

# Potential risk in public parks: Investigation of the tick species (Acari: Ixodida) in Bursa metropolitan area, Turkey

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**Abstract:** Ticks feed on a wide variety of mammals, birds, reptiles, and even amphibians. The majority of ticks choose specific animal species that are of no medical or veterinary importance for feeding, while others grasp a wide range of hosts, such as pet-breeding animals or humans. They can also transmit many human and animal pathogens include viruses, bacteria, rickettsia and protozoa in Turkey. This study was carried out to detect the distribution of ticks in public parks in six districts (Osmangazi, Yıldırım, Nilüfer, Gürsu, Kestel, Mudanya) of Bursa Metropolitan Municipality area (city centre) in Turkey, between May 2016 and May 2018. A total of 6186 ticks were collected with flagging or CO<sub>2</sub> trapping method from the public parks. The collected ticks were kept in 70% alcohol and then were identified under a stereomicroscope. Seven hard or soft tick species according to five genera were identified as *Rhipicephalus sanguineus*, *R. turanicus*, *Hyalomma marginatum*, *H. aegyptium*, *Dermacentor marginatus*, *Ixodes ricinus* and *Argas persicus*. Among them, *R. sanguineus* was the most abundant (59.79%) tick in the public parks. *Ixodes ricinus* increased significantly primarily in the forest areas. This is the first record of tick species in public parks in Turkey and these results may give us an acute insight into the prevalence of tick-borne infections in pets and humans.

**Keywords:** Bursa, public parks, tick species, Turkey.

## Parklardaki potansiyel tehlike: Türkiye’de Bursa Büyükşehir bölgesinde kene (Acari: Ixodida) türlerinin araştırılması

**Özet:** Keneler beslenmelerini memeliler, kuşlar, sürüngenler ve hatta amfibiler gibi geniş bir konak çeşitliliğinden sağlamaktadır. Kenelerin büyük bir kısmı beslenmek için tıbbi veya veteriner önemi olmayan spesifik hayvan türlerini seçerken, bir kısmı da pet-yetiştiricilik hayvanları veya insan gibi çok çeşitli konaklara saldırmaktadır. Ayrıca Türkiye’de insan ve hayvanlarda gözlenen virus, bakteri, riketsiya ve protozoon gibi birçok etkenden kaynaklanan hastalıkları bulaştırmaktadır. Bu çalışma, Türkiye’de Bursa Büyükşehir Belediyesi sınırlarında, Mayıs 2016 ve Mayıs 2018 yılları arasında, altı ilçedeki (Osmangazi, Yıldırım, Nilüfer, Gürsu, Kestel, Mudanya) park ve piknik alanlarındaki kene türlerini belirlemek amacıyla yapılmıştır. Çarşafalama ve karbondioksit tuzaklama yöntemiyle toplam 6186 kene parklardan toplanmıştır. Toplanan keneler %70’lik alkolde muhafaza edilmiş ve sonra stereo mikroskop ile teşhis edilmişlerdir. Beş cinse mensup yedi yumuşak veya sert kene türü; *Rhipicephalus sanguineus*, *R. turanicus*, *Hyalomma marginatum*, *H. aegyptium*, *Dermacentor marginatus*, *Ixodes ricinus* ve *Argas persicus* olarak belirlenmiştir. Bunların arasından en fazla *R. sanguineus* türüne (%59,79) parklarda rastlanmıştır. Ağaçlık alanlarda *Ixodes ricinus* türü belirgin şekilde daha fazla bulunmaktadır. Çalışmamız, Türkiye’deki halka açık park ve piknik alanlarında bulunan kene türlerini belirlemeye yönelik ilk kayıtları içermektedir ve sonuçlarımız insan ve pet hayvanlarında gözlenen kene kaynaklı hastalıkların dağılımı yönünden bir ön bilgi verebilecektir.

**Anahtar sözcükler:** Bursa, kene türleri, parklar, Türkiye.

## Introduction

Ticks are obligatory ectoparasites and may cause several serious infectious diseases either in humans or domestic/wild animals. Taxonomic studies on recent tick species indicated that the tick fauna of Turkey classified in two families, ten genera and 46 species infesting mammals,

reptiles and birds (4, 5). There are several tick-borne diseases increasing in Turkey; Crimean Congo Haemorrhagic Fever Virus, Lyme, Ehrlichiosis, Anaplasmosis and Babesiosis are commonly seen in humans or domestic animals (16, 22, 23).

Bursa is located in the Marmara coast of North-East Turkey, between the Uludağ Mountain and the Marmara Sea (40° 11' N; 29° 04' E) and the altitude of Bursa is from 0 to 2500 m above sea level. The population of Bursa Province is about 3.8 million (2018 census) and more than half of the city's population (about 2.5 million) lives in urban areas of the city: Osmangazi, Yıldırım, Nilüfer, Gürsu, Kestel, Mudanya districts which consist the Bursa Metropolitan Municipality (Figure 1).



**Figure 1.** Map of the Bursa Metropolitan Municipality.

Bursa city is generally quite humid (average humidity of 73%) due to its geographic location and the close proximity of the Marmara Sea. The total precipitation averages 706 mm per year, most of which recorded in December and the least in August. Bursa region is covered with mountains with natural forest (1). There are several public parks both in the city centre and rural areas where different species of bushes or trees are planted mixed. All of the parks investigated in this study can be used by the public as picnic areas at the same time.

Previous studies have shown that public parks in the city centre provide a basis for the habitat of ticks and related pathogens in European countries (6, 11, 25, 27, 28, 31, 33). Epidemiological studies on ticks in Turkey are mainly about the ones collected from domestic or wild animals and humans (3, 9, 12, 13, 15, 17, 18, 20, 24, 26). In this study, we aimed to investigate the tick species in the public parks where used by pets and people in the city centre and evaluate the risk status of ticks in Bursa Province.

### Material and Methods

The study was carried out in six districts (Osmangazi, Yıldırım, Nilüfer, Gürsu, Kestel, Mudanya) of Bursa Metropolitan Municipality area (city centre) in Turkey, between March 2016 and May 2018, where tick

specimens were collected with flagging for nidicolous ticks and with CO<sub>2</sub> trapping for hunter species from 468 public parks or picnic areas. Tick sampling was carried out periodically at intervals of about a month in a year, totally two years (24 months). In every park, four parts of the area in different corners, surface of 300 m<sup>2</sup> each were treated with flagging and sticking ticks were collected from the flag. Additionally, a shady area was selected near the trees for each park and a CO<sub>2</sub> trap made by plastic parts was placed on the ground. The trap was controlled after four hours about the presence of insects and ticks were separated and collected. All the public parks examined in this study were at altitudes between 100 and 500 m, which have a quite humid (73% annual average) climate (1).

Ticks were collected from the flag or trap through a fine-tipped forceps and were kept in test tubes contains 70% ethanol, then were taken to the laboratory and placed in a refrigerator until diagnosis. Data of location, number of ticks and date of the collection were recorded. Species identification was performed under a stereomicroscope (Nikon SMZ-10) according to morphological characters by the keys of Aydın (2) and Walker et al. (34). Larvae and nymph ones were identified at the genus level, while adults were identified at the species level. Some individuals could not be identified because of their damaged body parts. Distribution and density frequency analysis of tick samples were determined via the formula determined by SPSS® programme (30).

### Results

The study was carried out in six districts (Osmangazi, Yıldırım, Nilüfer, Gürsu, Kestel, Mudanya) of Bursa Metropolitan Municipality area (city centre) in Turkey, between May 2016 and May 2018. Seven hard or soft tick species belonging to five genera were identified as follows: *Ixodes ricinus*, *Rhipicephalus sanguineus*, *R. turanicus*, *Hyalomma marginatum*, *H. aegyptium*, *Dermacentor marginatus* and *Argas persicus*. Amongst them, *R. sanguineus*, *R. turanicus* and *I. ricinus* were common tick species in Bursa city and *R. sanguineus* (59.79%) was the most abundant tick in the public parks (Table 1). Frequency of sampling of the *I. ricinus* was significantly higher in the forest and humid areas.

468 public parks or picnic areas were investigated for 24 months about ticks. Amongst districts, tick samples were mostly collected from Nilüfer, while fewest from Mudanya.

All the species of hunter ticks (*Hyalomma marginatum* and *H. aegyptium*) were collected from CO<sub>2</sub> traps, while nidicolous ones were from flags. *Argas persicus* samples were collected from only one park in Nilüfer district where there are pigeon cages near the sampling areas.

**Table 1.** Distribution of the ticks in each district parks.

	Osmangazi	Yıldırım	Nilüfer	Gürsu	Kestel	Mudanya	Total	%
<b>Parks</b>	120	80	232	12	16	8	468	
<i>R. sanguineus</i>	851	680	1871	113	126	57	3698	59.79
<i>R. turanicus</i>	147	51	195	14	-	-	425	6.88
<i>H. aegyptium</i>	37	26	122	9	-	-	194	3.13
<i>D. marginatus</i>	13	9	24	-	6	-	52	0.84
<i>H. marginatum</i>	18	-	26	-	12	-	56	0.91
<i>I. ricinus</i>	57	34	47	-	-	-	138	2.23
<i>A. persicus</i>	6	-	-	-	-	-	6	0.09
<i>Rhipicephalus</i> spp. (nymph)	42	73	186	121	81	48	551	8.91
<i>Rhipicephalus</i> spp. (larvae)	93	89	152	170	69	74	647	10.45
<i>Ixodes</i> spp. (nymph)	51	44	86	-	41	-	222	3.59
<i>Ixodes</i> spp. (larvae)	49	81	67	-	-	-	197	3.18
Total	1364	1087	2776	427	353	179	6186	
%	22.05	17.57	44.88	6.90	5.71	2.89		100

**Table 2.** Seasonal mean activity of ticks collected from May 2016 to May 2018 in public parks of Bursa Province.

Tick species	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
<i>R. sanguineus</i>			+	+	+	+	+	+	+	+		
<i>R. turanicus</i>				+	+	+	+	+				
<i>H. aegyptium</i>					+	+	+	+	+			
<i>D. marginatus</i>								+	+	+	+	
<i>H. marginatum</i>				+	+	+	+					
<i>I. ricinus</i>	+	+								+	+	+
<i>A. persicus</i>										+	+	
<i>Rhipicephalus</i> spp. (larvae)		+	+	+	+	+	+				+	
<i>Rhipicephalus</i> spp. (nymph)			+	+	+	+	+	+	+			
<i>Ixodes</i> spp. (larvae)				+	+	+						
<i>Ixodes</i> spp. (nymph)		+	+	+	+	+	+					

Seasonal mean activities of all collected ticks were shown in Table 2. According to the data, adults of *Rhipicephalus* spp. and *Hyalomma* spp. were generally observed in spring and summer seasons, a peak from late May to early June. Adults of *I. ricinus* and *D. marginatus* were collected from autumn to early winter, the peak of late November. The undeveloped stages of *Rhipicephalus* and *Ixodes* were generally detected in spring and summer, and a small number of them were detected in early autumn. *Argas persicus* was identified only in a park in the spring where it contains pigeon cages inside (Table 2).

### Discussion and Conclusion

In recent years, there has been a significant increase in tick-borne infections in Turkey. Especially Rickettsia, Lyme and Crimean Congo Haemorrhagic Fever (CCHF) may cause severe problems in humans or animals (7, 10,

19, 32). There are considerable differences in tick epidemiology due to global climate change and unplanned urbanization and consequently, new tick-borne infections are expected (14, 21). Previous studies have shown that ticks are becoming increasingly as important vectors of pathogens in Europe's urban and peri-urban areas, which Ixodidae is the most common tick family encountered in Europe (6, 11, 25, 27, 28, 31, 33). In general, these types of studies were conducted for tick-borne diseases, not for tick species and were conducted in a limited area. Distinctly, there is no study about the tick species in the public parks of Turkey.

In a study of human ticks in Bursa Province of Turkey, a total of 19866 samples have been collected from human patients who applied to the hospitals suffering tick bites from the cities in the western part of Turkey between the years 2007 and 2011. Most of the ticks have been

identified as *Rhipicephalus* spp. (72.98%), *Ixodes* spp. (18.96%) and *Hyalomma* spp. (7.18%). Based on anamnesis, the majority of those patients have visited the parks, picnic or forestry areas where most of their ticks attached (81%). Amongst them, *Ixodes* spp. species have been commonly found in highland and forestry areas of Bursa (29). However, other studies conducted on the human tick species in Turkey have resulted in the dominance of *Hyalomma* spp. mostly from the urbanised areas (8, 16, 35). According to another study carried on ruminants in Bursa, 16 tick species belonging to 6 genera were detected in rural areas, and *I. ricinus* was the dominant species (3). Those results show that public parks/picnic areas have a significant source about ticks both for human and animals.

A high-intensity level of *R. sanguineus* detected in this survey is similar to the results gained from Selcuk et al. (29), which can be associated with the density of stray cats and dogs.

In conclusion, five genus and seven species of hard or soft ticks were identified in this study. *Rhipicephalus sanguineus*, *R. turanicus* and *Ixodes ricinus* were common tick species in Bursa city. While *R. sanguineus* (59.79%) was the most abundant tick, *I. ricinus* increased significantly in the forest areas of the public parks. In general, tick-related epidemiological studies have been conducted on living hosts like humans or animals. However, this study contains the first record of tick species carried out in the living environment and from the field in Turkey. These results give us the distribution of tick species according to each district of Bursa Province and also their seasonal activities. This data can have potential value for the epidemiological studies of tick-borne infections. Stray dogs and cats' population should be kept under control and antiparasitic drugs should be applied by municipalities and pet owners.

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### Ethical Statement

This study does not present any ethical concerns.

### Conflict of Interest

The authors declared that there is no conflict of interest.

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