Seasonal Prevalence of Gastro-Intestinal Helminths of Sheep (*Ovis Aries*) and Goat (*Capra Hircus*) with Respect to Age and Gender of Gurez Valley, Kashmir

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**Abstract**

The present study was carried out with an objective to assess the seasonal dynamics of intestinal helminth parasites in association with age and gender of sheep (*Ovis aries*) and goat (*Capra hircus*) in Gurez valley. Out of the total of 123 sheep and 96 goats examined through gut examination during May 2013 - May 2015, 25.20%, 17.07%, 27.64% in sheep and 22.91%, 15.62%, 26.04% in goats was the prevalence of trematodes, cestodes and nematodes respectively. Comparatively goats harbored low infection level as compared to sheep. There was no significant difference (P>0.05) in gastrointestinal parasite infection in *Ovis aries* and *Capra hircus* examined. Data showed that infection was moderately positive all year round but highest infection was found in the autumn season. A significant relationship was found between seasons and prevalence of infection (P<0.05). Generally lower age groups and nomad breed reported high infection. In conclusion, the present study states that seasons affected the prevalence of intestinal cestodes significantly while as gender and age of host were not significant factors in the onset of infection under temperate climatic conditions of Gurez valley. These findings may contribute to the existing epidemiological knowledge of the intestinal cestodes of Sheep and will also improve the control strategies of intestinal helminthiasis.

**Keywords:** Age, gender, sheep, goat, intestinal cestodes, prevalence, season.

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Introduction

The temperate agro-climatic conditions, traditional animal husbandry practices and poor veterinary infrastructure, abundance of alpine and sub alpine pastures are natural determining factors of incidence and severity of various parasitic diseases of livestock in Kashmir valley (Tariq, 2007). Gastrointestinal parasitism is the major cause of damage and decreased productivity in the goat industry particularly in developing countries. Soulsby (1982) mentioned that tape worms are relatively less pathogenic, but in heavy infections may cause reduced weight gain, diarrhoea and intestinal obstruction. Numerous epidemiological studies have been conducted throughout the world to arrive at the detailed information on the gastrointestinal parasites of livestock but scanty references are available on epidemiology and prevalence of intestinal helminths of sheep and goats. According to Odoi et al., (2007), the major risk factors of helmintiasis are broadly classified as parasite factors (including epidemiology of the different species), host factors (genetic resistance, age and physiological status of the animal) and environmental factors (climate, nutrition, stocking density and management). No epidemiological information was available on intestinal helminth of sheep and goat in Gurez valley. The present study was carried out with an objective to assess the seasonal epidemiological prevalence of intestinal helminths in association with age and sex of sheep and goat in Gurez valley, India.

Materials and Methods

During this study a total of 123 sheeps and 96 goats were examined over two consecutive years from May 2013 to May 2015. All intestinal tracts belonged to sheeps of Bhakarwal (nomad) and Gurez (local) breed. The animals were of both genders and age ranged from less than one year to more than four years. The samples were collected on monthly basis and later expressed seasonally in order to analyze the seasonal prevalence. The collected samples were carefully labelled with animal identification, sex, dental age and month of collection.

Gastrointestinal Tract of Animals

The gastrointestinal tracts of freshly slaughtered animals in various abattoirs of the valley were collected, tied off at both ends and brought to the laboratory and immediately processed to analyze the parasite species present. The abomasum and the small and large intestines were thoroughly opened and examined separately for the presence of tapeworms using standard procedures and worms were identified using the descriptions of Soulsby (1982). The faecal samples were obtained directly from the rectum of the animals in suitable air tight containers properly labelled and brought to the laboratory in 4% formalin and kept at 4°C until processing. The laboratory procedure was as per the methods of Soulsby (1982).

Statistical Analysis

Percentages to measure prevalence and chi-square test to measure association between the prevalence of infection and the age, gender and breed were the statistical methods applied. The association between seasons and prevalence of infection was analyzed by Pearson’s coefficient of correlation ‘r’. Means and standard error of means with their respective 95% confidence intervals were also calculated for each parameter tested in this study. The level of significance was statistically accepted at the 5% level (P≤0.05). The data was analyzed using Statistical packages MINITAB software version 13.2 for Windows.

Results and Discussion

Understanding the biology and epidemiology of gastro-intestinal parasites of sheep and goat, it is essential to improve the control measures and decrease in production losses (Pal and Qayyum, 1992). The epidemiology of gastrointestinal helminth parasites is governed by host-parasite relationship and reaction with environmental conditions. Tembely et al., (1997) and Vlassoff et al., (2001) demonstrated that the effect of helminth infection on production of particular livestock species depend mostly up on the age of the animals, the breed, the parasite species involved and the intensity of the worm populations within the host. The prevalence and distribution of
parasitic nematodes are largely governed by a combination of their ecological requirements for development and survival outside the host and farm management practice. The epidemiology of GIT parasites of sheep and goat in Gurez has been studied taking into consideration the overall prevalence (overall, seasonal, age-wise, sex wise) and the associated risk factors with GIT parasites.

**Overall Prevalence**
Out of the total of 123 sheep and 96 goats examined through gut examination during the study period, 25.20%, 17.07%, 27.64% in sheep and 22.91%, 15.62%, 26.04% in goats was the prevalence of trematodes, cestodes and nematodes respectively (Table 1, 2, 3 & Fig. 1, 2, 3). Comparatively goats harbored low infection level as compared to sheep. There was no significant difference (P>0.05) in gastrointestinal parasite infection in *Ovis aries* and *Capra hircus* examined.

![Graph showing the overall prevalence of sheep and Goat.](image)

**Fig. 1:** Graph showing the overall prevalence of sheep and Goat.

<table>
<thead>
<tr>
<th>Host</th>
<th>Examined</th>
<th>Uninfected</th>
<th>Infected</th>
<th>%age</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Ovis aries</em></td>
<td>123</td>
<td>89</td>
<td>34</td>
<td>27.64</td>
<td>P-Value =</td>
</tr>
<tr>
<td><em>Capra hircus</em></td>
<td>96</td>
<td>71</td>
<td>25</td>
<td>26.04</td>
<td>0.071</td>
</tr>
<tr>
<td>Total</td>
<td>219</td>
<td>160</td>
<td>59</td>
<td>26.94</td>
<td></td>
</tr>
</tbody>
</table>

*Table 1:* Distribution of Helminths in *Ovis aries* and *Capra hircus*.

![Graph showing the prevalence of recovered Helminth parasites.](image)

**Fig. 2:** Prevalence of recovered Helminth parasites.

<table>
<thead>
<tr>
<th>Host</th>
<th>Examined</th>
<th>Uninfected</th>
<th>Infected</th>
<th>Parabites collected</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Trematodes</td>
</tr>
<tr>
<td><em>Ovis aries</em></td>
<td>123</td>
<td>89</td>
<td>34</td>
<td>31 (25.20)</td>
</tr>
<tr>
<td><em>Capra hircus</em></td>
<td>96</td>
<td>71</td>
<td>25</td>
<td>22 (22.91)</td>
</tr>
<tr>
<td>Total</td>
<td>219</td>
<td>160</td>
<td>59</td>
<td>53 (24.20)</td>
</tr>
</tbody>
</table>

(Figures in parentheses indicate percentage)
In case of small ruminants, 89 out of 123 (27.64%) sheep and 71 out of 96 (26.04%) goat were infected with helminth parasites. A mean intensity & relative abundance of 81.64, 59.07 & 52.78, 39.04 in sheep and goat respectively was observed. The observed parasites were *Haemonchus contortus, Ostertagia, Chabertia ovina, Fasciola hepatica, Dicrocoelium dendriticum* & *Moneizia expansa* in both sheep & goat, and showed mean intensity & relative abundance of 88.23, 24.39; 32.93, 8.30; 26.79, 5.22; 5.00, 1.05; 82.86, 19.53 & 4.31, 0.56 in sheep and 74.4, 19.37; 23.81, 5.45; 16.82, 2.97; 3.90, 0.85; 43.72, 10.02 & 3.4, 0.35 in goat respectively.

### Table 3: Mean intensity and Relative abundance of Helminths in *Ovis aries* and *Capra hircus.*

<table>
<thead>
<tr>
<th>Host</th>
<th>No. Examined</th>
<th>No. Infected</th>
<th>% age</th>
<th>No. of parasites</th>
<th>Mean Intensity</th>
<th>Relative Abundance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sheep</td>
<td>123</td>
<td>89</td>
<td>27.64</td>
<td>7266</td>
<td>81.64</td>
<td>59.07</td>
</tr>
<tr>
<td>Goats</td>
<td>96</td>
<td>71</td>
<td>26.04</td>
<td>3748</td>
<td>52.78</td>
<td>39.04</td>
</tr>
</tbody>
</table>

**Fig. 3:** Graph showing the mean intensity and relative abundance of Helminths in sheep and goat.

### Table 4: Mean intensity and Relative abundance of different Helminths in *Ovis aries.*

<table>
<thead>
<tr>
<th>Parasite</th>
<th>No. Examined</th>
<th>No. Infected</th>
<th>% age</th>
<th>No. of parasites</th>
<th>Mean Intensity</th>
<th>Relative Abundance</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Haemonchus contortus</em></td>
<td>34</td>
<td>31</td>
<td>27.64</td>
<td>1021</td>
<td>32.93</td>
<td>8.30</td>
</tr>
<tr>
<td><em>Ostertagia</em></td>
<td>24</td>
<td>26</td>
<td>19.51</td>
<td>643</td>
<td>26.79</td>
<td>5.22</td>
</tr>
<tr>
<td><em>Chabertia ovina</em></td>
<td>26</td>
<td>21.13</td>
<td>23.57</td>
<td>130</td>
<td>5.00</td>
<td>1.05</td>
</tr>
<tr>
<td><em>Fasciola hepatica</em></td>
<td>29</td>
<td>24</td>
<td>10.00</td>
<td>2403</td>
<td>82.86</td>
<td>19.53</td>
</tr>
<tr>
<td><em>Dicrocoelium dendriticum</em></td>
<td>123</td>
<td>16</td>
<td>13.00</td>
<td>69</td>
<td>4.31</td>
<td>0.56</td>
</tr>
<tr>
<td><em>Moneizia expansa</em></td>
<td>18</td>
<td>15</td>
<td>17.64</td>
<td>666</td>
<td>32.93</td>
<td>8.30</td>
</tr>
</tbody>
</table>
Based on post mortem examination of sheep and goats obtained from different areas of Gurez the present endeavour revealed the presence of variety of gastrointestinal helminth parasitic fauna in them (Table 6). The parasites encountered during the present investigation in sheep were: Haemonchus contortus (27.64%), Ostertagia ostertagia (25.20%), Chabertia ovina (19.51%), Fasciola hepatica (21.13%), Dicrocoelium dendriticum (23.57%), Monezia expansa (13.008%). In goats the prevalence was Haemonchus contortus (26.04%), Ostertagia Ostertagia (22.91%),
SEASONAL PREVALENCE OF GASTRO-INTESTINAL HELMINTHS OF ...  

Chabertia ovina (17.70%), Fasciola hepatica; Monezia expansa (10.41%); (21.87%), Dicrocoelium dendriticum (22.91%),

<table>
<thead>
<tr>
<th>Parasite</th>
<th>Ovis aries (123 examined)</th>
<th>Capra hircus (96 examined)</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number infected</td>
<td>%age</td>
<td>Number infected</td>
</tr>
<tr>
<td>Haemonchus contortus</td>
<td>34</td>
<td>27.64%</td>
<td>25</td>
</tr>
<tr>
<td>Ostertagia ostertagia</td>
<td>31</td>
<td>25.20%</td>
<td>22</td>
</tr>
<tr>
<td>Chabertia ovina</td>
<td>24</td>
<td>19.51%</td>
<td>17</td>
</tr>
<tr>
<td>Fasciola hepatica</td>
<td>26</td>
<td>21.13%</td>
<td>21</td>
</tr>
<tr>
<td>Dicrocoelium dendriticum</td>
<td>29</td>
<td>23.57%</td>
<td>22</td>
</tr>
<tr>
<td>Moneizia expansa</td>
<td>16</td>
<td>13.00%</td>
<td>10</td>
</tr>
</tbody>
</table>

The epidemiological study of GIH infection revealed that sheep and goats harbour a spectrum of GIH fauna in Gurez valley. Sheep and Goats exhibited similar type of helminth fauna; this can be attributed to the co-rearing and mixed grazing in pastures and in other grazing areas. The proportions of the genera of gastrointestinal parasites identified in the present study in which Haemonchus was the most prevalent (27.64% sheep & 26.04% goats) and Monezia (13.00% sheep & 10.41% goats) the least, is in conformity with the findings of other studies carried out in many other climatic areas of India and other parts of world.

**Trematodes**

The prevalence rate of trematodes in the present study was 25.20% in sheep and 22.91% in goats, among trematodes Dicrocoelium spp. (23.57% in sheep and 22.91% in goats) was found most prevalent followed by Fasciola spp. (21.13% in sheep and 21.87% in goats) as shown in Table 4.35. The prevalence of Dicrocoelium spp. (Sheep: 23.57%; Goats: 22.91%) which is in conformity with the observations of other authors who also reported quite similar prevalences of Dicrocoelium spp. Garg et al., (2009) reported the overall abattoir prevalence of fasciolosis was 16.54%. The prevalence of infection was almost similar in sheep (4.78%) and goats (4.68%).

**Cestodes**

The prevalence rate of cestodes in the present study was 17.07% in sheep and 15.62% in goats, among cestodes Monezia expansa (13.008% in sheep and 10.41% in goats) was the only cestode found in sheep and goat during the present study as shown in Table 4.35. Similar results also have been reported in other parts of the world although prevalence varies. Sultan et al., (2010) reported Monezia expansa was the most prevalent parasite (19.04%) among cestodes followed by Avitellina centripunctata (1.6%) in Sheep of Gharbia Governorate, Egypt. Bashtar et al., (2010) also reported Monezia expansa was the highest prevalent cestode parasite in sheep. Aydenizoz and Yildiz (2003) observed highest infection of Anoplocephalidae (M. expansa, Avitellina centripunctata, Thysaniezia ovilla) infections in sheep from Kirikkale (Turkey) in July (9.89%) and the lowest in September (1.32%) in sheep. Muraleedharan (2005) reported the prevalence of Monezia spp. in sheep and goats as 1.65% and 0.94% respectively. Munib et al., (2004) reported the overall prevalence rate of 28% of M. expansa, M. benedeni and A. centripunctata. Kiran et al., (2005) found M. expansa as the most prevalent helminth in sheep and goats in Dehradun. Abebe and Esayas (2001) reported 26.75% prevalence of Monezia spp.; 33.77% of Avitellina spp., 31.65% of Stilesia spp. in sheep and 24.20%, 35.13%, and 28.80% in goats. Thangathurai et al., (2003) recorded the prevalence of Stilesia as 5% and 2.8% in sheep and goats respectively. Zgardan (2002) from sheep in Moldova recovered M. expansa, M. benedeni, T. giardi and A. centripunctata. Naem et al., (2011) recorded most prevalent cestode in sheep of Fereidoonkenar city, Iran was Monezia expansa (10%). From the necropsy and coproscopy observations it is possible to deduct that there is a continuous but moderate cestode infestation in sheep and goats. The moderate
prevalence of cestode parasites in sheep and goat was perhaps due to adequate nonavailability of oribated mites (intermediate host of cestodes) (Soulsby, 1986) in the study area. This was found to be in close agreement with the climatic conditions of the Gurez Valley as has been observed by other authors from Kashmir valley and other similar areas as discussed above. It is pertinent to mention here that Gurez valley has short growth periods which hinders the life history of intermediate hosts directly and consequently the helminth infestations indirectly. The helminth infections (although low) in sheep and goat of Gurez in such non supportive environmental conditions can be attributed to the fact that during short summers these ruminants share the high altitude pastures with non-local ruminants from Kashmir and Poonch areas where the transmissions might be occurring.

**Nematodes**

In present study prevalence of nematodes was 27.64% in sheep and 26.04% in goats which is lower than 81.17% as reported by Pandit et al., (2003). He also reported that *Haemonchus* and *Bunostomum* the predominant among all genera. However, the present study recorded the highest prevalence of *Haemonchus* (27.64%) and *Ostertagia* (25.20%) in sheep and *Haemonchus* (26.04%) and *Ostertagia* (23.85%) in goats respectively. Lone et al., (2011) reported the highest prevalent nematode *Haemonchus* (60%) followed by *Trichuris* (51%) in goats of Barramulla District of Jammu and Kashmir. Dhar et al., (1982) also reported *H. contortus* most prevalent parasite among nematodes in sheep of Kashmir. Although, *Haemonchus contortus* is particularly adapted to warm climates of tropics, subtropics and temperate Kashmir valley, it was very much prevalent in sheep and goats in the cold and dry climate of Gurez Valley as well. The increase in temperature due to climatic alterations and global warming can be one of the possible factors behind its occurrence and also the transport of small ruminants from tropical and sub-tropical parts to the Gurez valley for meat and for other purposes is also responsible for its predominance in Gurez valley. Besides the mixed grazing of sheep and goats of Gurez with those of Kashmir valley, Poonch and other areas during summers while sharing the same pastures for grazing may be the other reason for its occurrence as well. As reported by Kapahi et al., (1993) the diversity and abundance of medicinal plants of Gurez, like *Artimesia martina* (Noorie) found abundantly on high altitude pastures (2425 meters asl) acts as anthelmintic agent for the grazing sheep and goat as well. Other researchers of Kashmir also recorded *Haemonchus* as most dominant parasite in small ruminants (Sheep and Goat) of Kashmir. Nasreen et al., (2005) recorded the prevalence of *Haemonchus contortus* as 20.73% in sheep of Kashmir. Tariq et al., (2008) observed the prevalence of *Haemonchus contortus* (59.6%); *Ostertagia circumcincta* (38.0%); *Bunostomum trigonocephalum* (37.7%); *Chabertia ovina* (37.7%); Trichostrongylus spp. (33.9%); Nematodirus spathiger (29.4%); Oesophagostomum columbianum (28.4%); *Trichuris ovis* (23.5%) and Marshallagia marshalli (22.1%) in sheep managed under traditional husbandry system in Kashmir valley. Outside India similar results have been observed by other researchers. Kumsa and Wossene (2006) recorded 91.2% and 82.9% prevalence rate of *Haemonchus* in sheep and goats. Likewise, an overall prevalence of 37.7% and 40.2% *Trichostrongylus axei* was recorded in sheep and goats, respectively in Ogada. Okaiyeto et al., (2008) recorded prevalence of *Haemonchus* (49.9%); *Cooperia curtecie* (39.6%); Oesophagostomum spp. (14.9%) and *Trichostrongylus* spp. (1.9%) in Nomadic Sheep of Northern Nigeria. Mondal et al., (2000) in Bangladesh revealed the presence of *H. contortus*, *T. axei*, *Mecistocirrus digitatus*, *Oesophagostomum* spp., *Trichuris* spp. and *Bunostomum*. Jacquet et al., (1995) reported *H. contortus*, *O. columbianum*, *Trichostrongylus* spp and *S. globipunctata* as the most prevalent species in sheep and goats. Morales et al., (2001) reported *H. contortus*, *T. axei*, *T. colubriformis*, *Cooperia fuelleborni*, *C. pectina*, *C. curticei*, *C. punctata*, *T. ovis*, *O. columbianum*, *Skrjabinema ovis*, and *B. trigonocephalum* in ewes from Venezuela. Alani and Yahya (1991) in Iraq reported *Trichostrongylus* spp., *Nematodirus* spp., *B. trigonocephalum*, Strongyloides papillosus, *Cooperia* spp., *M. marshalli*, *Cameleosrongylus* spp., *T. ovis*, *T. skrjabini*, *T. discolor*, *T. globulosa*, *Chabertia ovina*, *O. venulosum* and *O. columbianum*
in sheep. Suarez and Busetti (1995) in Argentina's Western Pampas reported *Haemonchus*, *Nematodirus* and *Trichostrongylus*. Borgsteede and Dercksen (1996) in the Netherlands recovered *Ostertagia*, *Trichostrongylus*, *Strongyloides papillosus*, *H. contortus* and *Trichuris* from goats. Nwosu et al., (1996) reported that *Haemonchus* was the most common nematode recorded during their study. Comparing the observations of present study with those of earlier workers in other parts of the world it is obvious that differences in prevalence of nematode parasites is dependent on local geographical, climatic factors, management and husbandry strategies.

**Age Wise Prevalence**

After pooling all the data, age wise epidemiological observations were made which revealed highest prevalence rate in lower age groups in both sheep and goats (Table 7). With the increase in age, the infection level decreased. Generally, the <1-year age group was more infected. The results were significant (P < 0.05) for all parasites viz; trematodes, Cestodes and nematodes.

<table>
<thead>
<tr>
<th>Host</th>
<th>Age group (in Years)</th>
<th>No. Examined</th>
<th>Infected</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Trematode</td>
<td>Cestode</td>
</tr>
<tr>
<td><em>Ovis aries</em></td>
<td>&lt;1</td>
<td>28</td>
<td>9 (32.14)</td>
<td>6 (21.42)</td>
</tr>
<tr>
<td></td>
<td>1-3</td>
<td>56</td>
<td>15 (26.78)</td>
<td>10 (17.85)</td>
</tr>
<tr>
<td></td>
<td>&gt;3</td>
<td>39</td>
<td>7 (17.94)</td>
<td>5 (12.82)</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>123</td>
<td>31 (25.20)</td>
<td>21 (17.07)</td>
</tr>
<tr>
<td><em>Capra hircus</em></td>
<td>&lt;1</td>
<td>25</td>
<td>7 (28.00)</td>
<td>4 (16.00)</td>
</tr>
<tr>
<td></td>
<td>1-3</td>
<td>44</td>
<td>10 (22.72)</td>
<td>8 (18.18)</td>
</tr>
<tr>
<td></td>
<td>&gt;3</td>
<td>27</td>
<td>5 (18.51)</td>
<td>3 (11.11)</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>96</td>
<td>22 (22.91)</td>
<td>15 (15.62)</td>
</tr>
</tbody>
</table>

(Figures in parenthesis indicate percentage).

![Fig. 6: Graph showing age wise prevalence of Sheep and Goat.](image)
The lower age groups of animals found to be infected more with GIHPs in both sheep and goats is because of the high susceptibility and low resistance in young animals. Thus age was an important factor in the onset of infection because immunity played a great role in the establishment of parasites in the host body. The more infection observed in <1 year animals is attributed to the delay in the development of significant immunity, which is initially low but increases with intensity and duration of exposure of infection. When the animals cross 1 year of age the major part of their infection is eliminated because of development of self-cure phenomenon and tend to remain relatively resistant to re-infection; however, constant exposure of some level of infection is required to maintain their resistant status (Vlasoff et al., 2001). Lone et al., (2011) reported the highest prevalence of helminth parasites were <1-year age group (58%) as compared to >1-year age group (34%) in goats of Barramulla District of Jammu and Kashmir. The present study revealed that prevalence was higher (32.14% in sheep and 28.00% in goats) in animals below 1 year of age than the above 1 year. These results are closely related to the findings of Pal & Qayyum, (1992); Maqsood et al., (1996); Vlasoff et al., (2001); Magona and Musisi, (2002); Vanimisetti et al., (2004); Lateef et al., (2005). Maqsood et al., (1996) reported that the prevalence of haemonchosis was higher in both sheep and goats less than two years of age (67.1%; 47.8%) compared with those of above two years (40.4%; 33.3%). Rauf et al., (2005) in different age groups of sheep in Government and private farms in Pakistan reported young animals more prone to infection with tape worms than adult animals. Lone et al., (2012) reported that lambs become infected with nematodes and cestodes very early in life and pass eggs and ripe proglottids as was witnessed in a number of clinical cases from Jammu and Kashmir. According to Soulsby (1986) previous infection and age of the host afford some protection against reinfection and hence acute disease is usually seen in young animals. The high rate of infection with GINs in young lambs has been observed by Vlasoff et al., (2001). Young goats were two times more at risk of infections than adult goats (Magona et al., 2002). Adult animals harboured low number of worms, mainly O. ostertagi despite continuous grazing (Borgsteede and Dercksen 1996). It was recognized that sheep below 1 year of age are more susceptible to parasite infection than above 1 year of age, Wildeus and Zajac, (1992); Watson et al., (1991); Colditz et al., (1996). Lateef et al., (2005) reported higher infection of GIH parasites in young sheep reared under traditional husbandry system in Pakistan. Qamar et al., (2011) recorded the occurrence of haemonchosis was more frequently in younger (below 9 months) sheep and goats (39.91%) than in older (above 9 months) animals (33.23%). Age wise prevalence may be due to the fact that with the advancement of age, vigor of the animal becomes better and they develop resistance against the parasitic diseases. Immune response may not be fully developed in sheep before 6-10 months (Vlasoff et al., 2001). The results of the present study are in proximity with the above-mentioned workers.

**Gender Wise Prevalence**

After arranging all the data, sex wise observations were made which revealed that females were slightly more infected with GIHPs than males in both sheep and goats (Table 8).

<table>
<thead>
<tr>
<th>Host</th>
<th>Sex</th>
<th>No. Examined</th>
<th>Trematodes</th>
<th>Infected</th>
<th>Nematodes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male</td>
<td>56</td>
<td>13 (23.21%)</td>
<td>9 (16.00%)</td>
<td>14 (25.00%)</td>
</tr>
<tr>
<td><em>Ovis aries</em> Female</td>
<td>67</td>
<td>18 (26.86%)</td>
<td>12 (17.91%)</td>
<td>20 (29.85%)</td>
<td>P-Value = 0.001</td>
</tr>
<tr>
<td>Total</td>
<td>123</td>
<td></td>
<td>31 (25.20%)</td>
<td>21 (17.07%)</td>
<td>34 (27.64%)</td>
</tr>
<tr>
<td><em>Capra</em>  Male</td>
<td>50</td>
<td>11 (22.00%)</td>
<td>7 (14.00%)</td>
<td>13 (26.00%)</td>
<td>P-Value = 0.036</td>
</tr>
</tbody>
</table>

Over all females found to be more infected with GIHPs than males in both sheep and goats are comparable with the observations of many other workers. However, Gulland and Fox (1992) reported that the intensity and prevalence of GIHPs infection were higher in male sheep and goats than females, except during lambing season, and it decreased as age progresses in both sexes of sheep and goats. Patel et al., (2001) observed higher infection of GIF in female goats than males. Females were also found to be more infected with helminthes than males (Valcarde et al., 1999). Lateef et al., (2005) in sheep under traditional husbandry system in Pakistan also reported highest prevalence in females. Differences in susceptibility to infection between sexes have been observed by various workers. The observed disparity may not solely be due to differences in susceptibility but may also depend on a sex-related variation in behaviour that results in differences in exposure (Barger, 1993). The influence of sex on the susceptibility of animals to infections could be attributed due to the physiological peculiarities of the female animals, which usually constitute stress factors thus, reducing their immunity to infections, and for being lactating mothers, females happen to be weak/malnourished, as a result of which they are more susceptible to the infections besides some other reasons (Blood and Radostists, 2000). Qamar et al., (2011) reported analysis of the GIH disease pattern in male and female sheep and goats revealed no significant difference. Thus, while considering the present observations and the work of other researchers it seems that although sex plays a significant role in the preponderance of helminth infection but environmental, management and climatic conditions have a greater role to play in the onset of GIP in sheep and goats despite the gender differences reported in this study and by several authors in other parts of the world.

**Seasonal Prevalence**

The data pooled for seasonal estimation of helminth infection revealed definite seasonal prevalence of infection in both sheep and goats with highest infection in summer and lowest in winter (Table 9).

Sheep: Out of 123 sheep examined, 31 (25.20%), 21 (17.07%), and 34 (27.64%) were infected with trematodes, cestodes and nematodes respectively. For trematodes the highest infection (28.57%) was in summer and lowest (19.23%) in summer and lowest (19.23%) in...
winter (P < 0.05). The maximum cestode infection (20.00%) was reported in summer and lowest (11.53%) in winter and also the maximum nematode infection (31.42%) was observed in summer and lowest (19.23%) in winter (P < 0.05).

Goats: The number of goats examined was 96. Out of these 22 (22.91%), 15 (15.62%), and 25 (26.04%) were positive for trematodes, cestodes and nematodes respectively. The maximum infection of 25.92% (trematode), 18.51% (cestode) and 29.62% (nematode) was observed in summer and the lowest 15.78% (trematode), 10.52% (cestode) and 21.05% (nematode) was observed in winter (P < 0.05),

Thus, the gut examination of both sheep and goats revealed higher infection with helminths (trematodes, cestodes and nematodes) in summer, whereas winter revealed low infection of all the three groups during both the years of study, showing consistent results.

Table 9: Seasonal prevalence of GIPs according to gut examination.

<table>
<thead>
<tr>
<th>Season</th>
<th>Host</th>
<th>No. Examined</th>
<th>No. Infected</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Trematodes</td>
<td>Cestodes</td>
</tr>
<tr>
<td>Spring</td>
<td>Sheep</td>
<td>25</td>
<td>6 (24.00%)</td>
<td>4 (16.00%)</td>
</tr>
<tr>
<td></td>
<td>Goat</td>
<td>21</td>
<td>5 (23.00%)</td>
<td>3 (14.28%)</td>
</tr>
<tr>
<td>Summer</td>
<td>Sheep</td>
<td>35</td>
<td>10 (28.57%)</td>
<td>7 (20.00%)</td>
</tr>
<tr>
<td></td>
<td>Goat</td>
<td>27</td>
<td>7 (25.92%)</td>
<td>5 (18.51%)</td>
</tr>
<tr>
<td>Autumn</td>
<td>Sheep</td>
<td>37</td>
<td>10 (27.02%)</td>
<td>7 (18.91%)</td>
</tr>
<tr>
<td></td>
<td>Goat</td>
<td>29</td>
<td>7 (24.13%)</td>
<td>5 (17.24%)</td>
</tr>
<tr>
<td>Winter</td>
<td>Sheep</td>
<td>26</td>
<td>5 (19.23%)</td>
<td>3 (11.53%)</td>
</tr>
<tr>
<td></td>
<td>Goat</td>
<td>19</td>
<td>3 (15.78%)</td>
<td>2 (10.52%)</td>
</tr>
<tr>
<td>Total</td>
<td>Sheep</td>
<td>123</td>
<td>31 (25.20%)</td>
<td>21 (17.07%)</td>
</tr>
<tr>
<td></td>
<td>Goat</td>
<td>96</td>
<td>22 (22.91%)</td>
<td>15 (15.62%)</td>
</tr>
</tbody>
</table>

The present study reported highest GIH infection in both sheep and goats in the summer season (P < 0.05). The highest summer infection could be due to the presence of adequate temperature and moisture conditions as summer in Valley is followed in and/or rainfall. Translation of the infective stages was slow on pastures earlier on, but as rainfall, temperature and vegetative ground cover increased towards mid-summer (June-July), transmission of the infective stages occurred with increasing frequency. Parasite burdens reached maximum levels in the late summer and early autumn. In mid-autumn and onwards the infection level decreased in both sheep and goats because there was no or little rain during this period and faecal pellets rapidly dried out and there were least chances for the infection. In line with this seasonal trend are the observations of various authors (Dhar et al., 2016).

Fig. 8: Graph showing seasonal prevalence of recovered helminths.

The low infection reported during the winter season in the present study could be attributed to low temperature which helps in AD (hypobiosis) in host (Ogunsuri and Eysker, 1979; Gibbs, 1986; Tariq et al., 2008). Moreover, in winter the area remains mostly snow covered as such there is no grazing which hinders in loss of contact between host and parasites. El-azazy (1995) in Saudi Arabia also reported the overall worm counts and infection rates lowest in the winter season in goats. Valcare and Garcia (1999) observed lowest level of infection in the winter and rose progressively till the autumn. Shahadat et al., (2003) recorded lowest prevalence in the month of January of Haemonchus in Bengal goats. The initial exposure of native animals to infective larvae on pasture in spring generates egg production approximately 3-4 weeks after turnout.

There is peak biotic potential of Haemonchus contortus which results in rapidly assuming dominance at times when environmental conditions on pasture are favourable for the development and survival of the free-living stages. Nwosu et al., (1996) reported that Haemonchus was the most common nematode recorded during their study. They also reported that Haemonchus eggs and adults were high in prevalence and seasonal fluctuation was common in the study area. They further reported the high prevalence during hot humid season. These seasonal variations in the nematode worm burdens were similar to studies in other tropical countries with distinct rainy and dry seasons (Fritsche et al., 1993; Magona & Musisi, 2002; Nwosu et al., 1996). In general, moist and warm environmental conditions are favourable for the development, survival and transmission of the pre-parasitic stages of parasitic nematodes (Hansen & Perry, 1994; Urquhart et al., 1987). Nasreen et al., (2005) also observed highest infection (33.18 %) in summer and lowest in winter (15.25%). Makhdoomi et al., (1995) also observed highest infection in the summer season. Thus our findings of higher infection in summer are in agreement with them although the percent prevalence in different seasons differs which may be due to the topographic and climatic factors unique to the study area.

The 1st peak level of infection as recorded from April onwards is derived from over wintered larvae of Haemonchus originating from the eggs deposited. This contributes to what is known as the spring rise phenomenon. High rainfall in spring also helps in providing suitable molarity of salt present in soil which is an important factor for ecdysis (Soulsby, 1986). It also helps in larval dispersion on herbage which increases the chance of contact between host and larvae (Nginyi et al., 2001).

The 2nd peak level of infection from June onwards till autumn is derived from eggs deposited in the first grazing cycle (Soulsby, 1986). Ingestion of sufficient numbers of larvae results in type 1 disease in lambs during their first summer at pasture. In this study, the presence of sufficient moisture and optimum temperature conditions during the rainy season favored the survival of infective larvae in the pasture and higher probability of uptake of the infective larvae leading to higher prevalence rate. The rainy season which started in the spring and early summer made the environmental conditions more favourable for the development and survival of preparasitic stages and led to increased availability of infective larvae in the rainy and post rainy season. Climatic conditions influenced the build-up of pasture larval contamination and elevated levels were present in late July-August. This is in contrast to the situation in other parts of world- the tropical countries where disease primarily is caused due to infection with L3 derived from early season contamination (Vercruysse and Claerebout, 2003), thus climate plays significant role in epidemiology of GIH parasites.

It is well documented that GIP in grazing animals is directly related to the availability of larvae on pasture and seasonal pasture contamination (Soulsby, 1986). Kates (1950) demonstrated that hot and humid weather provides favourable conditions, for the development and survival of exogenous stages of H. contortus. Gordon (1953) stated that total monthly rainfall of more than 50 mm and a mean monthly maximum temperature of over 18.3 C provide optimum
conditions for the development and survival of exogenous stages of H. contortus. Therefore, it is expected that higher incidence of H. contortus and other nematodes would be restricted to months with adequate rainfall. H. contortus eggs can withstand extreme climatic conditions and also survive longer period during winter season (Blood and Radostits, 1989) resulting in mass hatching of ova and high summer infection of pasture. Sissay et al., (2007) in Ethiopia showed distinct seasonal patterns with high levels of infection during the short and long rainy seasons with peaks occurring in May and September of each year.

There are several studies which have reported highest GIN infection in rainy seasons (Charles, 1989; Ahmad Abdalla et al., 1997; Katoch et al., 2000; Laha et al., 2001; Fakae, 1990; Shahiduzzaman et al., 2003; Yadav Khajuria, 2006). Agyei (1997) in coastal Savanna regions of Ghana observed that the number of infective larvae of strongylate nematode on pasture was directly related to the pattern of rainfall. Qamar et al., (2011) the overall highest incidence of the year in sheep and goats was recorded during summer (43.69%), followed by autumn (38.46%) then spring (37.12%), while the lowest (28.79%) prevalence was recorded during winter. Singh et al., (2004) at an organized farm in Rajasthan reported H. contortus as the most predominant parasite and concluded that the period from July to October (rainy season) was more favourable for H. contortus. Tembely et al., (1997) in the highlands of Ethiopia indicated that rainfall and humidity seemed to be the most important factors for the development of eggs and free living stages of gastrointestinal nematode infections in sheep. Martinez-Gonzalez et al., (1998) concluded that environmental factors affected the prevalence and intensity of GIH infection under semi-intensive management conditions in dairy sheep flocks in Leon, Spain. Thamsborg et al., (1998) in Joannina (Greece) suggested that the factors affecting the epidemiology of GI nematodes of naturally infected sheep during grazing include anthelmintic treatment, host genotype and season. Rizvi et al., (1999) reported highest Haemonchus infection in spring season in goats in Pakistan. Najeeb-ur-Rehman and Akhtar Ali (2001) observed the highest GIH infection in sheep and goats in Pakistan in the months of June, July and August.

Magona and Musisi (2002) indicated that age, grazing system, season and agro-climatic zone have significant influence on the level of risk of GIN infections in Ugandan goats and on the worm egg output under field conditions. Soundarajan and lyue (2003) attributed the increasing infection trends of helminth infection of sheep in Nilgiris hills to varying climatic factors. Maturation of inhibited larvae of H. contortus in sheep and the resultant spring rise in FEC has been related to a loss of immunity due to the limited exposure to infection in winter, to stress, to immuno suppression associated with the late stages of pregnancy and lactation and to the frequent occurrence of poor nutrition at the end of winter (Uriarte et al., 2003).

Nganga et al., (2004) indicated that rainfall distribution was the major factor governing the development and survival of the pre-parasitic stages on pastures. Umur and Yukuri (2005) showed that the parasite counts increased slightly in spring and summer, and then reached maximum in autumn. Sreedevi and Murthy (2005) reported the overall prevalence of GIH in sheep higher in summer. However, Garg et al., (2009) recorded the highest incidence of GIN in winter in goats. Thus seasons have an important role in the prevalence of helminth parasites of sheep and goats.

From the above discussion it is now clear that season and the other associated environmental conditions including temperature and moisture have a greater role to play in the onset of G1H infection in sheep and goats. There are several factors that contribute the disease onset like warm, humid and wet grazing season, the more time animals spend on pasture, inefficient selection of de-wormers, poor husbandry practices and or the development of anthelmintic resistance. The low prevalence rate observed in sheep and goats of Gurez valley could be due to difference in management system of the animals and more importantly the environmental conditions prevalent in the area. However, our results are in close conformity with Tariq et al., (2006) who reported that higher parasite prevalence is more common in sheep than in goats due to the grazing habit of

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between 1996; fixation), parasite, morphological Troncy, environment having conditions in management 1988). The degree of infection in most of the study animals was low, agreeing with various works Kuchai et al., 2011, and 2012 indicating the sub-clinical cases of gastrointestinal parasites with subsequent subsistent low degree of pasture contamination. But it is inconsistent with reports from Kashmir (Dhar et al., 1988) that could be explained by the difference in management and breed of the respective animals.

This study revealed that the helminth infection in ruminants occurs throughout the Gurez valley. It also disclosed that regardless of the environmental conditions, the animals are infected with variety of helminth parasites. The various parasites recovered during the present study have also been reported from other two parts of the Jammu and Kashmir state, as well as from different parts of the world having almost same geographical locations and environment (Bali, 1976, Raina et al., 1987, Troncy, 1989, Nasreen et al., 2005, Fatima et al., 2012).

However, the various intraspecific morphological variations observed during the present study could be due to the variation in age of parasite, host species, intensity of infection (higher intensity, smaller parasites), methodology (fixation), environmental factors of the study area, body conditions of the host, etc.

The significantly higher prevalence in autumn than spring is in consent with many reports around the world, Tembely et al., 1997, 1998; Moyo et al., 1996; Fritche et al., 1993; Mbae et al., 2004. This could be due to the existence of a direct relationship between prevalence with the rainfall, humidity and temperature. In this study, the presence of sufficient rainfall and moisture during the autumn season favored the survival of infective larvae in the pasture and higher probability of uptake of the infective larvae leading to higher prevalence rate.

Similarly, a higher prevalence recorded in younger animals as compared to the adult ones is in agreement with most literatures Dunn, 1978; Shah-Fischer and Say, 1989; Keyyu, 2003; Nwosu et al., 1996; Nganga et al., 2004, from different corner of the world. This could be due to the fact that younger animals are more susceptible to infections than adults. Adult animals may acquire immunity to the parasites through frequent challenge and expel the ingested parasite before they establish infection, (Dunn, 1978; Shah-Fischer and Say, 1989). But the findings of this study are inconsistent with reports from Gambia where adults and older animals bear high worm burden.

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