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EPIDEMIOLOGY OF OVINE GASTROINTESTINAL NEMATODES IN HYDERABAD DISTRICT, PAKISTAN

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ABSTRACT

An epidemiological study on gastrointestinal nematodes of sheep was carried out in farms of small farmers in Hyderabad district from May 2004 to April 2005. Faecal egg counts, pasture larval counts and worm counts from permanent grazing animals were recorded for 12 months. *H. contortus* (24.6%) was found to be predominant of gastrointestinal nematode parasites, *Trichostrongylus spp*. (18.0%) was the next most prevalent species, others, including: *O. circumcincta, S. papillosus, T. ovis, Oe. columbianum* and *Chabertia ovina* were found in varying percentages. The highest faecal egg counts (FEC) were recorded in September, whereas the lower FEC were in February. Statistical analysis revealed that the FEC were significantly ($P<0.01$) affected by months (seasons). The peak of pasture infectivity was in August and declined to lower level in January. The mean worm burden counts were the highest in September and declined toward the minimum level in February in necropsized animals. The worm counts was influenced significantly ($P<0.01$) by FEC and pasture larval counts. The results of this study could be used to design a programme to minimize and control gastrointestinal nematode infections in sheep.

Key words: Epidemiology, gastrointestinal nematodes, sheep, faecal egg counts.

INTRODUCTION

Helminthiasis in small ruminant affects production losses due to mortalities, reduce weight gain and other losses of production (Chaudary *et al*., 2007). However, the effects of helminth infections on production of particular livestock species depend mostly upon the age of the animal, breed, parasite species involved and the intensity of the worm population. Several factors are known to determine the epidemiological pattern of the associated disease condition. These include weather condition, husbandry practice, and the physiological status of the animal (Khan *et al*., 1989; Tembely *et al*., 1997; Wall *et al*., 2004). For rational and sustainable control of helminth parasites especially the gastrointestinal nematodes of sheep, a comprehensive knowledge of the epidemiology of parasites and their interaction with the host in a specific climate and management practice is a prerequisite (Pal and Qayyum, 1992; Keyyu *et al*., 2005). This study was carried out to investigate some epidemiological aspects of gastrointestinal nematodes of sheep in Hyderabad district, Pakistan.

MATERIALS AND METHODS

Animals and management

The study was conducted for a period of 12 months from May, 2004 to April, 2005 in five areas of Hyderabad district including Hyderabad city, Tandojam, Tando Allahyer, Tando Muhammad Khan and Hallah. This area is situated in irrigated agro-ecological zone in the province of Sindh, Pakistan. Sheep of various local breeds, sexes, and age groups were randomly selected from small farmers. The animals were maintained under the semi-intensive management system and were released during the day for grazing and housed overnight. Traditionally, in study areas, small ruminant feeding was based on grazing with occasional supply of crop residues and household wastes.

Faecal samples

A total of 1200 faecal samples of sheep were collected from 20 selected farms/flocks of small farmers in study areas. The faecal samples were collected directly from rectum of sheep. All samples were individually analyzed for qualitative and quantitative examination. Faecal egg counts (FEC) were carried out by using a modified McMaster technique (Urquhart *et al*., 1996). Positive samples were pooled for each farm and cultured for identification of nematode species according to the techniques described by MAFF (1986).

Pasture larval counts

The herbage samples were collected from five communal grazing pastures of Hyderabad district including Hyderabad city, Tandojam, Tando Allahyar, Tando Muhammad Khan and Halla. The samples were collected at fortnight intervals for a period of 12 months. The grazing areas were traversed in a ‘W” shape route stopping every 5-10m and small wisp of pasture were picked by hand/scissors, collected in polythene bags and dispatched to a laboratory for processing. The infective larvae were recovered, identified to genus level and counted according the techniques described by Hansen and Perry (1994). The number of nematode larvae was expressed as L_3 per kg of herbage dry matter (L_3/kg DM).

Necropsy worm counts

The permanently grazed sheep were traced to metropolitan abattoirs of Hyderabad district, during the year of 2004-2005. A total of 1200 gastrointestinal tracts of sheep were collected and examined, as described by Urquhart *et al*. (1996). Tract parts including abomasum, small and large intestines were separated by ligature, the entire tracts were placed in a plastic container and brought to laboratory for examination. The contents of individual part of tract were washed into a tray using tap water. Each part was opened longitudinally and mucosa was carefully examined, scraped and washed to remove any adhering worms. The entire washings from the abomasum, small and large intestines were examined individually for worms. The nematodes present in various parts of gastrointestinal tract were identified and counted according the techniques described by Riche (1988).

Meteorological data

Climatic data regarding temperature, rainfall and relative humidity were recorded at meteorological station located within Sindh Agriculture University, Tandojam. The required climatic data viz: minimum and maximum temperature and rainfall for the study period were obtained every month from this station.

Statistical analysis

The data obtained from this study, namely faecal egg count (FEC), larval pasture counts and total worm counts (TWC) were analyzed using SPSS 15.0 program. The fixed effects of age, sex, breed, geographical areas and season (monthly variation) on FEC were analyzed with General Linear Model (GML) procedure. The EPG, TWC, and pasture larval counts were first transformed in the form $\log_{10}$ to stabilize the variance before analysis. The differences between group means were assessed by Turkey's test. Correlation (Spearman`s rho) tests were also conducted to ascertain association among pasture larval counts, TWC and FEC.

RESULTS

Meteorological data

Monthly mean minimum and maximum temperature, total rainfall and relative humidity during the study period are shown in Table 1. Climatically, the study area is subtropical, humid and receives average annual rainfall of about 129 mm. The average maximum temperature reached 40.8ºĊ in May and minimum 7.9°C in January. The relative humidity was highest (74%) in the month of November and lowest (50%) in the month of April. One year cycle is divided into four seasons viz: winter (December-February), spring (March-April), summer (May-September) and autumn (October-November). Summer also includes monsoon season (July-September).

Faecal egg counts

The faecal egg counts (FEC) of sheep during different months of the year of 2004-2005 are shown in Table 2. The faecal egg counts were significantly ($P<0.01$) affected by months variation (seasons). The animals were positive for gastrointestinal nematodes throughout the year but infection rate reached the peak in September (monsoon season). The mean FEC ranged from 826.2 in February to 1913.4 in September. The results of copro-culture of faecal samples revealed the presence of seven gastrointestinal nematode species including: *Haemonchus contortus* (24.6%), *Trichostrongylus spp*. (18.0%), *Ostertagia circumcincta* (15.7%), *Strongyloides papillosus* (12.7%), *Trichuris ovis* (10.8%), *Oesphagostomum columbianum* (8.3%) and *Chabertia ovina* (4.3%), as depicted in Table 3.

Table 1: Monthly means of temperature, humidity and rainfall in the study area during 2004-2005

Month	Maximum temperature (°C)	Minimum temperature (°C)	Temperature mean (°C)	Relative humidity (%)	Total rainfall (mm)
May	40.8	28.1	34.5	64	4.0
June	39.2	27.2	33.2	65	0.0
July	36.6	26.5	31.6	72	0.0
August	36.6	25.8	31.2	73	37.2
September	36.1	24.0	30.1	72	0.0
October	33.0	19.0	26.0	71	80.5
November	32.1	14.1	23.1	74	0.0
December	26.0	11.0	18.5	67	3.1
January	23.0	7.90	15.5	69	1.0
February	25.6	10.7	18.2	72	0.2
March	32.9	16.8	24.9	64	0.0
April	36.1	19.0	27.6	50	3.0

Table 2: Mean faecal egg counts (FEC) of sheep in various months of the year

Months	No. of animals examined	No. of animals infected	Mean FEC
May	100	44	1438.6 bcd
June	100	45	1256.7bcd
July	100	51	1373.1abc
August	100	67	1762.7a
September	100	56	1913.4ab
October	100	52	1484.0bc
November	100	44	1599.5bcd
December	100	34	972.1cde
January	100	36	963.9cde
February	100	21	826.2e
March	100	22	1466.1de
April	100	33	1510.1cde

Means with different letters are significantly different (P<0.05).

Table 3: Prevalence of different gastrointestinal nematode species in sheep

Nematode species	No. of animals examined	No. of animals infected	Percentage of infection
H. contortus	1200	295	24.6
Trichostrongylus spp.	1200	216	18.0
O. circumcincta	1200	188	15.7
S. papillosus	1200	152	12.7
T. ovis	1200	129	10.8
Oe. columbianum	1200	99	8.3
Chabertia ovina	1200	57	4.8

Percentage has been calculated from total number of animals examined.

The FEC in different study areas are presented in Table 4. The highest values of FEC were encountered in Tando Muhammad Khan (1709.6), followed by Tandojam (1468.9). Other areas in order were Halla (1445.7), Hyderabad (1383.1) and Tando Allahyar (1337.6). Statistically, significant differences in FEC were observed among different study areas.

The effect of age on the distribution of FEC of gastrointestinal nematodes of sheep is depicted in Table 4. The highest FEC (1514.3) were recorded in young animals of upto one year, whereas the lower values i.e. 1395.9, 1403.1, 1473.9 and 1427.3 were recorded in age groups of one year, two years, three years and above respectively. Significant difference (P<0.01) was observed in FEC among animals of different age groups.

Sex-wise data indicated that FEC were slightly higher in females compared to males (Table 4). Kooka (1469.9) breed was slightly more susceptible to nematode infection compared to Kacchi (1446.0) and Dumbi (1415.2) breeds (Table 4). However, differences of FEC among males and females or among breeds were non significant.

Pasture larval counts

The results of mean pasture larval counts recovered from herbage samples collected from five sampling sites of study area (Table 5) revealed the peaks of pasture larval activity in August (1885) and October (1548), whereas it declined to the lowest level in January (790). The infective larvae recovered from herbage were *Haemonchus contortus*, *Ostertagia circumcincta*, *Trichostrongylus spp*, *Strongyloides papillosus*, *Oesphagostomum columbianum* and *Chabertia ovina.* Statistical analysis showed that there were highly significant (P<0.01) affect of months on the total number of infective larvae recorded. The association between the pasture larvae and FEC (r = 0.106, P<0.01) was also significant.

Total worm counts

In this study, seven species of gastrointestinal nematodes were identified. The nematode species identified and mean worm burden are shown in Table 6. Statistical analysis showed that there was highly significant association between total worm counts (r = 0.934, P<0.01) and pasture larval counts.

DISCUSSION

The results of faecal examination of sheep from the small farmers of Hyderabad district showed that infections of gastrointestinal nematodes were prevalent throughout the year. However, the level of infection was different during the year, the mean FEC were above 800 eggs per gram (EPG) for most of the months, with distinct peaks occurring during the rainy season of the year, especially during months of August and September. These results are in agreement with other studies which showed that rainfall (r = 0.122, P< 0.01) and relative humidity (r = 0.103, P<0.01) were important factors in determining level of FEC and infections of gastrointestinal nematodes (Singh *et al*., 1997; Nginyi *et al*., 2001; Vlassoff et *al*., 2001; Keyyu *et al*., 2005).

In this study, the faecal copro-cultures examination revealed that *H. contortus* was found to be the predominant species of parasite of sheep in Hyderabad

Table 4: The effect of area, age, sex and breed on faecal egg counts (FEC) of sheep

Parameter	No. of animals examined	No. of animals infected	Mean FEC
Area			
Hyderabad	380	148	1383.1a
TandoJam	220	115	1468.9b
Tando Allahyar	210	93	1337.6ab
Tando M. Khan	190	68	1709.6a
Hallah	200	81	1445.7ab
Age			
Less than one year	347	186	1514.3a
One year	340	172	1395.9ab
Two years	338	113	1403.1bc
Three years	137	23	1473.9c
More thant three years	38	11	1427.3c
Sex			
Female	718	291	1461.2a
Male	482	214	1423.8a
Breed			
Kooka	426	186	1469.9a
Kacchi	384	164	1446.0a
Dumbi	390	155	1415.2a

Means with different letters within a parameter are significantly different (P<0.05).

Table 5: The pasture larval counts of gastrointestinal nematode species among 12 months

Month	*H. contortus*	*O. circumcincta*	*Trichostrongylus spp.*	*S. papillosus*	*T. ovis*	*Oe. Columbianum*	*C. ovina*	Total larvae (L_3/kg DM)
May	332	319	220	116	0	110	94	1191
June	364	190	256	212	0	116	94	1232
July	388	238	292	222	0	156	86	1382
August	420	224	394	364	0	257	226	1885
September	352	210	278	192	0	170	200	1402
October	460	190	386	260	0	166	86	1548
November	302	168	250	220	0	150	42	1132
December	250	122	196	136	0	84	46	834
January	202	146	164	146	0	92	40	790
February	388	206	352	260	0	180	110	1496
March	358	284	324	266	0	182	88	1502
April	348	214	320	230	0	134	100	1346

Each figure in columns 2, 3, 4, 5, 6, 7, 8 represents means of two counts.

district throughout the investigation, the biotic potential of this parasite justified the percentage of infection with this parasite (Nginyi *et al*., 2001). Faecal egg counts were significantly different among the areas of Hyderabad district. Tando Muhammad Khan had the highest FEC and Tando Allahyar showed the lowest FEC. This may be due to livestock density and topography of sampling areas. The highest FEC was recorded in upto one year old group of sheep. Urquhart *et al*. (1996) and Vlassoff *et al*. (2001) suggested that younger animals were more prone to infection compared to old ones. This may be due the host resistance which may be more established in old aged animals. The sex-wise results revealed that FEC of females were slightly more compared to males. According to Barger (1993) and Garcia *et al*. (2007), the temporary loss of acquired immunity against gastrointestinal nematodes near the parturition date and during lactation in ewes has been well documented. This temporary immunity loss leads to considerable

Table 6: The mean worm burden of gastrointestinal nematodes species in sheep during different months

Month	*H. contortus*	*O. Circumcincta*	*Trichostrongylus spp.*	*S. papillosus*	*T. ovis*	*Oe. Columianum*	*C. ovina*	Cumulative worm burden
May	139.4(34)	120(7)	145.4(26)	132(15)	83.1(13)	94.3(7)	80(3)	794.2
June	156.4(33)	106(9)	127.1(17)	158.8(17)	138.8(16)	108(5)	90(6)	885.1
July	159.9(26)	141.8(22)	128(15)	156.7(18)	101.3(16)	133.3(9)	60(1)	881.0
August	178.3(59)	171.4(7)	113.7(37)	165(20)	96(10)	98.9(11)	75(4)	898.3
September	178.1(31)	155.7(42)	190.1(11)	145.7(7)	85.7(7)	80(6)	84.7(17)	920.8
October	177.9(29)	125.7(21)	173.8(29)	114.5(11)	101.2(28)	120(4)	81.9(11)	894.1
November	148.4(19)	132.5(24)	145.4(21)	108(15)	144(10)	108(16)	60(1)	846.6
December	133.9(13)	146.9(16)	158.9(13)	120(8)	75(8)	109.1(4)	00.00	741.8
January	115(12)	142.5(16)	112.5(16)	86.7(9)	102(10)	87.3(11)	60(2)	724.0
February	120(9)	99.6(5)	124.2(14)	64.6(13)	77.1(7)	80(3)	60(1)	625.6
March	152.3(13)	150(2)	157.5(8)	125.5(11)	95.5(8)	90(2)	60(1)	803.8
April	143.4(14)	145(12)	135.8(38)	96(15)	91.8(17)	132(15)	96.9(13)	840.9

Figures in parenthesis indicated the number of infected gastrointestinal tracts.

increase of eggs expelled by gastrointestinal nematodes in faeces of sheep. The results revealed no significance effect of breed on the FEC. However, Bahirathan *et al.* (1996), Li et *al.* (2001) and Matika *et al.* (2003) carried out similar studies and reported the effect of breed on FEC was significant and some breeds of sheep were more resistant to gastrointestinal nematodes infection. The contradiction between the results of this study and findings of above workers could be attributed to genetic factor and management practice.

The ability of eggs and larvae of gastrointestinal nematodes to survive environmental conditions depends on the species and developmental stage of the parasite when adverse conditions occur. In this study, the highest pasture larval counts were recorded in August, whereas the lowest was in January. The higher larval counts in August could be attributed to weather conditions which were conducive for survival and development of free living stages of parasites. Urquhart *et al*. (1996) suggested that the optimal temperature for development of the maximum number of larvae in the shortest feasible time is generally in the range of 18-26ºC. At higher temperature, development is faster and the larvae are hyperactive, thus depleting their lipid reserves. The mortality rate then rises, so that a few will survive to L_3 stage. As the temperature falls, the process slows, and below 10ºC the development from egg to L_3 stage usually cannot take place. Furthermore, Ng`ang`a *et al*. (2004) also suggested that during the dry season, herbage cover at grazing pasture is reduced due to overgrazing by animals. This may expose the larvae to desiccation, resulting in high mortality or migration deeper into the soil. The low number and availability of infective larvae during December and January could be explained in the light of above workers suggestions.

This study showed, in general, that the animals under field conditions harbored a variety of worms, but the worm burden reached a threshed pathogenic level during the monsoon season. The total worm counts reached the peak in September and declined towards and reached the minimum level in February. These results are in agreement with those of Tembely *et al.* (1997); Jithendran (2000) and Chaudary *et al*. (2007). The number of infective larvae ingested by animals each day is considered as epidemiological variable of highest influence on the parasitic rates of the animals under grazing condition (Barger, 1999). The higher TWC of gastrointestinal nematodes in September may be due to the high number of infective larvae ingested by sheep and/or the arrested larvae resumed their development to adult stages. The low TWC in February could be attributed to low number of infective larvae pickup by sheep from pasture during this period.

Conclusion

It is concluded that the gastrointestinal nematodes were prevalent in Hyderabad district, the fluctuation of gastrointestinal nematode infections were associated with seasonal changes, exhibiting highest prevalence in monsoon. However, it is suggested that the combination of strategic use of anthelmintics with traditional/ veterinary medicine and good management could improve the control of gastrointestinal nematode infections in sheep in small-holder farms.

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