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# Epidemiological Study on *Paramphistomum* Infection in Goats-Kashmir Valley

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**Abstract:** An epidemiological study with an objective to assess the prevalence of *Paramphistomum* infection in association with season, age, sex and breed of goats in Kashmir Valley was carried out in naturally infected goats, the study was carried out over a period of two years from February 2005 to January 2007. Gut and faecal examination were conducted monthly to monitor the seasonal prevalence of amphistomes. Out of 645 examined goats in the first year, 42 (6.5%) were found to be positive for *Paramphistomum* infection. However, out of 622 examined goats in the second year, 44 (7.07%) were found to be infected with *Paramphistomum*. Highest infection was found in summer season, in lower age groups, in males and in Migratory (Bhakarwal) breed ($P \geq 0.005$). With the increase in age from <1 year onwards the infection level decreased. Winter, adult animals, females and local breed reported low infection. There was no report on the epidemiological prevalence of *Paramphistomum* parasites of goats in Kashmir Valley; the present study reports the epidemiological prevalence of *Paramphistomum* in goats. This is initially of great significance to understand the epidemiology of gastrointestinal helminths of goats and to devise the appropriate control strategies for helminthiasis in the cool temperate climate of Kashmir Valley, India.

**Key words:** Epidemiology · *Paramphistomum* · age · sex · season · breed · goat

## INTRODUCTION

Gastrointestinal parasites are a major constraint to health and productivity in grazing livestock production systems [1]. In Kashmir Valley helminthiasis is the most important gastrointestinal diseases among small ruminants. Various species of *Paramphistomum* cause a disease called Paramphistomosis. It affects production, since these parasites provoke a lower nutrition conversion, a loss of weight and/or a decrease in milk production, causing great economic losses [2]. Furthermore, bleeding and diarrhoea also occur which cause general weakness and anaemia in infected animals. The epidemiology of helminthiasis is determined by several factors governed by parasite-host-environment interactions. The major epidemiological variable influencing worm burdens of animals is the infection rate from pastures. It is also influenced by the climatic requirement for egg hatching and development and survival of the larvae [3]. The major risk factors of helminthiasis can broadly be 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). On the basis of temperature and precipitation, four seasons in a year recognised in Kashmir Valley are: Winter (December to February); Spring (March to May); Summer (June to August); Autumn (September to November).Cradled within the mountain slopes in Kashmir, there are many high land meadows or pastures which are used by the local and nomads namely Shepherds, Gujars and Bhakarwals for animal rearing. During the snowy winter the animals are housed in pens. Three well defined systems of traditional livestock rearing in Kashmir Valley are migratory, semi-migratory and sedentary.

Unfortunately no report was found on gastrointestinal helminth infection of small ruminants in Kashmir Valley and only scarce literature is available about the amphistomes of sheep and that too only covers

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the morphology and incidence [4-7]. No epidemiological information was also available on gastrointestinal trematode parasites of goats in Kashmir Valley; therefore, the objective of the present study was to investigate the seasonal epidemiological aspects with respect to age, sex and breed of host and associated risk factors of *Paramphistomum* infection of goats in cool temperate climate of Kashmir Valley, India.

## MATERIALS AND METHODS

This study was carried out in goats from 1st February 2005 to late January 2007. A total of 1267 (Gut analysis: 329; Faecal analysis: 938) goats were examined over the period of two years. Regular visits were conducted to different areas of the Kashmir Valley including Anantnag, Budgam, Kulgam, Pahalgam and Srinagar. Faecal samples were collected from both rectum and gastro intestinal tracts of slaughtered goats. Attempts were made to collect faecal samples from those areas where gut collection was inaccessible, so as to ensure homogenous sample collection. All examined goats belonged to Bhakarwal and Kashmiri breeds. All animals examined were of both sexes and age ranged from less than one year (<1) to more than four year (>4).

**Post mortem differential parasite examination:** The gastrointestinal tracts of slaughtered goats were collected monthly from abattoirs to determine the seasonal prevalence of parasite species and to asses the occurrence of each species with respect to age, sex and breed. In the laboratory, collected fresh guts immersed in normal saline (0.9%) were thoroughly opened and analyzed by standard procedures [8]. The parasites were shaken vigorously in a tube containing 1% NaCl. After the mucus had been removed, the trematodes were put in distilled water for some minutes prior to killing, which served to relax the specimen further. Parasites were then fixed in Carnoy's fixative and processed further for permanent mounts. Microscopic studies were carried out using an Olympus Research Microscope (DP 12, 4D 0082, U-TVO 35 X C, Japan) with lens combination of 5x, 7x, 10x and 15x eye pieces and 4x, 10x, 40x and 100x objectives.

**Identification of parasites and parasitic stages in the faecal samples:** The faecal samples were obtained directly from the rectum of the animal. Samples were collected in suitable air tight containers such as screw cap bottles, plastic bags. The samples were carefully labeled with animal identification, breed, sex, dental age, month and place of collection. Samples were collected in 4% formalin keeping them at 4°C until processing. Sedimentation technique [8] was employed for faecal analysis.

**Data analysis:** Percentages (%) to measure prevalence and chi-square to measure association between the parasitism and species of the animals, age, sex, breed and season were the statistical tools applied. The data was analyzed using Statistical packages MINITAB software version 13.2 (Minitab 2002). In all the analyses, confidence level was held at 95% and $P < 0.005$ was set for significance.

## RESULTS

The results of *Paramphistomum* prevalence among goats indicated a quite low incidence in different locations of Kashmir Valley. A total of 645 goats were examined in the 1st year, 42 (6.5%) were found positive for *Paramphistomum* infection. However, in 2nd year out of 622 investigated goats, 44 (7.07%) were found infected. Overall, out of the total of 1267 goats examined through faecal and gut examination, 7.3% and 6.7% was positive prevalence for *Paramphistomum* in goats, respectively.

**Seasonal prevalence:** The data pooled for seasonal estimation of *Paramphistomum* infection revealed definite seasonal prevalence of infection rate in goats over the period of the two years with the highest infection in summer and the lowest incidence in winter (Table 1 and 2).

**Gut examination:** The number of goat guts examined in year 1 was 175. Out of them 12(6.8%) were positive for *Paramphistomum* (Table 1). Highest infection (11.1%) was in summer and the lowest incidence (2.5%) was reported in winter ($P = 0.148$). The number of goat guts examined in year 2 was 154. Out of them 9(5.8%) were positive for infection. The highest infection rate (9.0%) was also found in summer and the lowest incidence (3.2%) was observed in winter ($P>0.005$).

**Faecal examination:** The results of faecal examination in 1st year revealed that out of 470 faecal samples, 30(6.3%) were found positive for *Paramphistomum* spp. with a highest infection rate (11.4%) in summer and the lowest one (0.97%) in winter ($P = 0.008$). The mean EPG with *Paramphistomum* spp. was high (91.0) in autumn and low

Table 1: Seasonal prevalence of *Paramphistomum* according to gut examination

| Season | Year | Examined | Infected (r=+0.99) | MWC |
|---|---|---|---|---|
| Spring | Year 1 | 45 | 2 (4.4) | 15 |
| | Year 2 | 40 | 1 (5.5) | 25 |
| Summer | Year 1 | 45 | 5 (11.1) | 20 |
| | Year 2 | 44 | 4 (9.0) | 23 |
| Autumn | Year 1 | 45 | 4 (8.8) | 39 |
| | Year 2 | 39 | 3 (7.6) | 30 |
| Winter | Year 1 | 40 | 1 (2.5) | 13 |
| | Year 2 | 31 | 1 (3.2) | 22 |
| Total | Year 1 | 175 | 12 (6.8) | - |
| | Year 2 | 154 | 9 (5.8) | - |

Figures in parentheses indicate percentage; MWC=Mean worm count; r = Pearson's coefficient of correlation

Table 2: Seasonal prevalence of *Paramphistomum* according to faecal examination

| Season | Year | Examined | Infected (r=+0.942) | Mean EPG |
|---|---|---|---|---|
| Spring | Year 1 | 123 | 6 (4.80) | 74.0 |
| | Year 2 | 123 | 6 (4.80) | 78.2 |
| Summer | Year 1 | 114 | 11 (11.40) | 84.6 |
| | Year 2 | 112 | 13 (11.60) | 81.1 |
| Autumn | Year 1 | 130 | 12 (9.20) | 91.0 |
| | Year 2 | 130 | 12 (9.23) | 93.3 |
| Winter | Year 1 | 103 | 1 (0.90) | 79.4 |
| | Year 2 | 103 | 4 (3.80) | 78.3 |
| Total | Year 1 | 470 | 30 (6.30) | - |
| | Year 2 | 468 | 35 (7.40) | - |

Figures in parentheses indicate percentage; M EPG=Mean of eggs per gram of faeces, r = Pearson's coefficient of correlation

(74.0) in spring (Table 2). However, out of 468 faecal samples collected in the 2nd year, 35(7.4%) were reported positive for *Paramphistomum* spp. The highest infection rate (11.6%) was also observed in summer and the lowest one (3.8%) in winter (P = 0.052). The mean EPG was high (93.3) in autumn and low (78.3) in winter.

**Age wise prevalence:** After pooling all the data age wise epidemiological observations revealed highest prevalence rate in lower age groups than adults (Table 3). With the increase in age from <1 year onwards the infection level decreased. Generally, less than one year age group was more infected (P = 0.005). Pearson's Coefficient of correlation (r) calculated between different age groups of goats towards infection with trematodes, year 1 (Gut exam: +0.893; Faecal exam: +0.910) and year 2 (Gut exam: +0.985; Faecal exam: +0.967) revealed definite age wise association towards infection as the value always approached +1.

Table 3: Age wise prevalence of *Paramphistomum* in goats

| | | Gut examination | | Faecal examination | |
|---|---|---|---|---|---|
| Year | Age group | Examined | Infected | Examined | Infected |
| Year 1 | <1 | 37 | 4 (10.8) | 98 | 9 (9.1) |
| | 1-2 | 40 | 4 (10.0) | 102 | 9 (8.8) |
| | 2-3 | 39 | 2 (5.1) | 105 | 6 (5.7) |
| | 3-4 | 34 | 2 (5.8) | 75 | 4 (5.3) |
| | >4 | 25 | - | 90 | 2 (2.2) |
| | Total | 175 | 12 (6.8)P=0.525 | 470 | 30 (6.3)P=0.336 |
| Year 2 | <1 | 28 | 3 (10.7) | 94 | 10 (0.6 |
| | 1-2 | 38 | 3 (7.8) | 95 | 9 (9.4) |
| | 2-3 | 31 | 2 (6.4) | 88 | 7 (7.9) |
| | 3-4 | 28 | 1 (3.5) | 89 | 7 (7.8) |
| | >4 | 29 | - | 102 | 2 (1.9) |
| | Total | 154 | 9 (5.8)P=0.520 | 468 | 35 (6.1)P=0.222 |

Figures in parentheses indicate percentage

Table 4: Sex wise prevalence of *Paramphistomum* in goats

| | | Gut examination | | Faecal examination | |
|---|---|---|---|---|---|
| Year | Sex | Examined | Infected | Examined | Infected |
| Year 1 | Male | 95 | 6 (6.3) | 228 | 15 (6.5) |
| | Female | 80 | *6 (7.5) | 242 | 15 (6.1) |
| | Total | 175 | 12 (6.8) | 470 | 30 (6.3) |
| | | | P = 0.773 | | P = 0.874 |
| Year 2 | Male | 70 | 5 (7.1) | 230 | 17 (7.3) |
| | Female | 84 | 4 (4.7) | 238 | *18 (7.5) |
| | Total | 154 | 9 (7.7) | 468 | 35 (7.4) |
| | | | P = 0.555 | | P = 0.948 |
| Total | Male | 165 | 11 (6.6) | 458 | 32 (6.9) |
| | Female | 164 | 10 (6.0) | 480 | 33 (6.8) |
| | | r=+0.999 | P = 0.843 | r=+0.976 | P = 0.950 |

Figures in parentheses indicate percentage

Table 5: Breed wise prevalence of *Paramphistomum* in goats

| | | Gut examination | | Faecal examination | |
|---|---|---|---|---|---|
| Year | Breed | Examined | Infected | Examined | Infected |
| Year 1 | Kashmiri | 80 | 5 (6.2) | 232 | 14 (6.03) |
| | Bhakarwal | 95 | 7 (7.3) | 238 | 16 (6.7) |
| | Total | 175 | 12 (6.8)P=0.785 | 470 | 30 (6.3)P=0.775 |
| Year2 | Kashmiri | 73 | 4 (5.4) | 233 | 16 (6.8) |
| | Bhakarwal | 81 | 5 (6.1) | 235 | 19 (8.08) |
| | Total | 154 | 9 (5.8)P=0.863 | 468 | 35 (7.4)P=0.642 |

Figures in parentheses indicate percentage

**Sex wise prevalence:** All data of sex wise observations revealed that the males goats were more infected than females (Table 4). However the sex difference was not much prominent and in some cases (Table 4*) females were found to be more infected than males. The observations are not statistically significant (P>0.005).

**Breed wise distribution:** The breed wise investigation of infection revealed that local Kashmiri breed were found to be resistant to paramphistomosis as was confirmed by its low prevalence of infection in them (Table 5). However the observations are not significant statistically (P>0.005). The r values calculated between Kashmiri breed towards infection (gut exam: +0.969; Faecal exam: +0.996) revealed that definite relation exists between resistant status of local breed and helminth infection. The Bhakarwal breed was reported to be more infected.

## DISCUSSION

*Paramphistomum* of goats in the present study has been studied taking into consideration the overall prevalence, seasonal prevalence, age wise prevalence, sex wise prevalence and breed wise distribution of infection. In Kashmir Valley earlier works were all related with morphology of *Paramphistomum* spp. of sheep and till 1995 no work on prevalence was conducted. No epidemiological information of goats was available till we took up the present endeavour. The present study reported low prevalence of *Paramphistomum* spp. (Sheep: 7.3%; Goats: 6.7%). These results were in agreement with the climatic conditions of the Valley and also in line with the observations of other authors in different parts of India. However, the prevalence of paramphistomosis in sheep in Kashmir was reported as 0.05% [6]. From Kathua region of J & K State, the prevalence has been earlier reported as 3.01% in goats [9]. Moreover, prevalence of paramphistomosis from different districts of Punjab and other adjoining areas was reported in goats as 0.85% [10] and 2.11% in goats from Gujarat [11].

The maximum infection of *Paramphistomum* spp. in summer season in the goats are comparable with those recorded earlier from other parts of J and K State, India and world with similar or different climatic conditions. The highest infection rate was observed in summer rainy season could be due to several factors; abundance of snails (*viz., Planorbis*, *Lymnaea* spp.) owing to rapid multiplication and dispersion. Furthermore, dispersion of faecal matter duo to rain splashes. These factors enhance self development of miracidia, infection of snails and metacercarial contamination to adjacent areas through water. In Kashmir Valley summer is followed in and/or by rainfall. Most of the sheep and goats are sent to high altitude pastures for grazing and return before the advent of winter. During this time, conditions on the lands are suitable for the survival of the intermediate snail hosts and they become heavily infected with the *Paramphistomum* intermediate stages/larval forms. So, ruminants are prone to get the infection of paramphistomes. The results are in agreement with other workers. From Jammu, the tropical part of the J and K State maximum infection of amphistomes was reported in summer [3]. From Kathua region of the J and K State [9] also reported highest infection (70.07% to 94.25%) in summer. The higher prevalence rate during the monsoon and post monsoon [10] in different districts of Punjab and other adjoining areas in goats is also in conformity with our observations.

The lowest prevalence in winter is also well documented [3, 12]. The low prevalence in winter could be attributed to harsh snowy winter conditions during which whole valley remains snow covered and there are no chances of fresh infection due to non availability of intermediate snail hosts. Thus the agroecological conditions in the valley play a significant role in the preponderance of infection with *Paramphistomum* in goats. Nevertheless, in other latitudes, some differences are observed. For instance in Australia, the prevalence of *Calicophoron calicophorum,* decreased in spring and summer and increased in autumn and winter [2]. Thus climatic conditions have a great role to play in the onset of helminth infection in ruminants.

The lowest age groups of animals found to be infected more with *Paramphistomum* spp. May be due to the high susceptibility and low resistance in young animals. Age is an important factor in the onset of infection because immunity plays a great role in the establishment of parasites in the host body. The more infection observed in <1 year animals is attributable to the delay in development of immunity. The low level of parasitism reported in adult animals is due to the development of significant immunity, which is initially low but increases with the intensity and duration of exposure of infection. Our observations are in accordance with that demonstrated in animals <1 year [11] which showed a greater susceptibility (61.90%) to *Paramphistomum* than animals >1 year (49.36%). According to Soulsby [8] previous infection and age of the host afford some protection against reinfection and hence acute disease is usually seen in young animals. Young goats were two times more at risk of infections than adult goats [13].

The influence of sex on the susceptibility of animals to infections could be attributed to genetic predisposition and differential susceptibility owing to hormonal control. Further experimental studies are needed to confirm the assumption. 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 [14]. Males (Ram) were found to be more infected (72.5%) as compared to females (64.07%) with *H. contortus* [15]. Our results are also in agreement with a study from Poland wherein males were more infected with the nematode species [16]. However, many studies have reported females more infected than males. Higher infection of intestinal helminthiasis was also found in female goats than males [11]. Highest rate of *H. contortus* infection was reported in females than males of Black Bengal goats in Bangladesh [17]. Although sex plays a significant role in the preponderance of the infection but environmental and climatic conditions have a greater role to play in the onset of parasitism in goats despite the gender differences reported by several authors.

The difference in the level of parasitism between different breeds of goats observed in the present study are in agreement with the observations of other workers in various parts of the world where, some breeds were found to be more susceptible to helminth infection than others. Some of this variation is due to genetic factors in the host, but there is the possibility that the observed differences in resistance may be due to heterosis if the animals are not pure bred [9]. In Kenya, small East African goats are more resistant to gastrointestinal parasitism than the Galla goats [18]. Breed differences in parasitic resistance have been reported for Goats in Asia [19]. White improved Goat breed was most susceptible to parasitic infections than Alpen Goat breed [16].

## CONCLUSIONS

The present study reported age, sex, season and breed were important factors that influence risk of *Paramphistomum* infection in goats in Kashmir Valley. These differences need to be taken in consideration when designing effective helminth control management systems for these animals. Further experimental studies are recommended to define and evaluate the predictable risk factors of trematode infection in goats managed under traditional husbandry system on naturally infected pastures during late spring, summer and early autumn and in pens during winter in Kashmir Valley.

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