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Prevalence of Gastrointestinal Parasites in Yaks (*Bos Grunniens*) in Boroghil and Shandur National Parks, Chitral, Northern Pakistan

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ABSTRACT

This research study focused on determining the prevalence and diversity of gastrointestinal parasites in yaks in the main high-altitude pastures declared as national parks, i.e., Boroghil and Shandur, in the province of Khyber Pakhtunkhwa. Data on gastrointestinal parasite infections in yaks (*Bos grunniens*) have not been reported in the mentioned locations in northern Pakistan. Fecal fresh samples total n=200 from each side n=100 were collected in the both seasons summer and winter. A flotation-sedimentation technique was applied to isolate the parasites, and formalin-ether sedimentation was used to detect trematode eggs, while the Sheather's sugar solution technique was used to diagnose protozoan oocysts and nematode eggs. McMaster slide chamber was used for Quantitative estimation of parasites eggs counting, Parasites were identified based on their morphological shape, structure and specific characteristics of oocysts larvae and eggs. The prevalence status overall of gastrointestinal parasites was 40.0% (40/100) in Shandur and 36.0% (36/100) in Boroghil, with no major difference between sites ($p > 0.05$). The parasites species at both locations, *Trichostrongylus* spp. was the mainly common nematode were detected in 32.5% (32/100) of yaks in Shandur and 27.8% (27/100) in Boroghil. Additional known parasites included *Moniezia* spp (cestodes) and *Eimeria* spp (protozoa), although at lower prevalence rates (<10%). The infection rate of Age and sex groups wise ($p > 0.05$) no differences were observed. Though, a strong positive involvement was identified between infection status and poor body condition (emaciation) in both valleys ($p < 0.001$), signifying a clinically related impact on host health. This study first time provide the baseline data on the prevalence of the gastrointestinal parasitic infection in the domesticated yaks from the both regions as declared national parks i-e Boroghil and Shandur ecologically diverse high-altitude grazing systems. These finding have broader impact for the livestock keeping and wildlife conservation plan in the Hindu Kush, Karakoram–Himalayan region. Particularly the need for targeted mass deworming enhanced management practices, rotational grazing and nutritional support. The Yak production losses factors identified and to improve the health status of yak in climate-sensitive pastoral systems.

INTRODUCTION

Gastrointestinal parasites, particularly nematodes, are a major constraint to the health and productivity of ruminants. In yaks (*Bosgrunniens*), these infections can lead to parasitic gastroenteritis (PG), characterized by weight loss, diarrhea, anemia, and suboptimal growth, ultimately resulting in significant economic losses for farmers. Newton, S. (1995). The presence of multiple parasite species often exacerbates clinical disease. Wimmer. *et al.*, (2004). The yak is a long-haired bovid native to the high-altitude regions of Central and South Asia, including the Himalayan range, the Tibetan Plateau, Mongolia, Russia, and parts of northern Pakistan, such as the Boroghil Valley (Wakhan corridor) and Shandur high pastures in Khyber Pakhtunkhwa and Gilgit-Baltistan. Local communities in these regions rely heavily on yaks for milk, meat, and as a source of livelihood. Despite their importance, gastrointestinal parasitic infections remain a major threat, leading to reduced milk yield, weight loss, and increased mortality. Several studies have documented

the prevalence of gastrointestinal helminths in yaks in countries such as Russia, India. Bam, J., *et al.* (2012), Ranga Rao, *et.al.*, (1994). Bandyopad hyay, H. (2010) and various provinces of China. Du, X. J.,(2014). Hu, G. *et al.* (2013) Bam, J. *et al.* (2012). These studies report a diverse array of parasites including *Haemonchus contortus*, *Trichostrongylus* spp, *Strongyloides* spp, *Moniezia* spp, *Trichuris* spp, *Fasciola* spp, and *Eimeria* spp. Dong, H., Li, *et al.* (2012), Ansari.,(1989). However, despite the presence of favorable ecological conditions and the co-grazing of yaks with other livestock, there is a conspicuous lack of data on gastrointestinal parasitic infections in yaks from the Chitral district of Khyber Pakhtunkhwa, Pakistan. The cooler, humid climates of northern Chitral, and also support ectoparasite populations. Ranga Rao, *et al.*, (1994). But no baseline information exists for endoparasites. To the best of our knowledge, this study represents the first systematic investigation into the prevalence and diversity of gastrointestinal parasites in yaks within the protected areas of Boroghil and Shandur in the Chitral.

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MATERIALS AND METHODS

Study Areas

The study was conducted in two national parks, Shandur and Boroghil, located in the northern region of Khyber Pakhtunkhwa, Pakistan. Both areas are managed by the provincial Wildlife Department and are characterized by high-altitude pastures where yaks are traditionally grazed.

Sample Collection

A total of 200 fresh fecal samples were collected from domesticated yaks across both study sites. Samples were collected during both summer and winter seasons (100 samples per season) to account for seasonal variation. To minimize stress to the animals, a non-invasive approach was adopted. Fresh fecal samples were collected in the evening or early night when yaks congregated for rest. Each sample was placed in a clean, labeled polythene bag to prevent contamination. Geographic coordinates of collection sites were recorded using a GPS device.

Laboratory Analysis

In the laboratory, samples were processed for both qualitative and quantitative examination. Fecal samples were thoroughly mixed, and wet mounts were prepared for direct microscopic examination. To identify helminth eggs and protozoan oocysts, flotation and sedimentation techniques were employed in accordance with standard protocols. Hu, G., *et al.* (2013) Quantitative analysis was performed using the McMaster egg counting technique to determine eggs per gram (EPG) and oocysts per gram (OPG) of feces. Jiang, X. L. (1987). Parasite identification was based on the morphological characteristics (shape,

size, and internal structures) of eggs, oocysts, and cultured larvae, as described by Soulsby, Hu, G. *et al.* (2013) and other standard references.

Data Analysis

Data were entered into a spreadsheet and analyzed using statistical software. Prevalence was calculated as the percentage of animals testing positive for at least one parasite species. Mean EPG/OPG values, standard errors, and 95% confidence intervals were calculated. The chi-square (χ^2) test was used to compare prevalence between sexes, age groups, seasons, and study sites. A p -value < 0.05 was considered statistically significant.

RESULTS AND DISCUSSION

Overall Parasite Prevalence

A total of 200 fecal samples were collected, with 100 from each valley. The overall prevalence of gastrointestinal parasites was 40.0% (40/100) in Shandur/Laspur Valley and 36.0% (36/100) in Boroghil Valley.

Parasite Species Distribution

In Shandur/Laspur Valley, *Trichostrongylus* spp. was the most prevalent (32.5%), followed by *Strongyloides* spp. (27.5%), *Ostertagia* spp. (25.0%), and *Marshallagia* spp. (15.0%). In Boroghil Valley, *Strongyloides* spp. was most common (30.5%), followed by *Trichostrongylus* spp. (27.8%), *Ostertagia* spp. (25.0%), and *Marshallagia* spp. (16.7%). No statistically significant difference was observed in the distribution of parasite species between the two valleys ($p > 0.05$) (Table 1).

Table 1: Distribution of Parasite Species in Shandur/Laspur and Broghil Valleys

Parasite Species	Shandur/Laspur Valley (n=40)	%	Boroghil Valley (n=36)	%
Ostertagia	10	25.0	9	25.0
Trichostrongylus	13	32.5	10	27.8
Marshallagia	6	15.0	6	16.7
Strongyloides	11	27.5	11	30.5
Total Positive	40	100.0	36	100.0

Sex-Wise and Age-Wise Prevalence Shandur/Laspur Valley:

The prevalence was 43.1% in females and 36.7% in males. Age-wise prevalence ranged from 23.8% (9 years) to 57.1% (4 years). No significant association was found between infection status and sex or age $p > 0.05$ for all tests as mentioned in the Table no 2.

Boroghil Valley

Prevalence was 37.3% in females and 34.1% in males. The highest prevalence (54.8%) was observed in 6-year-old animals, while the lowest (20.7%) was in 5-year-old

animals. No statistically significant differences were found for sex or age ($p > 0.05$) in the Table 3).

Association with Body Condition

A highly significant association was found between parasite infection and emaciation in both valleys. In Shandur, 100% (15/15) of emaciated animals tested positive for parasites compared to 29.4% (25/85) of healthy animals ($\chi^2 = 26.471$, $p < 0.001$). Similarly, in Boroghil, 100% (11/11) of emaciated animals were positive compared to 28.1% (25/89) of healthy animals ($\chi^2 = 21.973$, $p < 0.001$) (Tables 4 and 5).

Table 2: Sex-wise and Age-wise Prevalence in Shandur/Laspur Valley

Variable	Category	Negative (n)	Positive (n)	Total (n)	% Negative	% Positive
Sex	Female	29	22	51	56.9	43.1
	Male	31	18	49	63.3	36.7
	Total	60	40	100	60.0	40.0
Age	4 Years	3	4	7	42.9	57.1
	5 Years	15	11	26	57.7	42.3
	6 Years	9	7	16	56.3	43.8
	7 Years	6	6	12	50.0	50.0
	8 Years	11	7	18	61.1	38.9
	9 Years	16	5	21	76.2	23.8
	Total	60	40	100	60.0	40.0

*Statistical results: Sex-wise ($\chi^2 = 0.427$, $df = 1$, $p = 0.514$); Age-wise ($\chi^2 = 3.811$, $df = 5$, $p = 0.577$).

Table 3: Sex-wise and Age-wise Prevalence in Boroghil Valley

Variable	Category	Negative (n)	Positive (n)	Total (n)	% Negative	% Positive
Sex	Female	37	22	59	62.7	37.3
	Male	27	14	41	65.9	34.1
	Total	64	36	100	64.0	36.0
Age	3 Years	1	1	2	50.0	50.0
	5 Years	23	6	29	79.3	20.7
	6 Years	14	17	31	45.2	54.8
	7 Years	4	1	5	80.0	20.0
	8 Years	12	8	20	60.0	40.0
	9 Years	10	3	13	76.9	23.1
	Total	64	36	100	64.0	36.0

*Statistical results: Sex-wise ($\chi^2 = 0.104$, $df = 1$, $p = 0.748$); Age-wise ($\chi^2 = 9.532$, $df = 5$, $p = 0.090$).

Table 4: Association between Health Status and Parasite Infection in Shandur Valley

Health Status	Negative (n)	Positive (n)	Total (n)
Healthy	60	25	85
Emaciated	0	15	15
Total	60	40	100

* $\chi^2 = 26.471$, $df = 1$, $p < 0.001$.

Table 5: Association between Health Status and Parasite Infection in Boroghil Valley

Health Status	Negative (n)	Positive (n)	Total (n)
Healthy	64	25	89
Emaciated	0	11	11
Total	64	36	100

* $\chi^2 = 21.973$, $df = 1$, $p < 0.001$.

Discussion

This study provides the first baseline data on the prevalence and diversity of gastrointestinal parasites in yaks from the Boroghil and Shandur National Parks in northern Pakistan. The overall prevalence rates of 40.0% and 36.0% in the two valleys are comparable to findings from other yak-rearing regions. For instance, studies in the Qinghai-Tibetan Plateau reported prevalence rates ranging from 31.8% to 68.5% for gastrointestinal nematodes. Hu, G. W. *et al.* (2013). Bam, J. Deori, *et al.*, (2012). Similarly, research in India has documented prevalence rates between 35% and 55% in yaks. The relatively high prevalence observed in this study underscores the significant parasitic challenge faced by yak populations in these high-altitude pastoral systems. The identification of *Trichostrongylus* spp, *Strongyloides* spp, *Ostertagia* spp, and *Marshallagia* spp. as the predominant parasites aligns with previous reports from China and Russia. Dong, H., *et al.* (2012). Du, X. J., (2014). These nematodes are known to thrive in cool, temperate climates, which characterize the study areas. The dominance of *Trichostrongylus* and *Strongyloides* is particularly noteworthy, as these genera are associated with significant morbidity in young and stressed animals, leading to reduced growth rates and milk production. Newton, S. E. (1995). The absence of a significant difference in prevalence between sexes and across age groups was unexpected, as younger animals are often more susceptible to parasitic infections due to their developing immunity. Demias zkiewicz, A. W. (2014) However, this finding may be explained by the traditional management system, where all animals share common grazing grounds and are exposed to similar levels of infective larvae. Furthermore, the lack of any strategic deworming program in these herds' likely results in a continuous build-up of pasture contamination, affecting all age groups equally. Liu, W. D., Peng, (1989). The most striking finding of this study was the strong association between parasitic infection and poor body condition. All emaciated animals in both valleys were found to be infected with gastrointestinal parasites, and the statistical association was highly significant. This finding corroborates the well-established link between chronic parasitism and malnutrition in ruminants. Mi, R., Wang, *et al.* (2013). Heavy parasite burdens, particularly with *Trichostrongylus* and *Ostertagia*, lead to protein-losing enteropathy, reduced feed intake, and impaired nutrient absorption, ultimately manifesting as emaciation. Wu, J. *et al.*, (1964) This highlights the urgent need for intervention to prevent production losses and mortality in these valuable livestock while this study provides important baseline data, it has limitations. The use of fecal examination alone does not differentiate between pre-patent infections or allow for the quantification of adult worm burdens. Additionally, larval culture was not performed for all positive samples, which may have limited the detection of mixed infections and the precise identification of some *Trichostrongylid* species. Future studies should incorporate molecular diagnostic tools

(e.g., PCR) for more accurate species identification and to investigate anthelmintic resistance in this populations. This study confirms that gastrointestinal parasites, particularly *Tricho-strongylus* and *Strongyloides*, are highly prevalent in yaks in the Boroghil and Shandur National Parks and are significantly associated with emaciation. These findings underscore the need for the implementation of sustainable parasite control programs, including strategic deworming and improved grazing management, to enhance the health and productivity of yaks in this region.

CONCLUSION

This study provides the baseline data on gastrointestinal parasites load in yaks in both regions of Boroghil and Shandur National Parks and revealing of overall prevalence rates 40.0% and 36.0%, respectively. The major parasites were identified *Tricho strongylus* spp, *Strongyloides* spp. *Ostertagia* spp., and *Marshallagia* spp., which are known to thrive in the cool, temperate climate of the region. A strong and statistically significant association was observed between parasitic infection and poor body condition, with all emaciated animals found to be infected. The absence of significant differences in prevalence across sex and age groups suggests uniform exposure due to shared grazing practices and the lack of strategic deworming programs. These findings highlight the urgent need for sustainable parasite control interventions to reduce production losses and mortality in emaciated yak in these high-altitude pastoral systems. It is recommended that strategic deworming programs be implemented, targeting high-risk seasons and vulnerable age groups. Improved grazing management, including pasture rotation and reduced stocking densities, should be adopted to minimize environmental contamination. Future research should employ molecular diagnostic tools, such as PCR, for accurate species identification and to monitor anthelmintic resistance. Additionally, longitudinal studies are needed to assess the seasonal dynamics of parasitic infections and evaluate the effectiveness of control measures. Ultimately, integrating these strategies will enhance yak health, productivity, and the livelihoods of pastoral communities in northern regions of shandure and boroghil Pakistan.

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