EPIDEMIOLOGY AND RESPONSE OF SOME DOMESTIC GOAT BREEDS TOWARDS NATURAL HELMINTHS FAUNA OF DISTRICT FAISALABAD, PAKISTAN

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ABSTRACT: A total of 3096 faecal samples from different goat (*Capra hircus*) breeds were screened through McMaster egg counting technique to determine prevalence of Gastrointestinal (GI) helminths. The distribution of nematodes, trematods and cestodes was 55.65%, 6.23% and 3.71% respectively with overall prevalence of 65.60%.Recorded species of helminths were: *Haemonchus contortus, Ostertagiacircumcincta, Trichostrongylusspp, Chabertiaovina, Fasciola hepatica, Marshallagiamarshalli, Oesphagostomum* (*O.*) *columbianum, Bunostomumtrigonocephalum, O. radiatum, Moneiziaexpansa, Trichuris ovis and Strongyloidespapillosus* in descending order of abundance. Statistically significant association among prevalence of GI helminths and breed, age, floor design, animal containment and feeding system ($P < 0.05$) of goat was found. Gender and housing system were not found associated ($P > 0.05$) with the prevalence of GI helminths. The present study provided data about prevalence of GI helminths along with associated risk factors to devise combat strategies against GI helminths.

Key words: GI helminthiasis, goat breeds, prevalence, associated risk factors, breed resistance.

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INTRODUCTION

Domestic goats (*Copra hiricus*) infected by various life-threatening parasites (cestodes, trematodes, nematodes) causing critical situation worldwide. Most common clinical observations that are shown with GI helminth are include diarrhea, loss of appetite, retarted growth, cachexia, hypoproteinemia, anemia and finally death. Helminths are responsible to cause economic losses associated with production losses due to parasitic gastro-enteritis, cost of anthelmintics, secondary infections due to immunocompromisation and death of animals (Makun *et al*., 2020; Bordes*et al*. 2020; Garedaghi*et al*. 2011). Helminths have been reported to reduce the growth rate of infected animals to one third with 10-20% morbidity. In tropical and sub-tropical countries, the situation is worst with an estimated helminth distribution in >95% of small ruminant population with *Haemonchus* spp. and *Trichostrongylus* spp. as major culprits (Yuan *et al*., 2019).

Among the possible control measures including: chemotherapy, pasture management, selective breeding, biological control, vaccination, ethnoveterinary practices, bioactive forages, phytotherapy, homeopathy and copper wire particles (Mushonga*et al*., 2018), identification of the resistance/ resilient breeds against GI helminths is a sustainable strategy to minimize the worm burden in the developing countries. In recent years, evidences have emerged suggesting a genetic based on resistance to GI helminths among and within breeds of sheep and goats from various regions of the world. In Pakistan, up to extent of our knowledge, there is no study narrating the association of goat breeds with the GI helminth distribution. However, a study conducted by Saddiqi*et al*. (2010) describes the resistant breeds of sheep against *Haemonchus contortus*. This inspired us to perform a preliminary helminth fauna epizootiology in various available goat breeds in Punjab district of Faisalabad, Pakistan.

MATERIALS AND METHODS

Study area and target population: The chosen study area is the Faisalabad District situated to the North East towards Punjab, with 31 ° 4504 N latitude and 73 ° 1350E longitude, 184 m above sea level.Approximately city covers an area of 1230 km^2. The boundary of district Faisalabad is covered with the cities of district Chiniot, Okara, Sheikhupura, Jhang, Sahiwal and Toba Tek Singh. Faisalabad district is made up of eight self-governing towns as ChakJhumra, Iqbal, Jaranwala, Jinnah, Lyallpur, Madina, Samundri and Tandlianwala town. Figure 1 shows the physical map of district Faisalabad.

There was total 0.95 million goat population present in the Faisalabad (Livestock Census-2006), Documented goat breeds in Faisalabad district are: Beetal, Teddy, Damani, Daira Din Panah, Jatan, Nachi, Kamori, Barbery, Kghani, and Non-descript. Among

these Beetal, Teddy and desi (non-descript) are the most common breeds reared in Faisalabad district.

Collection, transportation and examination of samples: A total of 3096 goats of different breed (Beetal 1053; Teddy 778; Non-descript 1289) were screened from July 2013 to June 2014. By using plastic gloves faecal samples were directly collected from goat's rectum. The samples were individually packed in a sterile zipper polythene bag with appropriate description. All the samples were placed in an airtight cool box until the laboratory arrived and refrigerated at 4 ° C until the analysis was completed.

All the faecal samples have been examined with direct and indirect parasitological standard techniques. (Soulsby 1982). Standard identification key was used to identify the helminth egss (Soulsby 1982; Anonymous 1986). L3 larval stage of nematodes was obtained and identified by performing copro-culture. Briefly, faecal samples containing unrecognizable parasite eggs that were finely crushed with the aid of pestle and mortar and put in a petri-dish that was closed and incubated at 27 °C for 7 days.After incubation, L_3 were procured through the Baermann's technique and identified through standard keys (Anonymous, 1986).

All the intrinsic (breed, age and sex) and extrinsic factors (housing system, floor pattern, animal keeping, feeding system) associated with GI helminthiasis were recorded for each animal. For this purpose, a questionnaire consist of multiple choice and dichotomous closed ended type questions was developed and refined through formal and informal testing (Thrusfield, 2007).

Statistical analysis: For district based epidemiological studies, data was statistically analyzed at 95% confidence interval. Odd's ratio and MLR (Multiple logistic regression) analysis done. SAS software package was used to carried out all statistical procedures.

RESULTS

Of the total goats screened, 2031 goats (65.60%) were found infected with GI helminths. Overall, 12 species of GI helminths were procured in decreasing order of abundance viz; *H. contortus*, *Trichostrongylusspp*, *Os. circumcincta*, *C. ovina*, *O. columbianum*, *F. hepatica*, *Ma. marshalli*, *B. trigonocephalum*, *O. radiatum*, *M. expansa*,*Tr. ovis* and *S. papillosus.* Four species of nematodes confirmed through coproculture were; *Oesphagostomum spp.*, *H. contortus*, *Ostertagia spp. and Trichostrongylus spp.* Figure 1 shows the reported species of GI helminths in goat breeds of Faisalabad district.

In August the prevalence found 81.01% which was highest and in January 53.49% which was found lowest. Figure 2 shows the month wise goat breeds prevalence of GI helminth in district Faisalabad.

Prevalence of GI helminths in goat among intrinsic factor breed and age showed statistically association ($P < 0.05$) and there was no association ($P > 0.05$) of prevalence with gender. In the case of extrinsic factors, there was a statistically associated floor pattern, animal captivity and feeding system ($P < 0.05$) with the prevalence of GI helminths in goatsbut no correlation was identified with the housing system ($P > 0,05$).Figure 3 shows the associated extrinsic and intrinsic factors for prevalence of GI helminths among goat breeds of Faisalabad district.

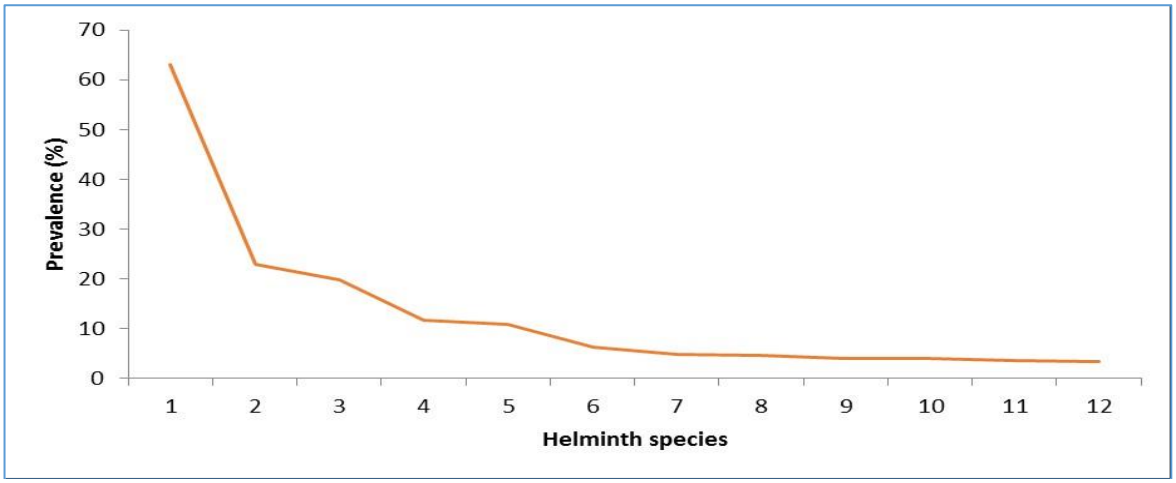

Fig.1. Prevalence (%) of different species of gastrointestinal helminths in goat breeds of Faisalabad district;
1.*Haemonchus contortus*;2. *Trichostrongylusspp*; 3. *Ostertagiacircumcincta*; 4. *Chabertiaovina*; 5. *Oesphagostomum*(*O.*)*columbianum*; 6. *Fasciola hepatica*; 7. *Marshallagiamarshalli*; 8. *Bunostomumtrigonocephalum*; 9. *O. radiatum*; 10. *Moneiziaexpansa*; 11. *Trichuris ovis*; 12. *Strongyloidespapillosus*

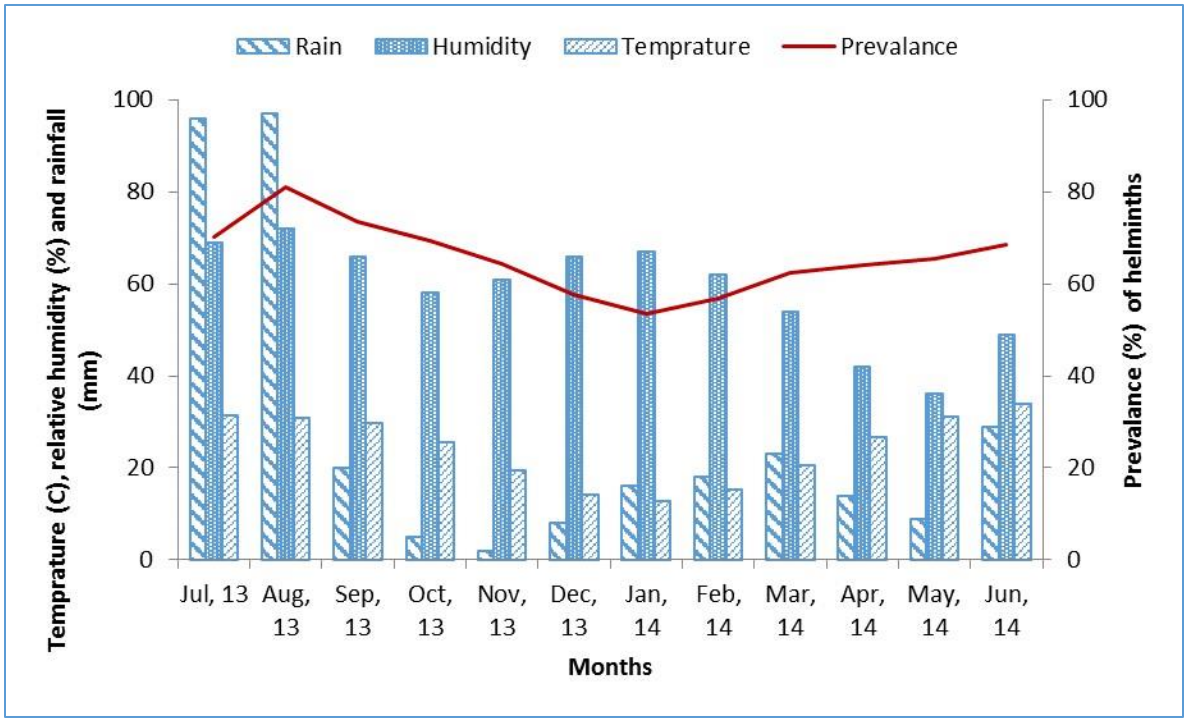

Fig.2. Monthly prevalence (%) of GI helminths in goat breeds of district Faisalabad.

X-axis: showing months for a calendar year; Primary Y-axis: showing temperature (C), relative humidity (%) and rainfall (mm) associated with GI helminthasis; Secondary Y-axis: showing prevalence (%) of helminths during reporting period.

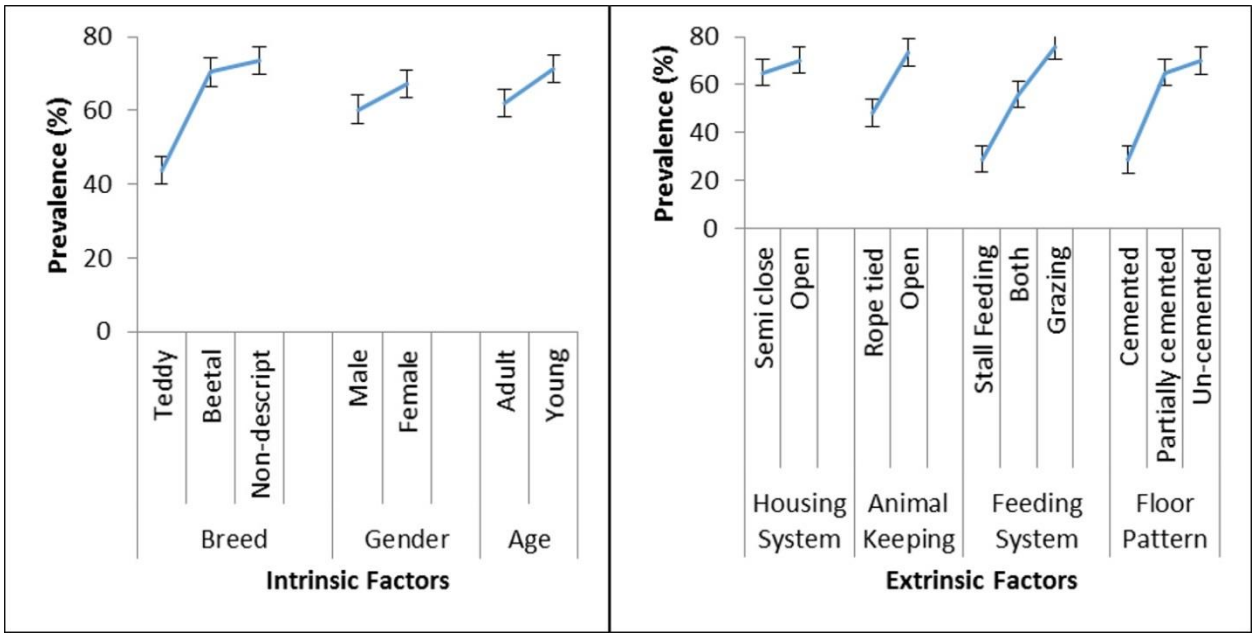

Fig.3. Prevalence (%) among intrinsic and extrinsic factors associated with prevalence of gastrointestinal helminths in the district Faisalabad goat breeds. (A) Intrinsic factors associated with prevalence of GI helminths in goat breeds (B) Extrinsic factors associated with prevalence of GI helminths in goat breeds.

DISCUSSION

In tropical and subtropical areas small ruminant production system have major constraints with helminths infection. Small ruminants are experiencing a live network of GI helminths, which are badly affecting their competitive and breeding success in developing countries as a result of the sudden decline in feeder intake or feed

conversion (Zeryehun 2012; Ayaz etcoll. 2013) (Brito *et al*. 2018).Especially insufficient nutrient usage results in delayed growth (Terefe *et al*. 2012; Wang *et al*. 2017) and in high-level anemia and even mortality (Hassan *et al*. 2011). In addition, animal immune status with helminth infection is lower than these and is susceptible to other pathogens causing heavy loss in farmers ' economic conditions (Garedaghi *et al*. 2011).

In the present study, overall prevalence of helminths is closely related to the findings of the Farooq *et al*. (2012) and Mehmood *et al*. (2013) in Punjab. This is because of almost same climatic conditions among study area and reported area. During the reported period, nematode infection in goats is found highest followed by trematodes and cestodes parasites. Similar results have also been reported by Chan Perez *et al*. (2017), Zeryehun (2012) and Raza *et al*. (2014) from different parts of world. High prevalence of GI helminths in small ruminants is due to many factors, related approaches of raising, direct nematodal life, reproduction system potential of nematodes (lays up to 10,000 eggs / day / parasite), short incubation period, increased fertility, overwintering, a variety of predilection places, hypobiosis of L3 disease in the open environment and alternative energy conditions in the open environment(Alam*et al*. 2019; Shrivastava *et al*., 2018; Bagnall *et al*., 2017; Kotze and Prichard, 2016; Nabukenya*et al*. 2014).

H. contortus was higher among infected nematodes found in goat bread in the district of Faisalabad. Several worldwide researchers have also reported similar results. (lone *et al*. 2012; Martínez-Ortíz-de-Montellano*et al*., 2013; Raza *et al*. 2014). The short generation interval, high proliferation rate, favorable environment and development of anthelmintic resistance were attributed to *H. contortus* prevalence(Kumar *et al*. 2015).

Low prevalence of treamtodes and cestodes can be due to low frequency of intermediate hosts, climatic conditions and lack of marshy area (Kotze and Prichard, 2016; Raza *et al*. 2014). Previously, same results have been reported by lone *et al*. (2012), Martínez-Ortíz-de-Montellano*et al*. (2013), Raza *et al*. (2014), Farooq *et al*. (2012) and Mehmood *et al*. (2013) reported low prevalence of cestodes.

Beetal breed is a large sized goat breed as compared to Teddy breed that is a dwarf breed; both are highly prevalent in Faisalabad district. Former breed is usually kept for dairy purpose while later mostly serves as meat breed in study area specifically and generally in Pakistan (Chaudhry *et al*., 2016). Non-descript is a breed of goat which lacks the specific breed characteristics in the region. The resistant Teddy breed for natural GI helminths infection in the study area is having a common character of dwarfness with the other reported resistant goat breeds in various parts of world (Al-jebory*et al*. 2012). This character of dwarfness does not seem to have a scientific argument; however, can be explored to determine the statistical association with the GI helminth distribution (if any). On the other hand, we can presume that Beetal; a milch breed can have higher lactational stress as compared to Teddy; a meat breed predisposing the former for a higher GI helminth burden (Hussain *et al*., 2014).

Sex impacts on the prevalence of GI helminths are highly controversial because some researchers have reported higher prevalence in female animals, and others have reported a higher infection rate for males. (Ayaz *et al*. 2013; Nabi *et al*. 2014). It is reported that antibodies and immunoglobulins in circulation of female have higher and sustained level towards antigens as compared to males. Similarly, graft rejection in females are more pronounced due to cell-mediated immune (CMI) responses and in castrated males as compared to intact males. Although, cell-mediated and humoral responses are shown by stimulation of level of oestrogens production in females, while androgens have the opposite effect (Alam*et al*. 2019). GI helminths have high susceptibility against female goats that attributes the extrinsic and intrinsic factors includes: gestational stress, more grazing phenomenon and peri-parturient rise phenomenon as compared to male goats which gets more care and conserved for breeding purpose and slaughtering at home (Kotze and Prichard, 2016; Raza *et al*. 2014).

With reference to higher prevalence in young animals, findings of the present study are being supported by Raza *et al*. (2014) and Nabi *et al*. (2014). Due the low resistance and high susceptibility of young animals, the lower age groups of animals have been more infected with GI helminth parasites in caprine. Thus, theage is a major factor in infection onset because immunity plays a vital role in the development of host parasites.Significant immunity is reported in adult animals because of low level of parasitism and resistant to reinfection is also due to self-cure phenomenon (Chaudhry *et al*., 2016).

Feeding criteria, floor design, housing system and animal keeping are those extrinsic factors which influence the GI helminths prevalence in goats with higher level. Rate of infection is higher in open housing and mud/sand floor as compared to cemented floor and semi-closed, closed housing systems and stall feeding. In this scenario, grazing animals are more likely to pick-up the infection as compared to those on stall feeding as infective stages of helminths are reside in the vegetation top and probability of acquiring the questing L_3 is higher as compared to later(Brito *et al*. 2018). Animal kept open and at un-cemented floor have more exposure to infective stage of helminths as compared to semi close housing and cemented floor pattern.

Prevalence of helminths in goats is greatly influenced by environment round the year. Provision of optimum temperature, humidity and rainfall conditions in

the area favours the high prevalence of GI helminths. In the current study, in the month of august prevalence was found to be highest due to high level of humidity and optimum temperature for GI helminths survival. While, the rate of infection was found lowest in the month of January because of harsh environmental conditions for GI helminths which slow down the reproductive potential (Swarnkar and Singh 2013). Additional factors may include decreases in animal grazing levels and hypobiotic nematodes (Garedaghi*et al*. 2011).

Conclusions: GI helminthiasis is a major threat and a primary constraint to goat productivity, endangering animal welfare in Faisalabad district. The main culprit is *H. contortus* which causes haemonchosis, anemia and parasitic gastroenteritis in goats in the study area. It is also concluded that associated risk factors such as age, sex, husbandry conditions greatly influence the rate of infection. So, these should be kept in mind while establishing the control programs. Current investigation provides a way to selectively breed the resistant goats as significant association is found between worm load and different breeds of goat in study area. It is also suggested that indigenous goat breeds of Pakistan should be evaluated under controlled condition in order to investigate inherent resistance towards GI helminths as well.

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Conflicts of Interest: It is stated that all the authors have no potential conflicts of interest and contributed equally.

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