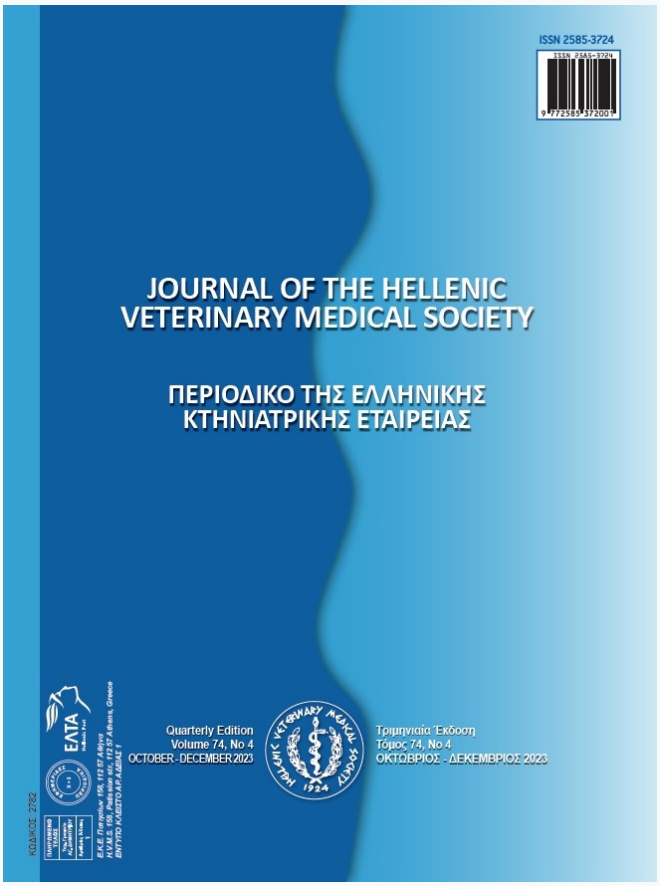
Journal of the Hellenic Veterinary Medical Society

Vol 74, No 4 (2023)



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doi: 10.12681/jhvms.30549

To cite this article:

Şevik, M. (2024). Survey of antibodies to Peste des petits ruminants virus in small ruminants in the Mediterranean Region of Turkey. *Journal of the Hellenic Veterinary Medical Society*, *74*(4), 6393–6398. https://doi.org/10.12681/jhvms.30549

J HELLENIC VET MED SOC 2023, 74 (4): 6393-6398
ΠΕΚΕ 2023, 74 (4): 6393-6398

Research article
Ερευνητικό άρθρο

Survey of antibodies to Peste des petits ruminants virus in small ruminants in the Mediterranean Region of Turkey

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ABSTRACT: Peste des petits ruminants (PPR) is a viral disease affecting sheep and goats caused by peste des petits ruminants virus (PPRV) has a serious economic impact due to the restrictions on animal trade and animal movements and high mortality rates in small ruminant populations. The common clinical signs of PPR are fever, mucopurulent nasal discharge, diarrhoea, and abortion. Seroepidemiological studies of PPRV infection in sheep and goats in Turkey are scant. Therefore, this study aimed toevaluate the seroprevalence of PPR in small ruminants in Turkey. Ovine blood samples were collected by random sampling method from sheep (n=77) and goats (n=61) from unvaccinated flocks (n = 40) in the Antalya Province in the Mediterranean region of Turkey. A competitive enzyme-linked immunosorbent assay (c-ELISA) kit was used to detectantibodies against PPRV in sera samples. Out of 138 sera samples analysed, eighteen sera samples (13%, 95% CI: 7.4 - 18.7) were PPRV seropositive, of which 18.2% (95% CI: 9.6-26.8; 14/77) were from sheep, whereas 6.6% (95% CI: 0.3-12.8; 4/61) were from goats. Although the PPRV seropositivity rate was higher in sheep than in goats, it was not statistically significant (P = 0.07). PPRV seropositivity was higher in small ruminants older than 24 months (19.4%) compared with less than or equal to 24 months (7%) (P = 0.04). Although there was no statistically significant difference between sexes, the PPRV seropositivity rate was higher (14.5%) in females than in males (10.9%) (P = 0.61). The flock-level seroprevalence was 30% (12/40). The result of the present study showed that seroprevalence of PPRV infection is high in sheep and goats in the Antalya Province. However, the results of the study are not enough to determine the regional and country-based profile of the PPRV infection in Turkey. Further epidemiological studies are required to get more epidemiology data on PPR in Turkey.

Keywords: Peste des petits ruminants virus; sheep;goats; seroprevalence; Turkey

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Date of initial submission: 11-06-2022
Date of acceptance: 08-08-2022

INTRODUCTION

Peste des petits ruminants (PPR) is a significant economic viral disease affecting domestic and wild ruminants such as goats, sheep, gazelle, and impala, and it has been classified as a notifiable disease by the Office of International Epizootics due to the high mortality rates in small ruminant populations, restrictions on trade and animal movements (OIE, 2019). Peste des petits ruminants virus (PPRV) which was renamed as small ruminant morbillivirus, can cause subclinical infection in cattle, pigs, and camel. Although they are not known to transmit PPRV to susceptible animals, there is limited data about the role of wild ruminants in the transmission of PPRV infection (Banyard et al., 2010). Therefore, the role of wild ruminants in PPR epidemiology needs to be clarified (Idoga et al., 2020; Gao et al., 2021).

The causative virus of the disease belongs to the genus *Morbillivirus* of the *Paramyxoviridae* family and is closely related to rinderpest virus, canine distemper virus, and measles virus. The genome of PPRV consists of negative sense, linear, and single-stranded RNA (Gibbs et al., 1979). Although four genetically distinct lineages (lineages I-IV) of PPRV have been determined based on molecular characterisation of the PPRV, it has only one serotype. Epidemiological studies reported that lineages I and II are circulating in West Africa, lineage III in southern India, the Middle East and East Africa, and lineage IV in the Middle East, Asia,and Turkey (Banyard et al., 2010; Muniraju et al., 2014; EFSA, 2015; Şevik and Sait, 2015; Dundon et al., 2020).

The major clinical signs of PPR in domestic small ruminants are fever, oral erosions, ocular and nasal discharges, anorexia, stomatitis, diarrhoea, and pneumonia (Kulkarni et al., 1996; Balamurugan et al., 2014; OIE, 2019). The severe outcomes of the disease depend on the PPRV strain, host species, and host immune response (Couacy-Hymann et al., 2007; Fakri et al., 2017). It has been reported that the severity of the PPR is higher in goats than in sheep (Truong et al., 2014). The morbidity rate could be as high as 100% in the naïve population and case fatality rates range from 50 to 100% (OIE, 2019). Transmission of PPRV infection occurs through close contact with infected animals or contaminated fomites (Parida et al., 2019).

The first case of PPRwas reported in Turkey in 1999 (OIE, 1999). Since then, the disease has become endemic in Turkey (Ozkul et al., 2002; Albayrak and Alkan, 2009; Şevik and Sait, 2015; Altan et al., 2019). Several studies have reported molecular detection and

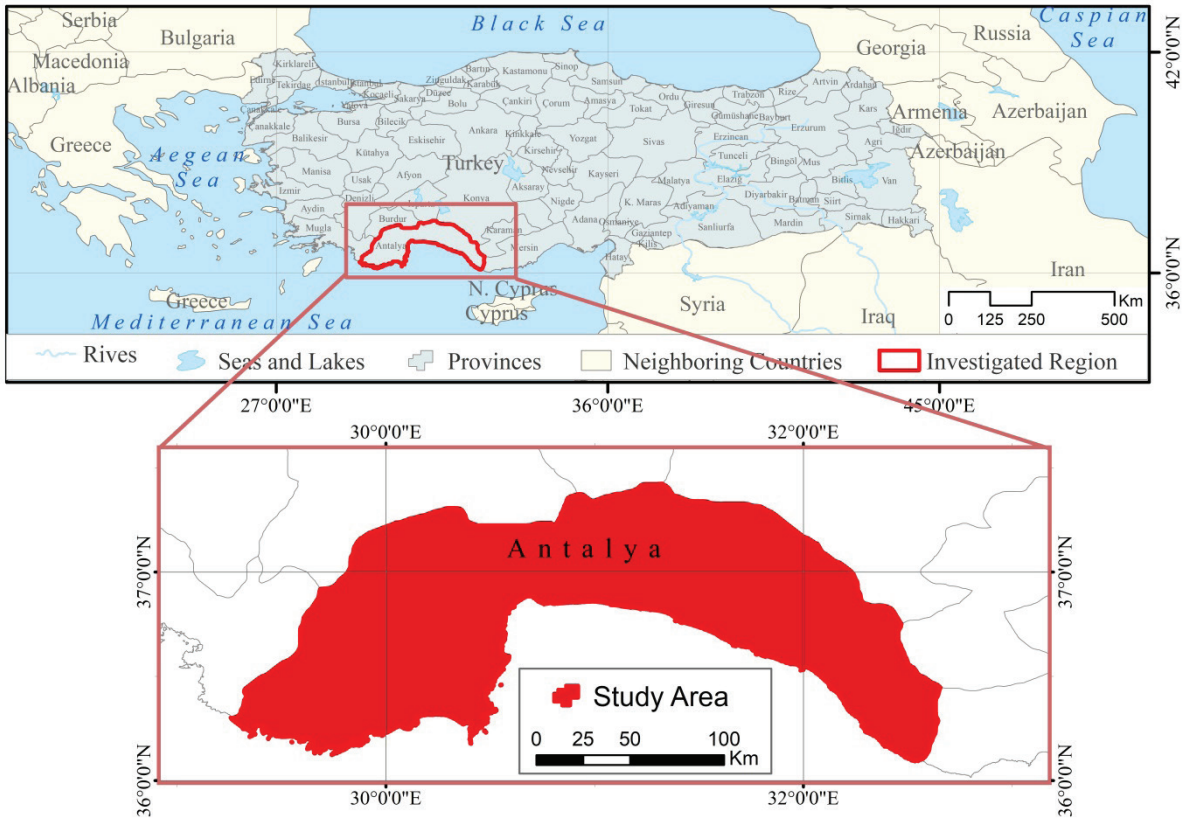

Figure 1. Location of study area in Turkey

genetic characterization of PPRV in Turkey (Ozkul et al., 2002; Şevik and Sait, 2015; Altan et al., 2019; Sait and Dagalp, 2019). However, seroepidemiological studies of PPRV infection in sheep and goatsin Turkey are scant. Therefore, this study aimed to estimate the seropositivity rates of PPR in sheep and goats.

MATERIALS AND METHODS

Ethical approval

This study was carried out with the permission of the General Directorate of Food and Control dated 13.11.2017 and numbered E.2852005. The study was performed under the regulation on the Working Procedures and Principles of the Animal Experiments Ethics Committees published by the Ministry of Agriculture and Forestry (2014).

Study area and sampling procedure

This cross-sectional study was conducted in the Antalya Province which is located in the Mediterranean region of Turkey (Figure 1). It has a Mediterranean climate characterised by wet and cool winters and dry and hot summers. Small ruminants are the dominant ruminant species in the studied area.

Ovine blood samples, including sheep (n=77) and goats (n=61), were collected by random sampling from unvaccinated flocks (n = 40) in the Antalya Province (Table 1). Three to four animals were randomly selected in each selected flock. The sample size was calculated according to the expected prevalence of 50% with a precision of 7% and 90% confidence level. To obtain sera samples, ovine blood samples werecentrifuged at 3000×g at 4 °C for 7 min. Obtained sera samples were stored at -20°C until analyses.

Serological analysis

The sera samples were analysedfor anti-nucleoprotein antibodies against PPRV bya competitive enzyme-linked immunosorbent assay (c-ELISA) kit (IDvet Innovative Diagnostics, Montpellier, France). It has been reported that the specificity and sensitivity of the c-ELISA kit are 99.4% and 94.5%, respectively (Libeau et al., 1995). All sera were run in duplicate. The analysis was performed according to the c-ELISA kit's instructions. Results of the c-ELISA analysis were assessed using an ELISA reader (Epoch, BIOTEK, USA), and were interpreted according to the c-ELISA kit's instructions.

Statistical analyses

GraphPad Prism version 5.0 (GraphPad Software, California, USA) was used to perform statistical analyses. The association between the seropositivity of PPRV and animal species, age, and sex was determined by a chi-square test. P-values<0.05 were considered to be significant.

RESULTS

Eighteen sera samples (13%, 95% CI: 7.4 - 18.7) were PPRV seropositive, of which 18.2% (95% CI: 9.6 - 26.8; 14/77) were from sheep, whereas 6.6% (95% CI: 0.3 - 12.8; 4/61) were from goats. Although PPRV seropositivity was higher in sheep than in goats, it was not statistically significant (P = 0.07). PPRV seropositivity was higher in small ruminants > 24 months of age compared with ≤ 24 months of age (P = 0.04). Furthermore, PPRV seropositivity was high in females (14.5%) but was not statistically significant (P = 0.61). Serological analysis results are shown in Table 1.

The PPRV-infected flock was defined as at least one of the animalshad anti-PPRV antibodies within the flock. In this study, flock-level seroprevalence was 30% (12/40).

DISCUSSION

Although vaccination and quarantine measures are used, PPR still affects sheep and goats in Turkey (Şevik and Sait, 2015; Altan et al., 2019). The situation of PPR in Turkeyis important because Turkey is a bridge between the Middle East and Europe where a large population of naïve small ruminants exist. Surveillance, monitoring, and epidemiology

Table 1. Details of the sampled small ruminants.

Variable	Categories	Seropositivity (%)	P value
Animal species	Sheep	18.2 (14/77)	0.07
	Goats	6.6 (4/61)	
Age	> 24 months	19.4 (13/67)	0.04
	≤ 24 months	7 (5/71)	
Sex	Female	14.5 (12/83)	0.61
	Male	10.9 (6/55)	

of the disease are important for the development of effective control and eradication programs against PPR (Balamurugan et al., 2014). Several studies have been carried out in different countries including the Middle East, Asia, and Africa to obtain information on the seroprevalence of PPR in domestic and wildlife ruminant species (Swai et al., 2009; Acharya et al., 2018; Dayhum et al., 2018; Balamurugan et al., 2020). However, there are few studies available about the seroprevalence of PPRV infection in sheep and goats in Turkey (Ozkul et al., 2002; Albayrak and Alkan, 2009; Altan et al., 2019). Therefore, this study was performed to get information about seropositivity rates of PPR in sheep and goats in Turkey.

In this study, out of 138 sera analysed, antibodies to PPRV were detected in 18 animals (13%, 95% CI: 7.4 - 18.7). This result agrees with a previous report from Turkey (Altan et al., 2019). Altan et al. (2019) reported that PPRV seropositivity in sheep was 11.7% in the Marmara region of Turkey. However, the seropositivity rate in this study was lower than that reported in previous studies that determined seropositivity rates ranged between 14.9% and 29.2% in different regions of Turkey (Ozkul et al., 2002; Albayrak and Alkan, 2009). Albayrak and Alkan (2009) reported that seropositivity in sheep was 14.9% in the Black Sea Region of Turkey. Furthermore, Ozkul et al. (2002) found that the PPRV seropositivity rate in PPR-suspected sheep and goats was 51.6% in different provinces of Turkey. This variation in seropositivity rates may be due to sampling methods, the number of sampling flocks, animal species, the age of the sampled animals, and flock management.

Different PPRV seropositivity rates ranging between 5.8% and 74% in small ruminants have been found in different countries (Lefèvre et al., 1991; Zahur et al., 2008; Balamurugan et al., 2011; Shyaka et al., 2021). The variations in seropositivity rates in different regions and countries may be associated with sampling techniques, the number of sampled flocks and animals, the age of the sampled animals,and flock management conditions.

In this study, PPRV seropositivity was higher in sheep 18.2% (14/77) than in goats 6.6% (4/61) but was not statistically significant (P = 0.07). This finding is in agreement with previous field studies that found that the prevalence of PPR was higher in sheep than in goats (Ozkul et al., 2002; Singh et al., 2004; Gelana et al., 2020; Shyaka et al., 2021). However, some studies reported that PPRV infection is more common in goats than sheep (Farougou et al., 2013; Fentie et al., 2018). These differences in seropositivity rates between sheep and goats may be related to the strain of the virus, immune status of the sampled animals, number of sampled flocks and animals, age of the sampled animals, and management practices of the sampled flocks.

In this study, small ruminants > 2 years had higher PPRV seropositivity than small ruminants lower than 2 years (P = 0.04). This finding agrees with the result of other studies that reported a higher seropositivity rate in adult small ruminants (Kardjadj et al., 2015; Abubakar et al., 2017; Acharya et al., 2018). However, Bello et al. (2018) found that the rate of seropositivity was highest in the age group of animals 1 and 2 years, and they also reported that animals older than 2 years of age had lower seroprevalence rate than animals aged 1-2 years of age. The higher PPRV seropositivity in adults can be explained by the increased probability of coming into contact with the virus that is circulating in the field and the decay of maternally derived antibodies in older animals. Contrarily, higher seropositivity in young small ruminants may be due to suppressed immune system response related to other viral or bacterial infections, and poor management.

Although there was no statistically significant difference between sexes,the PPRV seropositivity rate was higher (14.5%) in females than in males (10.9%) (P = 0.61). Higher seroprevalence rates of PPRV in female animals than in male animals have also been found in previous field studies (Farougou et al., 2013; Kihu et al., 2015; Bello et al., 2018). However, Rony et al. (2017) reported that the seroprevalence rate was higher in male than in female animals. The observed higher rate of seropositivity in females could be the result of breeding and higher female population density in flocks. Females kept in flocks longer than males due to their reproduction performance. However, males are sold earlier for meat production (Ahaduzzaman, 2020).

CONCLUSION

In conclusion, the findings of the current study suggest that seroprevalence of PPRV infection is high in sheep and goats in the Antalya Province. However, the results of the study are not enough to determine the regional and country-based profile of the PPRV infection in small ruminants in Turkey. Further epidemiological studies are required to get more epidemiology data on PPR in Turkey.

ACKNOWLEDGMENTS

The part of the study was presented as an oral presentation in the 4th International Conference of Food, Agriculture and Veterinary Sciences in Van, Turkey, 27-28 May 2022.

CONFLICT OF INTEREST

The author stated that there are no conflicts of interest.

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