Recommendations

Broader epidemiological studies and the adoption of integrated parasite management strategies, including genetic selection for resistance, are essential for sustainable parasite control in Afghan goat populations.

5.2 Acknowledgments

Not applicable.

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