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Infestation of Helminth Parasites in Goat and Sheep in Tehsil Charbagh at District Swat

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ABSTRACT

Many rural people rely primarily on small ruminants like sheep and goats as a source of income, particularly in dry and semi-arid areas. However, the health and productivity of livestock are greatly impacted by gastrointestinal helminth parasitic infections, which can result in major financial losses. **Objective:** To assess the prevalence and different types of gastrointestinal helminth parasites among sheep and goats at Tehsil Charbagh, District Swat. **Methods:** Faecal samples were collected from eighty sheep and seventy goats. The samples were stored in sealed containers at 4°C until they were further processed. To determine whether helminth eggs were present, standard flotation procedure was used. **Results:** Helminth parasites were detected in 105 (70%) of the total samples. In sheep, the prevalence was 51.43%, whereas in goats, it was 48.57%. The identified helminth parasites were *Trichuris vulpis, Nematodirus spathiger, Haemonchus contortus* and *Trichostrongylus axei.* The species-wise incidence in goats was 1.96% for *N. spathiger* and *T. axei*, 31.37% for *T. vulpis,* and 64.70% for *H. contortus*. In sheep, the incidences of *T. Vulpis* and *H. contortus* were 72.22% and 27.78%, respectively. **Conclusions:** The high incidence of helminth infections in goats and sheep suggests that the health of the livestock in the research area is seriously threatened. These results highlight the necessity for systematic deworming procedures, expanded epidemiological research, and more awareness to promote sustainable management of livestock and enhance rural livelihoods.

INTRODUCTION

In Pakistan, livestock production is essential to the livelihood of farmers with limited resources and makes a substantial contribution to rural development, revenue generation, and food security. Approximately 11.6% of the national GDP and 55.1% of the value of agriculture added are attributed to the livestock industry [1]. Sheep, goats, and other small ruminants are important livestock, especially in arid and semi-arid areas. They play social and religious responsibilities, deliver meat, milk, fibers such as wool skin, and carcasses, and provide as an alternative source of emergency cash [2]. One of the most prevalent and dangerous parasites infecting small ruminants is intestinal helminths [3]. These multicellular eukaryotic invertebrates, which mostly live in their hosts' gastrointestinal tracts, comprise nematodes (roundworms), the cestodes (tapeworms), as well as trematodes (flukes) [4]. In goats and sheep, the illnesses collectively referred to as helminthiasis can result in severe morbidity and mortality, which can include diarrhoea, anorexia, decreased milk production, poor weight gain, and finally death [5, 6]. *Trichuris vulpis*, a whipworm that is usually present in the large intestine, is one of the main helminth parasites. Despite being more prevalent in dogs, it has been documented to occur in ruminants and is linked to inflammation, anaemia, and impaired nutritional absorption as a result of mucosal injury [7]. *Trichostrongylus axei, Haemonchus contortus* and *Nematodirus spathiger* are other important nematodes

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that lower animal productivity and cause financial losses [8]. Due to decreased fertility, slower development rates, less milk along with wool production, higher treatment costs, as well as mortality, especially in seriously infected animals, helminth infections result in significant economic losses [9]. Environmental factors (temperature, humidity, or rainfall), animal grazing practices, pasture quality and host immunity are some of the factors that affect infection rates [10, 7]. Control becomes more difficult in areas with warm, humid climates because these conditions encourage the growth and survival of the parasite larvae. High intestinal helminth infection rates in small ruminants have been reported by studies carried out in different regions of Pakistan, such as Dir and Peshawar. This study investigated the diversity, prevalence, and associated risk factors of gastrointestinal parasites in both wild and domestic animals across various regions of Pakistan [11]. Studies conducted in many parts of Pakistan, including Dir and Peshawar, have found high gastrointestinal helminth infection rates among small ruminants. Although helminthiasis has been extensively investigated in some ecological areas, few data are reported from Tehsil Charbagh, District Swat location with communal grazing and favorable environmental conditions for parasite transmission. Due to the debilitating effect of helminth infection on animal productivity and health, parasitological surveys have to be carried out at a regional level. The current research concerns identification and determination of the gastrointestinal helminth parasites of the sheep and goats at Tehsil Charbagh, District Swat.

The results of this research can be used in planning local livestock husbandry practices and to direct parasite control measures to enhance animal health and rural livelihood.

METHODS

In total, 150 fecal samples were collected from sheep (n=80) and goats (n=70) across different localities in Tehsil Charbagh District Swat using stratified random sampling. Localities were first identified as strata, and within each stratum, animals were selected systematically (e.g., every 5th animal) or using a random number generator to ensure representativeness. The sample size was determined using the formula $n = (Z^2 \times P(1-P))/E^2$, where Z=1.96 (95% confidence level), P=0.7 (expected prevalence based on regional studies [17,25]), and E=0.1 (10% margin of error). This yielded a minimum requirement of 81 animals per group; our study included 80 sheep and 70 goats, ensuring robust prevalence estimates. Fresh fecal samples of about 10–15 grams. Localities were first identified as strata, and within each stratum, animals were selected systematically (e.g., every 5th animal) or using a random number generator to ensure unbiased representation. Fresh fecal samples of about 10–15 grams per animal were collected directly from the rectum under strict standards, with the immediate use of disposable plastic gloves. Each sample was placed into sterile labeled zip-lock bags along with animal ID, date, and time of collection; samples were transported in a cool box without air and stored at 4°C until laboratory analysis [12]. The flotation method described by Zajac and Conboy (2012) was used to examine samples for helminth eggs. Approximately 3 grams of feces were thoroughly mixed with 42 mL of a 33% zinc sulfate solution (prepared by dissolving 331 g of zinc sulfate in 900 mL of warm distilled water) using a mortar and pestle. The suspension was filtered through a tea strainer to remove debris, and the filtrate was transferred into 15 mL plastic centrifuge tubes [13]. The tubes were centrifuged at 1400 rpm for 4 minutes. A coverslip was gently placed onto each tube and left for 20 minutes to allow egg attachment before being carefully lifted and placed onto a clean glass slide. Slides were examined under a light microscope at 4X and 10X magnification for helminth eggs. Parasite identification was based on the morphological traits of the eggs (size, shape, shell thickness, and internal structures), compared with standard parasitological keys. Descriptive statistics were used to calculate the prevalence of intestinal helminth infestations in goats and sheep. The Chi-square (χ^2) test was applied to compare infection rates between species, and 95% confidence intervals (CI) were calculated to assess the reliability of prevalence estimates. All statistical analyses were performed using IBM SPSS (Version 2021)."

RESULTS

This descriptive study of a cross-sectional nature compared 150 fecal samples (70 sheep and 80 goats) to find the prevalence of gastrointestinal helminth infections in Tehsil Charbagh, District Swat. Of the 105 samples (70%), all were positive for one or more helminth species (Figure 1).

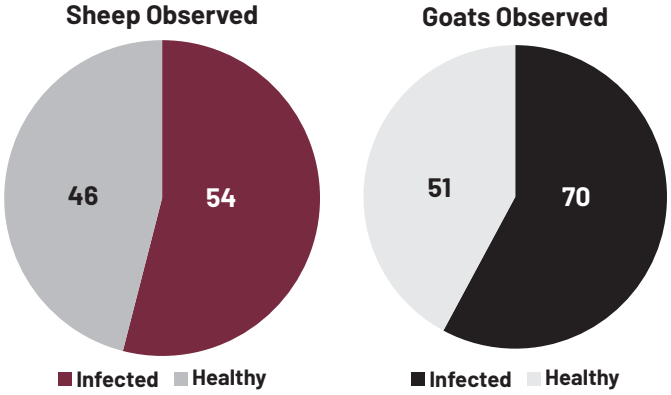

Figure 1: Observed Goats and Sheeps

Incidence of Helminth Infections

Of the 105 exposed animals, 54 (67.5%) were sheep and 51 (72.85%) goats. Infection rates were slightly higher among

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goats, but this did not differ significantly ($\chi^2 = 0.53$, $p = 0.47$), indicating similarly high exposure among species (Table 1).

Table 1: Total Observed Goats and Sheeps

Species	Examined	Infected Frequency (%)
Sheep	80	54 (67.50)
Goat	70	51 (72.85)
Total	150	105 (70.00)

Single vs. Multiple Infections

Single and multiple infections were identified. Multiple infections with helminths were more prevalent, where 44 sheep (81.5% of infected sheep) and 41 goats (80.4% of infected goats) were infected with more than one species. Prevalence of multiple infections was statistically significant ($p < 0.05$), reflecting high environmental exposure to broad range of helminths (Table 2).

Table 2: Single vs. Multiple Infections in sheep and goats

Species	Single Infections	Multiple Infections	Total Infected
Sheep	10	44	54
Goat	10	41	51

Species-wise Distribution of Helminths

Four gastrointestinal helminth species were identified:
Haemonchus contortus (Figure 2)
Trichostrongylus axei (Figure 3)
Nematodirus spathiger (Figure 4)
Trichuris vulpis (Figure 5).

In goats, *H. contortus* was the most prevalent (64.70%), followed by *T. vulpis* (31.37%), and *T. axei* and *N. spathiger* in 1.96% of infected goats (Table 3).

Table 3: Prevalence of Helminths in Goats (n = 51 infected)

Helminth Species	Number Infected Frequency (%)
Haemonchus contortus	33 (64.70)
Trichuris vulpis	16 (31.37)
Trichostrongylus axei	1 (1.96)
Nematodirus spathiger	1 (1.96)

Figure 2: *Haemonchus contortus*

Figure 3: *Trichostrongylus axei*

Figure 4: *Nematodirus spathiger*

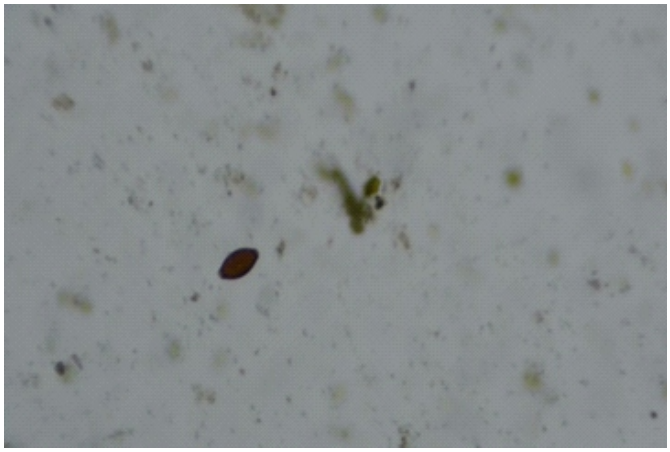

Figure 5: *Trichuris vulpis*

Additionally, *H. contortus* dominated sheep (72.22%), with *T. vulpis* coming in next (27.78%). In sheep, no additional helminth species were found (Table 4).

Table 4: Prevalence of helminths in sheep (n = 54 infected)

Helminth Species	Number Infected
Haemonchus contortus	39 (72.22)
Trichuris vulpis	15 (27.78)

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4. Environmental Factors

It was noted that the prevalence of infections was considerably higher in animals within open grazing areas, particularly where communal pastures and poor sanitation were noted. Specific measurements of environmental conditions (temperature, rainfall, etc.) were hardly taken into record, but from qualitative field observation, many of the positive cases went together with low-lying humid poorly drained grazing conditions-a requirement for larval development and survival.

- Total prevalence: 70% (95% CI: 62.1–77.1%)
- There is no difference in prevalence between sheep and goats ($p = 0.47$)
- Infection rates are greatly impacted by age and grazing system ($p < 0.05$)
- No sexual difference ($p = 0.30$).

DISCUSSION

According to the current study, the overall parasite occurrence in sheep and goat was 67.50% (n=54/80) and 72.85% (n=51/70). Various studies has been published on the prevalence of helminth parasites in sheep and goat. The present study was conducted in Tehsil Charbagh at District Swat. This meta-analysis explores the extent, patterns, and health impacts of helminth polyparasitism in human populations worldwide [14]. This systematic review summarizes the prevalence and types of gastrointestinal helminths affecting domestic ruminants in Ethiopia [15]. This study examined the prevalence of gastrointestinal helminths in dogs on sheep and goat farms in Greece, including the role of wild canids and anthelmintic use [16]. The study of Ashraf *et al.,* conducted in 2022 estimated a general helminth parasite prevalence of 89.20% (281 out of 315 animals) in Upper Dir, Pakistan, with infection rates in sheep 94% (173/184) and in goats 82.43% (108/131). The most prevalent parasites in sheep were *Fasciola hepatica* (13.58%), *Haemonchus contortus* (21.73%), the Trichuris ovis (17.39%), and *Strongyloides papillosus* (41.30%). The frequency of *Trichuris ovis* was 25.20%, Fasciola hepatica was 10.68%, *Haemonchus contortus* was 28.70%, and *Strongyloides papillosus* was 33.33% in goats [16]. In the present study's overall infection rate was 70.0%, the most common genera were *H. contortus, T. vulpis, Nematodirus spathiger,* and *Trichostrongylus axei.* While in May/June and August/September of 2002, the Khan A *et al*. study revealed 36% and 52% infection [17]. The presence of various climatic or environmental factors that could support the survival and development of the infective larval stage of most nematodes could account for the difference in nematode parasites. Nematodes were shown to be equally common in sheep and goats, according to research conducted by Khan R *et al.,* in 2019 [18]. According to the work done by Krishnamoorthy P *et al.*, in 2019, also explained the idea of infection caused by nematodes parasite in small ruminants and elaborate the animal-parasite-vegetation relationship and to use this specific strategy for the control of these harmful nematodes. They also extravagant the idea of disease resistance in many nematodes which have greater influence on their environmental conditions of specific area. They also elucidated the concept that warm and humid environmental conditions of tropical and subtropical regions of the world are best places for the nematodes survival [19]. Which is similar to the current results. However, while in the current investigation only found a 100% overall prevalence rate of nematodes. Variations in the weather and atmospheric humidity may be the cause of the discrepancy in the outcome. While a study conducted on goats in Lahore, Pakistan, found that nematodes had the highest infection rate (42.67%), followed by trematodes (16.67%) and cestodes (4%) while the current study showed that the most common helminth parasites in goats are *Trichuris vulpis, Haemonchus contortus, Nematodirus spathiger* and *Trichostrongyloids axei.* While the most frequent gastrointestinal parasites found in goats and sheep were *Emeria, Trichostrongylus, Haemonchus, Moniezia,* and *Fasciola,* according to Maurizio A *et al.,* in 2023 [20]. According to work done in Lahore region by Mohamed HI *et al.,* in 2021, on different genera of helminths parasites. They have collected 160 fecal samples from different places of the study area. To determine the occurrence of parasites in varios genera, whole samples were exposed to parasitological examination and investigated using the direct smear method [21]. In general, an inclusive occurrence of 40% was verified which exposed 64 samples were positive. The detected parasitic species were *Balantidium coli, Ostertagia ostertagi, Fasciola hepatica, Coccidia, Chabertia ovina, Shistosoma bovis, Trichuris globulosa, Haemonchus contortus,* and *Strogyloides papillosus.* Out of 160 total samples, 64 samples were positive, while 40% prevalence was verified in all ruminants. Among bovines (cows and buffaloes), the multi-parasites prevalence was recorded to be 47.5. However, in ovine (sheep) and caprine (goats), the prevalence was 42.5 and 32.5%, respectively. The parasitic prevalence was observed alike in adults and young. However, the current investigation revealed that *Haemonchus contortus* had the highest occurrence rate, followed by *Trichuris vulpis* in goat and sheep. There was some commonality between the four nematode species that were found in this investigation. While according to Mekonnen, 2007, in goats and sheep of eastern Ethiopia found that Haemonchus had the highest occurrence rate, followed by Trichostrongylus. There were two distinct rainy seasons when the worm burden peaked, between May and

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September. There have been reports of four kinds of flukes and thirteen species of nematodes by Khan W *et al.*, in 2023 [22]. Similar work to our results has also been done by Khan *et al.*, in 2025, in Dir region of Khyber Pakhtunkhwa. Gloved fingers were used to irregularly collect a fecal sample from the rectum of sheep (Ovis aries). The fresh fecal ingredients were placed in sterile plastic vessels with 10% formalin. A total of 584 sheep fecal samples were assembled, and their parasite contents were scrutinized. There were 365 female sheep and 219 male sheep among them. The overall prevalence rate was 89.09%. *Haemonchus species, Strongyloides species, Trichuris species, Fasciola hepaticas species,* and Moniezia species were the most widespread parasites, with relative prevalences of 43.27, 28.57, 15.59, 3.6, and 1.7%. The total incidence of gastrointestinal parasites in male sheep (33.39%) and female sheep (55.65%) differed significantly ($p<0.05$) according to sex. Associated with young lambs (19.86%), the prevalence of gastrointestinal parasites was complex in adult sheep (69.18%). Linked to the Lokhi breed (18.32%), the uppermost infection rates were perceived in the Balkhi breed (38.7%) and the Damani breed (32.53%). In distinction, tehsil Samar Bagh had the maximum frequency of gastrointestinal parasites (17.46%) in the tehsil-wise evaluation, after Samarbagh followed by tehsil Munda (15.23%), Lal Qila (11.01%), Balambat (9.1%), and Khall (8.4%). In the current investigation, sheep and goats had double parasite infection rates of 44 (41.90%) and 61 (58.10%), respectively. Comparably, research from throughout the globe has shown that the current study's findings are very comparable to those of a study carried out by Rafi U *et al.*, 2023 [23]. According to their analysis, the prevalence of infections in sheep and goats was 53.33% and 66.45%, respectively, with the majority of the sample showing multiple infections rather than a single infection in 38 (42.22%) and 156 (50.32) sheep and goats, respectively while the current syudy revealed that 4 species of nematodes were identified which were *H. contortus, T. vulpis, T. axei,* and *N. spathiger.* Among nematodes 6 species were identified which are *H. contortus, T. vitrinus, Strongyloides papillosus, N. spathiger, Ostertagia spp.* and *Trichuri spp.* The similar study was conducted in the Metro Livestock Office in Boalia, Rajshahi District. The study was carried out for 22 months to investigate the prevalence of gastrointestinal helminths parasites in sheep and goat. A total of 240 animals were used in the research. Under a semi-intensive system, the general prevalence of helminthes invasion was found to be 70% (168). Invasions of the trematodal parasites *Fasciola* and *Paramphistomum* were distinguished in goats 21.29% and 18.06% and in cattle 37.64% and 20%, respectively. Invasions of Ascaris and Trichuris nematodes were identified in cattle at 12.94% and 3.52%, and in goats at 25.16% and 3.22%, correspondingly. Goats had a higher frequency of parasitic occurrence (43.75%) than cattle (26.25%). Cross-bred cattle had a larger occurrence of helminths parasites (60.31%) than local-bred cattle (39.68%), but Black Bengal goats (45.71%) were less liable to intestinal parasite contamination than Jamunapari goats (54.28%). According to this study, to minimize parasitic infestation in cattle, proper management, better hygiene, and routine deworming should be ranked. As a result, the conclusions of this study will support researchers and veterinary professionals in working gastrointestinal parasite infestations in this region by Sebatjane PN *et al.*, in 2021 [24]. Their results were similar to the current work. The findings of this study align with previous research indicating a high prevalence of gastrointestinal helminths in small ruminants, particularly in rural and semi-arid regions. Similar results were observed in An-Lemo, Southern Ethiopia, where Sebro *et al.*, reported a significant burden of helminth infections among sheep and goats [25]. The persistence of such infections is often attributed to inadequate deworming practices, lack of awareness, and environmental factors conducive to parasite transmission. Classical literature by Soulsby and contemporary parasitology manuals such as Zajac and Conboy have long emphasized the pathogenic significance and complex life cycles of helminths in domesticated animals, underlining the need for regular surveillance and targeted control strategies. These sources collectively reinforce the urgent requirement for integrated parasite management and routine veterinary intervention to safeguard livestock health and productivity in endemic areas [26, 27].

CONCLUSIONS

According to the current study, sheep had an overall helminth parasite prevalence of 67.50%, whereas goats had a prevalence of 72.85%. *Haemonchus contortus, Trichuris vulpis, Nematodirus spathiger,* and *Trichostrongylus axei* were among the gastrointestinal helminths that were found. The most common species among these were *H. contortus* and *T. vulpis,* suggesting a high parasite burden in the area. On the other hand, the least common species found were *T. axei* and *N. spathiger.* In order to reduce helminthic infections in small ruminants, these findings emphasise the necessity of routine deworming, better pasture management, and more knowledge among livestock owners.

Authors Contribution

Conceptualization: NU
Methodology: SI, HUR, TUR, AR
Formal analysis: SI, HUR, TUR, AR
Writing, review and editing: S, SI, HUR, TUR, AR, NU

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All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest

All the authors declare no conflict of interest.

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REFERENCES

[1] Alhshem HH and Ghader M. A study of agriculture value added percentage of gross domestic product for selected Asian countries. Journal of Asian Multicultural Research for Social Sciences Study. 2022 Oct; 3(4): 33-42. doi: 10.47616/jamrsss.v3i4.327.

[2] Maizels RM. Regulation of immunity and allergy by helminth parasites. Allergy. 2020 Mar; 75(3): 524-34. doi: 10.1111/all.13944.

[3] Parveen F, Ullah N, Shabbir I, Shah R. Infestation of gastrointestinal nematode parasites in sheep, Ovis aries Linnaeus in Peshawar, Pakistan. Proceeding of Parasitology. 2012; 53: 25-36.

[4] Ashraf A, Tramboo SR, Maqbool I, Allaie IM, Bulbul KH, Shahardar RA *et al.* Occurrence of GI parasites in ruminants of Kashmir and Ladakh. Journal of Parasitic Diseases. 2022 Mar; 46(1): 196-201. doi: 10.1007/s12639-021-01437-3.

[5] Arsenopoulos KV, Fthenakis GC, Katsarou EI, Papadopoulos E. Haemonchosis: A challenging parasitic infection of sheep and goats. Animals. 2021 Feb; 11(2): 363. doi: 10.3390/ani11020363.

[6] Bhowmik M, Hossen MA, Mamun MA, Hasıb F, Poddar S, Hossain MA *et al.* Prevalence of gastrointestinal parasitic infections in sheep and goats of Sandwip Island, Chattogram, Bangladesh. Van Veterinary Journal. 2020 Nov; 31(3): 152-7. doi: 10.36483/vanvetj.821083.

[7] Rzepecka J and Harnett W. Can the study of parasitic helminths be fruitful for human diseases?. InHelminth Infections and Their Impact on Global Public Health. 2022 Aug; 607-640. doi: 10.1007/978-3-031-00303-5_17.

[8] Brewer MT and Greve JH. Internal Parasites: Helminths. Diseases of Swine. 2019 Jun: 1028-40. doi: 10.1002/9781119350927.ch67.

[9] Fayisa O, Duguma A, Temesgen M, Lemma F. Gastrointestinal parasites of sheep and goat in and around Gondar town, Northwest, Ethiopia. Biotechnology in Animal Husbandry. 2020; 36(3): 371-80. doi: 10.2298/BAH2003371F.

[10] Sarker C, Akter M, Kayser A, Asgar MA, Mollah ML. Prevalence of gastrointestinal parasitic infestation in cattle and goat at Boalia upazilla in Rajshahi district of Bangladesh. Asian Journal of Medical and Biological Research. 2021 Dec; 7(4): 367-74. doi: 10.3329/ajmbr.v7i4.57617.

[11] Khattak I, Akhtar A, Shams S, Usman T, Haider J, Nasreen N *et al.* Diversity, prevalence and risk factors associated to gastrointestinal tract parasites in wild and domestic animals from Pakistan. Parasitology International. 2023 Dec; 97: 102777. doi: 10.1016/j.parint.2023.102777.

[12] Torres-Acosta JF, Hoste H, Sandoval-Castro CA, Torres-Fajardo RA, Ventura-Cordero J, González-Pech PG *et al.* The art of war against gastrointestinal nematodes in sheep and goat herds of the tropics. Revista Acadamica Ciencia Animal. 2019 Nov; 17(suppl 1): 39-46.

[13] Naseer Ullah NU, Khan MS, Muzafar Shah MS. Infestation of helminthes parasite in sheep, Ovis aries (L.) in district Peshawar, Pakistan. International Journal of Biosciences. 2013 Feb; 3(2): 28-34.

[14] Donohue RE, Cross ZK, Michael E. The extent, nature, and pathogenic consequences of helminth polyparasitism in humans: a meta-analysis. PLOS Neglected Tropical Diseases. 2019 Jun; 13(6): e0007455. doi: 10.1371/journal.pntd.0007455.

[15] Fentahun T. Systematic review on gastrointestinal helminths of domestic ruminants in Ethiopia. Online Journal of Animal and Feed Research. 2020 Sep; 10(5): 216-30. doi: 10.51227/ojafr.2020.31.

[16] Katsarou EI, Arsenopoulos KV, Michael CK, Lianou DT, Petinaki E, Papadopoulos E *et al.* Gastrointestinal Helminth Infections in Dogs in Sheep and Goat Farms in Greece: Prevalence, Involvement of Wild Canid Predators and Use of Anthelmintics. Animals. 2024 Nov; 14(22): 3233. doi: 10.3390/ani14223233.

[17] Khan A, Jamil M, Ullah S, Ramzan F, Khan H, Ullah N *et al.* The prevalence of gastrointestinal nematodes in livestock and their health hazards: A review. World's Veterinary Journal. 2023 Mar; 13(1): 57-64. doi: 10.54203/scil.2023.wvj6.

[18] Khan R, Salam A, Saira S, Khayyam K, Iqbal A, Khattak RM *et al.* Prevalence and Diversity of Ovine Gastrointestinal Parasites in the District Lower Dir: Prevalence and Diversity of Ovine Gastrointestinal Parasites. MARKHOR (The Journal of Zoology). 2025 Mar: 26-31. doi: 10.54393/mjz.v6i1.148.

[19] Krishnamoorthy P, Lakshmi HK, Jacob SS, Suresh KP, Shome BR. Scientometric analysis of gastrointestinal parasites prevalence in sheep and goats of India. Acta Parasitologica. 2023 Sep; 68(3): 496-519. doi: 10.1007/s11686-023-00687-w.

[20] Maurizio A, Perrucci S, Tamponi C, Scala A, Cassini R, Rinaldi L *et al.* Control of gastrointestinal helminths in

DOI: https://doi.org/10.54393/mjz.v5i04.165

small ruminants to prevent anthelmintic resistance: the Italian experience. Parasitology. 2023 Oct; 150(12): 1105-18. doi: 10.1017/S0031182023000343.

[21] Mohamed HI, Arafa WM, El-Dakhly KM. Prevalence and associated risk factors of gastrointestinal helminths and coccidian infections in domestic goats, Capra hircus, in Minya, Egypt. Beni-Suef University Journal of Basic and Applied Sciences. 2023 Mar; 12(1): 29. doi: 10.1186/s43088-023-00369-6.

[22] Khan W, Al-Jabr OA, Khan T, Khan A, El-Ghareeb WR, Aguilar-Marcelino L *et al.* Prevalência de parasita gastrointestinal em pequenos ruminantes do distrito Upper Dir, da província de Khyber Pakhtunkhwa, no Paquistão. Brazilian Journal of Biology. 2021 Oct; 83: e248978. doi: 10.1590/1519-6984.248978.

[23] Rafi U, Yasmeen R, Qureshi AW, Bukhari R, Bukhari SS. Prevalence of Parasitic Species in Ruminants Found in the Vicinity of Lahore, Pakistan. Scientific Inquiry and Review. 2021 Dec; 5(4). doi: 10.32350/sir.54.04.

[24] Sebatjane PN, Njuho PM, Tsotetsi-Khambule AM. Statistical models for helminth faecal egg counts in sheep and goats. Small Ruminant Research. 2019 Jan; 170: 26-30. doi: 10.1016/j.smallrumres.2018.11.006.

[25] Sebro E, Kebamo M, Abebe A. Prevalence of gastrointestinal parasites of sheep and goats in An-Lemo, Hadiya Zone Southern Ethiopia. Indian Journal of Science and Technology. 2022 Jun; 15(22): 1084-90. doi: 10.17485/IJST/v15i22.1384.

[26] Soulsby EJ. Helminths, arthropods and protozoa of domesticated animals. 1982.

[27] Zajac AM and Conboy GA. Veterinary clinical parasitology. Blackwell publishing; 2006.