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Effect of gender, age and season on the distribution *Coenurus cerebralis* in sheep

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ABSTRACT: The aim of the study was to determine the prevalence of *C. cerebralis* as well as its sex, age and seasonal distribution in sheep raised in Isparta province of Turkey. The study material consisted of 451 sheep skulls collected from slaughterhouses. The skull of the slaughtered animals was opened with a suitable saw and examined for cerebral and cerebellar coenurosis. *C. cerebralis* was detected in 25 (5.5%) of 451 sheep skulls that were clinically healthy throughout the year. The parasites were found to be 7.3% in females and 4.2% in males. *C. cerebralis* was detected in 0.7% in the 0-1 age group, 6.3% in the 1-2 years age group and 10.3% in the 2 years old group. The difference was statistically significant when -the parasite prevalence among the age groups was compared with the chi-square test ($p < 0.05$). The lowest prevalence was determined in February (2.5%) and the highest in July (11.1%). As a result, Coenurosis which is an important problem of sheep breeding, has determined the prevalence in the region of Isparta as 5.5%.

Keywords: Age; *Coenurus cerebralis*; Gender; Prevalence; Sheep

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INTRODUCTION

Coenurosis is a common disease in the world. It is more common in underdeveloped and developing countries (Abera et al., 2016). Coenurosis is characterized by cysts in the brain of intermediate hosts such as sheep, goats, cattle, camels, horses as well as pigs and caused by larval forms of several taenia species such as *Taenia multiceps*, *Taenia brauni*, *Taenia glomerata* and *Taenia serialis* that live in the small intestine of carnivores such as adult dogs, coyotes, wolves (Sonmez et al., 2017).

Coenurosis in sheep clinically occurs in three forms such as acute, asymptomatic and chronic (Adane et al., 2015). The acute form occurs during the migration of the eggs in the body and the symptoms may not appear if few agents are taken. In some cases, the infection may result in death due to encephalitis. In the asymptomatic form, there are mostly no clinical symptoms. The chronic period usually appears in sheep in the age group of 9-18 months (Gashe and Sewalem, 2017). The clinical symptom varies according to the localization of the cyst. It causes clinical signs such as ataxia, paralysis, tooth creaking, incoordination, torticollis and circling. Because of the pressure caused by the cysts it may result in brain atrophy, skull bones malacia and even perforation of the skull. Sudden death can occur depending on the size of the cyst (Güçlü et al., 2006; Scala and Varcasia, 2006). Although a temporary diagnosis is made based on clinical findings, the definitive diagnosis is achieved with the necropsy examination. It is therefore very important for the herd's health to define the disease without clinical symptoms (Amrabadi et al., 2019).

Prevalence of sheep coenurosis has been reported to vary between 1.3% - 36.8% in Turkey (Özgen, 2020). The prevalence of coenurosis has been reported to be 43.3% in Tanzania (Miran et al., 2015), 5% in Greece (Al-Riyami et al., 2016), 23.68% in Iraq (Ajaj et al., 2021) and 18.65% in Iran (Tavassoli et al., 2011).

The aim of this study was to investigate the cyst in brain of sheep according to the age, sex, location and regional distribution of *coenurosis cerebralis*.

MATERIALS AND METHODS

Sample area and animals

The material of this work was formed by slaughtered sheep at Canbolat Kirazlı Meat Integrated Facility in Isparta between January 2014 and December 2014. Isparta province is located in 38° 17' 58.1028" N-31° 10' 32.8944" E.

Methods

Throughout the study 451 heads of sheep with clinically healthy appearance were examined. The age and sex of the animals as well as the season of sample collection were recorded. The skulls of the slaughtered animals were opened with a suitable saw and examined for cerebral and cerebellar coenurosis. Localizations of macroscopically detected cysts were recorded. Diameters of removed cysts were also measured by using a digital compass.

Statistical analysis

Prevalence of the cysts were expressed as per cents. Differences in the presence of the cysts between age, sex, seasonal groups or brain parts were tested by using a Chi-Square test. A value of $P < 0.05$ was considered significant. The effect of sex or age on the size of the cysts was assessed by a mixed model analyses with restricted maximum likelihood. Windows 16.0 (SPSS Inc., Chicago, IL, USA) was used for statistical analyses.

RESULTS

C. cerebralis cysts were detected in 25 (5.5%) of 451 sheep brain samples (Figure 1). The prevalence of the cysts was found to be 7.3% in females and 4.2% in males without statistically significant difference. Cysts were detected in 4.07% in the age group of 0-2 years and 10.3% in the age group older than 2 years. The difference between the age groups was statistically significant ($p < 0.05$). The lowest prevalence was determined in winter (2.7%) and the highest in summer (8.3%) although no significant difference was observed among seasons (Table 1).

The cysts were found to be located at the highest level in the cerebral hemisphere and less in the cerebellum. The distribution of the cysts in different locations of the brain were shown in table 2. The measured diameters of the cysts were presented in table 3. The diameter of the detected cysts varied from 1.75 cm to 5.5 cm. No statistically significant relationship between the diameters of the cysts and the age or the sex of the animal was observed.

DISCUSSION

C. cerebralis causes herd problems in sheep and goats (Gashe and Sewalem, 2017). The prevalence of *C. cerebralis* among sheep populations in different provinces of Turkey has been reported to be 64.7% in Van (Biçek et al., 2019), 16.3% in Konya (Uslu and Güçlü, 2007), 15.5% in Kars (Gıcık et al., 2007), 12% in Kırıkkale (Gökpinar and Yıldız, 2012), 12.6% in

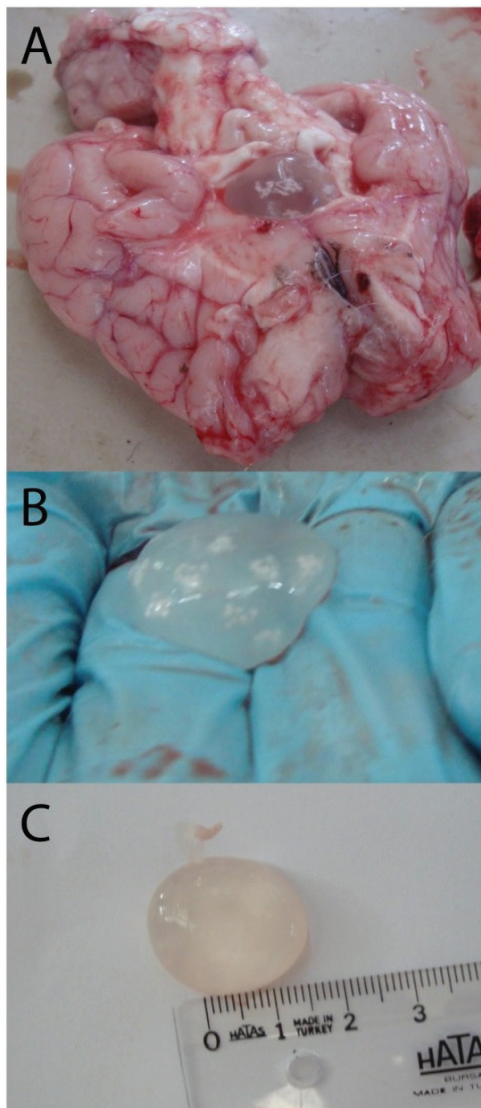


Figure 1: Necropsy pictures of *Coenurus cerebralis* cysts. A) A coenurus cerebralis cyst in the basis of the brain; B) Visible clusters of protoscolexes; C) Measuring the diameter of a cyst

southeastern Ethiopia (Aliye and Deressa, 2017). The prevalence of *C. cerebralis* in our study (5.5%) was lower than those reported in the literature. The difference might be attributed to geographical and climatic differences. For instance Scala and Varcacia (2007) reported that the eggs of *T. multiceps* can stay infective for more than 30 days in cold and humid environment while they are inactivated in high temperatures within few hours. Although the prevalence of *C. cerebralis* in females was higher than that in males no significant sex predisposition to *C. cerebralis* infection was detected in the present study ($p > 0.05$). Similarly Bashir et al. (2017) have reported no relationship between sex and the presence of coenurus cerebralis in Kashmir merino sheep. However there are several studies reporting a higher predisposition of ewes compared to rams (Gök-

Table 1. Prevalence of *Coenurus cerebralis* and risk factors associated with its prevalence in Isparta province

Factor	Classes	Number of examined samples	Frequency of infected animals		χ^2
			Number	Prevalence (%)	
Sex	Female	191	14	7.30	n.s.
	Male	260	11	4.20	
Age groups	0-2	344	14	4.07	*
	>2	107	11	10.30	
Seasons	Winter	112	3	2.68	n.s.
	Spring	89	5	5.62	
	Summer	133	11	8.27	
	Autumn	117	6	5.13	

* $P \leq 0.05$; n.s.: not significant ($P > 0.05$)

Table 2. Localization of *Coenurus cerebralis* in the brain

Localization	Infected number of animals (n=451)	Prevalence (%)
Cerebellum	1	0.2
Left parietal lobe of brain	3	0.7
Right parietal lobe of brain	6	1.3
Left frontal lobe of brain	3	0.7
Right frontal lobe of brain	4	0.9
Left temporal lobe of brain	3	0.7
Right occipital lobe of brain	5	1.1

Table 3 Effect of age and sex on the mean diameters of the cysts

Age	Females	Males	Total	P (Sex)
0-2	4,150±0,563	3,472±0,420	3,811±0.351	
>2	3,778±0,420	2,500±0,891	3,139±0.492	n.s.
Total	3,964±0,351	2,986±0,492		
P (Age)		n.s.		

pinar and Yıldız, 2012). It is thought that the detection of infection in female sheep is due to the longer use of these animals in the livestock enterprises. In our study, the prevalence of *C. cerebralis* infections was found to be higher in animals older than two years ($p < 0.05$). In accordance with the present study several research groups have also reported an increased prevalence of *C. cerebralis* with age (Bussell et al., 1997; Miran et al., 2015). The reason of this finding might be attributed to the higher probability of older animals to be exposed to parasite eggs than the younger ones.

In our study, prevalence of *C. cerebralis* was highest in summer (8.27%) and lowest in winter (2.68%) although no significant relationship between the prevalence and the season was detected ($p > 0.05$). In a

study conducted in the Kars province of Turkey *C. cerebralis* prevalence has been found to be lowest in April (3.1%) and highest in October (28.5%) (Gıcık et al., 2007). In another study, prevalence of *C. cerebralis* was found to be the highest in March (42.42%) and the lowest in June (2.94%) (Tavassoli et al., 2011). The discrepancies between the data obtained in the present study and those reported in the literature can be attributed to local climate or production systems.

It has been reported that *C. cerebralis* localize frequently in cerebral hemispheres especially in the parieto-occipital region (Akbari et al., 2015; Bıyıkoğlu et al., 2001; Gıcık et al., 2007; Soundararajan et al., 2017). Although no affinity of *C. cerebralis* to a specific region of the cerebral hemispheres was determined most of the cysts were located in cerebrum while only in one animal the cyst was detected in cerebellum. Similarly Uslu ve Guclu (2007) also observed that only %10 of *C. cerebralis* cysts were located in cerebellum. The difference between cerebrum and cerebellum with respect to infection rate might be attributed to the mass difference of these organs. Ovine cerebrum has a volume about 2.6 times higher than that of cerebellum (Masoudifard et al., 2022).

The size of cysts in sheep has been reported to be

1-4.5 cm, 2-6 cm and 0.8-6.5 cm in diameter (Tavassoli et al., 2011; Yılmaz et al., 2014). The sizes of the cysts found in our study ranged from 1.75 to 5.5 cm which were within the range reported in the literature. No statistically significant difference in the diameter of the cysts between age or sex groups might be explained by difference of the developmental stages of the cysts depending on the time of intake of parasites eggs.

CONCLUSIONS

The results of the present study indicated that *C. cerebralis* was still an important problem among sheep populations raising in Isparta province although the prevalence of this disease (5.5%) was lower than that observed in other parts of the country. Furthermore the results suggested that the prevalence of *C. cerebralis* increased depending on the age while its prevalence was not affected by the sex of animals included into the study.

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CONFLICT OF INTEREST

We have no conflict of interest to declare.

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