

Influence of Host Breed, Sex and Age on the Prevalence and Intensity of *Cysticercus tenuicollis* in Sheep

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Abstract: The aim of this study was to determine the effects of host breed, sex and age on the prevalence and intensity of *Cysticercus tenuicollis* infections in sheep in Bursa province, Turkey. A total of 594 sheep were slaughtered and examined for the presence of *C. tenuicollis*. *C. tenuicollis* cysts were found in 143 sheep and an overall infection rate was 24.1%. The predominant predilection site of cysticerci in infected sheep was significantly ($p < 0.01$) the omentum (76.9%). No difference in the prevalence of *C. tenuicollis* could be found between kivrıcık (25.2%) and merino breeds (22.1%). Although, numerically higher prevalence was observed in male animals (26%) compared to females (23.9%), there was no significant difference between the sex groups. Prevalence of infection on the different age groups was insignificant. A significantly ($p < 0.05$) higher mean intensity rate of *C. tenuicollis* was detected in kivrıcık breed sheep (3.3 ± 0.6) compared with merino breed sheep (1.8 ± 0.2). The mean intensity rate between male and female animals showed significant difference ($p < 0.01$) with intensity rate of 5.5 ± 2.2 and 2.2 ± 0.2 , respectively. Although, the number of *C. tenuicollis* cyst was higher in older animals compared to younger ones, no significant differences in mean intensity of infections were observed in the studied age categories. These results suggest that the intensity of *C. tenuicollis* infections in sheep may be influenced by host breed and sex. This study also indicated that sheep was acquired immunity to reinfection by *Taenia hydatigena* eggs.

Key words: Age, breed, *Cysticercus tenuicollis*, sheep, sex

INTRODUCTION

Cysticercus tenuicollis is the larval stage of the canine tapeworm *Taenia hydatigena*. This cestode has been found in a large number of hosts throughout the world (Soulsby, 1986; Kaufmann, 1996). The intermediate hosts becomes infected by ingesting of proglottids or eggs passed in the faeces of the dog in pastures or feeding areas. The cysticerci are most commonly found attached to the omentum, mesentery, liver and peritoneum (Soulsby, 1986; Kaufmann, 1996; Schinieder, 2006). Normally, infection with *T. hydatigena* is not very pathogenic in dogs. However, its larvae *C. tenuicollis* are responsible for morbidity and mortality in sheep (Radfar *et al.*, 2005). Heavy infections in young lambs are leading to death (Soulsby, 1986). Migration of cysticerci in the liver parenchyma may cause haemorrhagic-fibrotic lesions and peritonitis (Kaufmann, 1996; Blazek *et al.*, 1985). These pathologic changes may be resulted in condemnation of the liver and other organs that cause economic losses.

The prevalence of infection is considerably high in the world and in some countries even more than 85% of

the sheep population was found to be infected with this metacestod (Garcia-Marin and Peris-Palau, 1987). Although, numerous surveys on the prevalence have been reported in different parts of world (Hasslinger and Weber-Werrighen, 1988; El Azazy and Fayek, 1990; Belem *et al.*, 2005; Radfar *et al.*, 2005), there were very limited number of studies on *C. tenuicollis* in Turkey (Sarımehmetoglu *et al.*, 1993; Deger *et al.*, 2001; Deger and Bicek, 2005) and no comprehensive study of this parasite in sheep in Bursa province has been conducted so far. Furthermore, only a limited number of studies focused on the examination of the effect of sex, age and/or breed of *C. tenuicollis* infections in sheep and other animals (Dajani and Khalaf, 1981; Torgerson *et al.*, 1998; Bhaskara *et al.*, 2003). Analysis of these factors might provide further insight into the epidemiology of *T. hydatigena* infections.

Because of the scarcity of such data in the literature, we aimed by the present work to determine the prevalence of *C. tenuicollis* in sheep in Bursa province as well as to examine the effect of host breed, sex and age on the prevalence and intensity of the infection.

MATERIALS AND METHODS

Study area: Study area (Bursa) is located in southeast of the Marmara Sea. The altitude of area is 100 m above sea level. Bursa has a typical Marmara climate having hot summers with some rain and mild to cool winters. In the study area the mean annual rainfall is 706 mm.

Animals: A total of 594 sheep carcasses slaughtered at two abattoir of Bursa were examined for *C. tenuicollis* cysts. One or two visit per week was made to the abattoirs during the 4 months period. Before slaughtering the animals were recorded for their breed, sex and age. The age of the sheep was estimated by the stage of dentition, season and by questioning the owners. Only animals originating from the Bursa province were examined in the study.

Parasitological examination: The omentum, mesentery, peritoneal cavity, liver and other visceral organs were investigated for the presence of *C. tenuicollis* cyst. The numbers and localization of cysts were recorded.

Statistical analysis: The prevalence is expressed as the percentage of infected sheep and the intensity as the arithmetic mean number of *C. tenuicollis* per sheep. Prevalence data were analyzed using a Chi-square or Fisher's exact tests. The effect of host breed and sex on intensity of infections was analyzed by the Mann-Whitney U-test. The intensity of infection in different age category was compared using Kruskal-Wallis test. All statistical calculations were performed using the Graphpad InStat Software V2.02. programme (LSU Medical Center).

RESULTS

A total of 594 animals were observed through postmortem examination and 24.1% of which were found positive for *C. tenuicollis* infection. The prevalence of *C. tenuicollis* as to the breed, sex and age are presented in Table 1. Although, the higher prevalence was observed in kivircik sheep (25.2%) compared to merino sheep (22.1%) there was no significant difference between 2 sheep breeds. As presented in the Table 1 there was also no significant difference on the prevalence of *C. tenuicollis* infection between male (26.0%) and female (23.9%) animals. The highest (30.2%) infection rate was observed with 2 years old animals while the lowest (8.3%) was with 1 year old ones. The infection rate was 21.8 and 24.0% in 3 years old and 4 years or older sheep, respectively. Statistically there was no significant difference between age groups.

Table 1: The effect of breed, sex and age on the prevalence of *Cysticercus tenuicollis* infections in sheep

Category		n	No of infected sheep	Prevalence (%)
Breed	Kivircik	381	96	25.2
	Merino	213	47	22.1
x ² = 0.571, df= 1, p>0.05				
Sex	male	50	13	26
	female	544	130	23.9
x ² = 0.023, df= 1, p>0.05				
Age (year)	1	12	1	8.3
	2	96	29	30.2
	3	174	38	21.8
	4≤	312	75	24.0

Fisher's exact test, p>0.05

Table 2: The effect of breed, sex and age on the intensity of *Cysticercus tenuicollis* infections in sheep

Category		n	Mean±SE	Range (min.-max.)
Breed	Kivircik	96	3.3±0.6	1-22a*
	Merino	47	1.8±0.2	1-16b*
Sex	male	13	5.5±2.2	2-16a**
	female	130	2.2±0.2	1-22b**
Age (year)	1	1	2±0.0	-
	2	29	2.3±0.4	1-9 n.s.
	3	38	2.4±0.3	1-7 n.s.
	4≤	75	3.5±1.1	1-22 n.s.

min: minimum; max.: maximum; n: number of infected animals; n.s.: non significant; Means with different letters are significantly different (*:p<0.05, **:p<0.01) within Categories

The results showed that the cysticerci in examined sheep had a tendency to locate more in the omentum (76.9%). The percentage of cyst found in other organs was as follows: 15.4% in mesentery, 16.1% in liver and 4.2% in peritoneum. The difference recorded between omentum and other organs was statistically important (p<0.01). The intensity of cyst in examined organs showed variations. The mean intensity was higher in the liver with a value of 3.1±0.5 (range: 1-7) (p<0.05), while this value was 2.6±0.4 (range: 1-22) for omentum, 2.0±0.6 (range: 1-2) for mesentery and 1.1±0.4 (range: 1-3) for peritoneum.

The effect of sheep breed, sex and age on the mean intensity of *C. tenuicollis* is shown in Table 2. In kivircik sheep the mean intensity was higher (3.3±0.6) than that of merino (1.8±0.2). The difference between breeds was statistically significant (p<0.05).

The male (5.5±2.2) animals were more heavily infected compared to the female ones (2.2±0.2) and it was found that the sex had significant influence on the mean intensity of *C. tenuicollis* (p<0.01).

The intensity of the cyst was also compared by taking into account the age of animals. As shown in Table 2, the mean intensity was determined as 2.3±0.4 for 2 years old sheep, 2.4±0.3 for 3 years old sheep and 3.5±1.1 for 4 years old or older animals. Since, only one animal was infected with *C. tenuicollis* in one year age group, this group was excluded from statistical analyses. There was however, no statistical evidence for the age-related difference.

DISCUSSION

The results of the present survey revealed that the prevalence of *C. tenuicollis* infection is 24.1% in sheep in Bursa province of Turkey. The overall prevalence of this metacestode reported in our study was markedly lower than those reported for the eastern part of Turkey ranging between 65.6-72.8% (Deger *et al.*, 2001; Deger and Bicek, 2005), but similar to those of recorded for western part of Turkey (Sarımehmetoglu *et al.*, 1993; Oge *et al.*, 1999). The grazing behaviour and management can be considered as the major reasons for this regional difference. Shepherd dogs on grazing land as well as in paddocks, greatly contributes to the prevalence of this parasite. Dogs are frequently fed on viscera and trimmings of slaughtered animals and they are generally not treated for parasitic diseases in eastern regions of Turkey. Comparison of our data with those obtained by other studies around the world indicates that the prevalence of *C. tenuicollis* in sheep is similar to that encountered in Nigeria (Dada and Belino, 1978), lower than that found in Burkina Faso (Belem *et al.*, 2005) and Spain (Garcia-Marin and Peris-Palau, 1987) and higher than those in Jordan (Dajani and Khalaf, 1981) and Iran (Radfar *et al.*, 2005).

The present study evaluated the influence of breed, sex and age of the host on *C. tenuicollis* infections. Although, numerically higher prevalence was found for kivrıcık breed, no statistically significant difference was observed for the prevalence of *C. tenuicollis* infection between kivrıcık and merino breeds. In our knowledge there was no any other report studying the influence of host breed on the prevalence of *C. tenuicollis* infection in sheep. Therefore, it was not possible for us to discuss and compare our findings with the others. Our results indicated that the male animals were numerically greatly infected compared to female ones; nonetheless the difference was not statistically significant ($p > 0.05$). Although, this finding is in agreement with those of Sarımehmetoglu *et al.* (1993) and Deger and Bicek (2005) who reported the highest infection rate with male sheep, there were no detailed statistical comparisons in their reports.

Adult animals were found be numerically higher infected compared to younger ones and the lowest prevalence was noted for 1 year old sheep. But, there was no statistical difference among the age groups. The low prevalence rate observed in 1 year old animals may be linked to various reasons. Maternal immunity which was described previously for *T. hydatigena* (Gemmell, 1969) can be one of them. Our results showed that infections with *C. tenuicollis* were most common at the second age

of sheep and after that age the prevalence rates decreased. This result is consistent with those of reported by Dajani and Khalaf (1981) who found the highest prevalence rate in 2 years old sheep. The reasons for the lower prevalence of the infections in older sheep may be explained by the increased resistance occurred by the age due to the raised immunity which is resulted by the intake of small number of eggs.

In contrast to these findings, Bhaskara *et al.* (2003) reported that *C. tenuicollis* infection was higher for the groups of animals which are older than 4 years compared to youngers. However, they reported that there was not statistically important significance between age groups. Torgerson *et al.* (1998) pointed out that prevalence of infection increased with age in sheep.

In the current study, the predominant predilection site of cysticerci (76.9%) was determined as omentum. Similar observation was reported by Sarımehmetoglu *et al.* (1993), El Azazy and Fayek (1990) and Radfar *et al.* (2005). The number of cysticercus found each animal exhibited variations and ranged from 1-22. This finding is in consistent with the data of Deger *et al.* (2001) who reported that the cyst numbers in examined animals varied from 2-26. Meanwhile, the highest mean intensity rate was observed in the liver (3.1 ± 0.5 , range: 1-7).

The intensity of cyst showed variations as a function of sheep race and kivrıcık race sheep had higher amount of cyst compared to merino race ($p < 0.05$). This difference may be linked to the divergence in genetic structure of these animals. Another reason for variation in intensity between breeds may arise from the differences in grazing behaviour, which would influence the intake of infective eggs of *T. hydatigena*.

There was evidence of sex-biased parasitism with male sheep tending to be more heavily parasitised with *C. tenuicollis* than females ($p < 0.01$). Relatively lower intensity in females may be attributable to the additional care and attention they received, being breeding stock for the production of viable and healthy offspring. In our study, although higher mean intensity was observed in older animals, there was no statistically significant differences among the age groups. This is also in line with the findings of Torgerson *et al.* (1998) who found slight increase in the number of cysts with the age of the animal.

CONCLUSION

Based on the data generated in the present study, neither prevalence nor intensity of infection with *C. tenuicollis* significantly increased with sheep age implying that immunity was acquired to reinfection. In

addition these results indicated that the intensity of *C. tenuicollis* infections in sheep may be influenced by host breed and sex.

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