

## Different Abundances of Human-Biting Ticks in Two Neighboring Provinces in Turkey

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Makale Kodu (Article Code): KVFD-2010-3545

### Summary

In this study, tick samples were examined, which were obtained from humans who applied to the regional hospitals with complaints of tick bites between May and November 2007 in two neighboring provinces, Kocaeli and Sakarya, in Eastern Marmara Region of Turkey. The samples were evaluated in terms of species, developmental stage and season for each province. In the course of the study, totally 3121 ticks were collected. Of those, 1610 ticks were from Kocaeli, 1511 ticks were from Sakarya. Among the total samples *Ixodes* spp. (52.87%), *Hyalomma* spp. (41.78%), *Rhipicephalus* spp. (4.2%), *Haemaphysalis* spp. (0.7%), *Dermacentor* spp. (0.35%) and *Argas* spp. (0.003%) were identified. Additionally, it was seen that one person was bitten by male *Rhipicephalus* (*Boophilus*) *annulatus* and one other was bitten by nymphal stage of *Otobius megnini*; these species were recorded for the first time in humans in Turkey. Concerning with the incidences of tick species, majority belongs to *Hyalomma* spp. (60.06%) in Kocaeli and *Ixodes* spp. (75.65%) in Sakarya. There were somewhat differences also in incidences of other tick species between these provinces. These disparities encountered between two neighboring provinces which have adjacent coordinates and similar climates, showed that the risk of tick bites or characteristic of this risk in a region could vary distinctly in terms of sub-regions which have some specific sub-conditions.

**Keywords:** Tick, Eastern Marmara, Turkey, Human

## Türkiye'de İki Komşu İlde İnsanları Tutan Kene Dağılımındaki Farklılıklar

### Özet

Bu çalışmada, 2007 yılı Mayıs ve Kasım ayları arasında, Doğu Marmara Yöresinde yer alan komşu iki ilde, Kocaeli ve Sakarya, kene tutunma şikayeti ile hastanelere başvuran insanlardan alınan kene örnekleri incelenmiştir. Örnekler, her bir il için tür, gelişim dönemi ve tutunma zamanı yönünden değerlendirilmiştir. Bu dönemde Kocaeli'den 1610, Sakarya'dan ise 1511 olmak üzere toplam 3121 kene toplanmıştır. Toplamda teşhis edilen kenelerin %52.87'si *Ixodes* spp., %41.78'i *Hyalomma* spp., %4.2'si *Rhipicephalus* spp., %0.7'si *Haemaphysalis* spp., %0.35'i *Dermacentor* spp. ve %0.03'ü de *Argas* spp.'dir. Ayrıca, Kocaeli'de bir kişinin *Rhipicephalus* (*Boophilus*) *annulatus* türü erkek kene, yine bir kişinin de *Otobius megnini* nimfi tarafından tutulduğu görülmüştür. Bu türlere Türkiye'de insanlarda ilk olarak rastlanmıştır. Kene türlerinin yoğunlukları bakımından Kocaeli'de *Hyalomma* spp.'nin (%60.06), Sakarya'da ise *Ixodes* spp.'nin (%75.65) baskın olduğu görülmüş ve bütün kene gruplarının yoğunluklarının da illere göre farklılık gösterdiği anlaşılmıştır. Yakın koordinatlara ve iklim yapısına sahip iki komşu il arasında karşılaşılan bu fark, belli bir bölgedeki kene ısırma riskinin ve riskin karakterinin, o bölgede bulunan özgün coğrafi alt alanlara göre belirgin şekilde değişebileceğini göstermiştir.

**Anahtar sözcükler:** Kene, Doğu Marmara, Türkiye, İnsan

### INTRODUCTION

Up to the present, 907 valid species of ticks which are one of the most significant parasites of animals and man,

particularly in tropical and subtropical zones, were affirmed worldwide. (Argasidae, Ixodidae and Nuttalliellidae



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consisting of 186, 720 and 1 species, respectively) <sup>1</sup>. Approximately 10% of these tick species take role in transmission of more than 200 pathogens, including many zoonotic agents <sup>2,3</sup>.

Most of tick species have a species specific host preference but in case of necessity they can utilize other host alternatives <sup>4</sup>. Although there is not a known tick species which tends to complete its life cycle on humans, it is reported that almost 200 tick species can attach to and feed on humans <sup>5,6</sup>. Furthermore, risk of tick attachment and related tick-borne diseases in a given region could be affected some factors other than host preferences of the ticks, such as vector tick abundance, human activities, geographical and climatic conditions <sup>6-9</sup>.

In this study, tick bite cases were evaluated and compared primarily in terms of abundances and seasonal activity of tick species in two neighboring provinces in Turkey between May and November, 2007.

## MATERIAL and METHODS

**Description of the study areas:** Kocaeli is situated on eastern Marmara Region and north-west Anatolia. It is bounded on the west by Istanbul, on the east by Sakarya, on the north by the Black Sea, and on the south by the Marmara Sea (Fig. 1). The central city is located at 40°41'N, 29°91'E. The population of the province is 1.522.408 and the acreage is 3.418 km<sup>2</sup>. South and North side along to the Black Sea cost are covered by high mountains. Central city is located on a narrow lowland where is closed to the Marmara Sea. Vegetation is composed of Mediterranean type predominantly on the cost of the Marmara Sea, and the

Black Sea type on the north side. The highlands are covered by rainy forests especially on the north side and maquis in places on the south parts. The summers are generally hot and moderately rainy, except the Black Sea coast receiving high precipitation. The winters are cold and rainy, temperatures below 0°C in places. Average temperature and rainfall are 14.8°C and 784.6 mm respectively.

Sakarya is situated on eastern Marmara region and bounded on the west by Kocaeli and on the north by the Black Sea (Fig. 1). The central city is located at 40°46'N, 30°22'E. The population of the province is 851.292 and the acreage is 4.821 km<sup>2</sup>. The province is covered by forested mountains (34%) plateaus (44%) and lowlands (22%). The Sakarya River, one of the biggest rivers of Anatolia, goes 159.5 km on this province to the Black Sea. There are a lot of lakes in different size and two big dams. Effects of the Marmara Sea and predominantly the Black Sea climatic zones could be seen in the province. The summers are generally hot and moderately rainy, except the Black Sea coast and its extension to the inner part of the provinces receiving high precipitation. The winters are cold and rainy, temperatures below 0°C in places. Average temperature is 14°C.

**Tick collection and identification:** Between the dates of 01.05.2007 and 30.11.2007, ticks were collected from humans who applied to the regional hospitals with complaints of tick bites in Kocaeli and Sakarya, and date of the bites and the related data about the patients were recorded. In the laboratory identification process, adult ticks were identified at the species level, while larvae and nymphs at the genus level with the exception of *Hyalomma aegyptium* nymphs. Identification was done using related taxonomic keys <sup>10-13</sup>.



**Fig 1.** Topographic map of Kocaeli and Sakarya provinces (modified from <http://www.multimap.com/maps>)

**Şekil 1.** Kocaeli ve Sakarya illerinin topografik haritası

## RESULTS

In the course of the study, 3121 ticks were collected. Of those, 1610 ticks were from Kocaeli, 1511 ticks were from Sakarya. The samples were identified as 1650 (52.87%) *Ixodes* spp., 1304 (41.78%) *Hyalomma* spp., 131 (4.2%) *Rhipicephalus* spp., 22 (0.7%) *Haemaphysalis* spp., 11 (0.35%) *Dermacentor* spp. and 1 (0.003%) *Argas* spp. Additionally, it was recognized that one person was bitten by male *Rhipicephalus* (*Boophilus*) *annulatus* and one other was bitten by nymphal stage of *Otobius megnini* in Kocaeli (Table 1, 2).

It was attained that, number of larval, nymphal and adult stages are 148 (1.69%), 1666 (74.77%) and 1307 (23.54%) respectively. Gender ratio of the adults showed 7 (0.66%) male and 1055 (99.34%) female in *I. ricinus*, 134 (54.69%) male and 111 (45.31%) female in other species. It was also seen that of the total patients, 34 were infested with more than one ticks belong to same species and developmental stages. Of those, 7 were infested with 2 and 1 with 3 *Hyalomma* nymphs, 1 person was infested

with 10 *Hyalomma* larvae, 1 person was infested with 7 and 1 person was infested with 2 *Rhipicephalus* nymphs, 6 were infested with 2 *I. ricinus* females, 3 were infested with 2 *Ixodes* nymphs and 7 were infested with 4, 5, 8, 14, 19, 20 and 29 *Ixodes* larvae respectively.

The ticks collected from Kocaeli were consisted of 967 (60.06%) *Hyalomma* spp., 507 (31.49%) *Ixodes* spp., 113 (7.02%) *Rhipicephalus* spp., 16 (0.99%) *Haemaphysalis* spp., 4 (0.25%) *Dermacentor* spp., 1 (0.06%) *R. (B.) annulatus*, 1 (0.06%) *O. megnini* and 1 (0.06%) *Argas* spp. In this province, during the period from May to November, cases of tick bites were reported each month except November. The count of the cases reached to a peak with 473 cases (29.38%) in August (Table 1).

The ticks collected from Sakarya were consisted of 1143 (75.65%) *Ixodes* spp., 337 (22.30%) *Hyalomma* spp., 18 (1.19%) *Rhipicephalus* spp., 7 (0.46%) *Dermacentor* spp. and 6 (0.40%) *Haemaphysalis* spp. The tick bite cases were reported each month during the study period. The count of the cases reached to a peak with 538 cases (29.10%) in June (Table 2).

**Table 1.** Number of human-biting ticks by months in Kocaeli province

**Tablo 1.** Kocaeli'nde insanlardan tutan kenelerin aylara göre dağılımı

| Tick Species                     | Numbers of Human-Biting Ticks by Months in Kocaeli |            |            |            |            |           |          |             |
|----------------------------------|----------------------------------------------------|------------|------------|------------|------------|-----------|----------|-------------|
|                                  | May                                                | June       | July       | August     | Sept.      | Oct.      | Nov.     | Total       |
| <b><i>Hyalomma</i> spp.</b>      |                                                    |            |            |            |            |           |          |             |
| Larva                            | -                                                  | 6          | 4          | 12         | 1          | -         | -        | 23          |
| Nymph*                           | -                                                  | 37         | 143        | 367        | 276        | 61        | -        | 884         |
| <i>H. marginatum</i>             | 1                                                  | 10         | 11         | 18         | 1          | -         | -        | 41          |
| <i>H. aegyptium</i>              | 2                                                  | 6          | 7          | 1          | -          | -         | -        | 16          |
| <i>H. detritum</i>               | 1                                                  | 2          | -          | -          | -          | -         | -        | 3           |
| <b><i>Ixodes</i> spp.</b>        |                                                    |            |            |            |            |           |          |             |
| Larva                            | -                                                  | 12         | 3          | 9          | 2          | 1         | -        | 27          |
| Nymph                            | 19                                                 | 113        | 14         | 24         | 6          | 2         | -        | 178         |
| <i>I. ricinus</i>                | 41                                                 | 182        | 42         | 17         | 4          | 16        | -        | 302         |
| <b><i>Rhipicephalus</i> spp.</b> |                                                    |            |            |            |            |           |          |             |
| Nymph                            | -                                                  | -          | 7          | 5          | -          | -         | -        | 12          |
| <i>R. bursa</i>                  | -                                                  | 8          | 37         | 13         | 2          | -         | -        | 60          |
| <i>R. sanguineus</i> (gr.) **    | 5                                                  | 28         | 4          | 3          | 1          | -         | -        | 41          |
| <b><i>Haemaphysalis</i> spp.</b> |                                                    |            |            |            |            |           |          |             |
| Nymph                            | -                                                  | -          | 1          | 2          | -          | -         | -        | 3           |
| <i>H. parva</i>                  | -                                                  | 1          | -          | 1          | 1          | 5         | -        | 8           |
| <i>H. punctata</i>               | -                                                  | 2          | -          | -          | 1          | 1         | -        | 4           |
| <i>H. sulcata</i>                | -                                                  | -          | -          | -          | -          | 1         | -        | 1           |
| <b><i>Dermacentor</i> spp.</b>   |                                                    |            |            |            |            |           |          |             |
| <i>D. marginatus</i>             | -                                                  | -          | -          | 1          | 1          | 2         | -        | 4           |
| <i>B. annulatus</i> (male)       | -                                                  | -          | 1          | -          | -          | -         | -        | 1           |
| <i>O. megnini</i> (nymph)        | -                                                  | -          | 1          | -          | -          | -         | -        | 1           |
| <i>Argas</i> sp.                 | -                                                  | -          | 1          | -          | -          | -         | -        | 1           |
| <b>Total</b>                     | <b>69</b>                                          | <b>407</b> | <b>276</b> | <b>473</b> | <b>296</b> | <b>89</b> | <b>0</b> | <b>1610</b> |

\* *H. aegyptium* nymphs, \*\* *R. sanguineus* group: *R. sanguineus* and *R. turanicus*

**Table 2.** Number of human-biting ticks by months in Sakarya province  
**Tablo 2.** Sakarya'da insanlardan tutan kenerin aylara göre dağılımı

| Tick Species                     | Numbers of Human-Biting Ticks by Months in Sakarya |            |            |            |            |           |          |             |
|----------------------------------|----------------------------------------------------|------------|------------|------------|------------|-----------|----------|-------------|
|                                  | May                                                | June       | July       | August     | Sept.      | Oct.      | Nov.     | Total       |
| <b><i>Hyalomma</i> spp.</b>      |                                                    |            |            |            |            |           |          |             |
| Larva                            | -                                                  | 3          | 7          | 6          | 1          | -         | -        | 17          |
| Nymph*                           | 4                                                  | 5          | 57         | 86         | 109        | 19        | 1        | 281         |
| <i>H. marginatum</i>             | 2                                                  | 15         | 8          | 4          | -          | -         | -        | 29          |
| <i>H. aegyptium</i>              | 2                                                  | 3          | 2          | 2          | -          | -         | -        | 9           |
| <i>H. detritum</i>               | 1                                                  | -          | -          | -          | -          | -         | -        | 1           |
| <b><i>Ixodes</i> spp.</b>        |                                                    |            |            |            |            |           |          |             |
| Larva                            | 1                                                  | 12         | 29         | 37         | 2          | -         | -        | 81          |
| Nymph                            | 96                                                 | 160        | 22         | 20         | -          | 4         | -        | 302         |
| <i>I. ricinus</i>                | 322                                                | 336        | 60         | 37         | 3          | 1         | 1        | 760         |
| <b><i>Rhipicephalus</i> spp.</b> |                                                    |            |            |            |            |           |          |             |
| Nymph                            | -                                                  | -          | 1          | -          | 1          | -         | -        | 2           |
| <i>R. bursa</i>                  | 3                                                  | 2          | 6          | -          | -          | -         | -        | 11          |
| <i>R. sanguineus</i> (gr.)**     | 4                                                  | 1          | -          | -          | -          | -         | -        | 5           |
| <b><i>Haemaphysalis</i> spp.</b> |                                                    |            |            |            |            |           |          |             |
| <i>H. parva</i>                  | 2                                                  | -          | -          | -          | 1          | 2         | -        | 5           |
| <i>H. inermis</i>                | 1                                                  | -          | -          | -          | -          | -         | -        | 1           |
| <b><i>Dermacentor</i> spp.</b>   |                                                    |            |            |            |            |           |          |             |
| Nymph                            | -                                                  | 1          | -          | 1          | -          | -         | -        | 2           |
| <i>D. marginatus</i>             | 1                                                  | -          | -          | 1          | 2          | 1         | -        | 5           |
| <b>Total</b>                     | <b>439</b>                                         | <b>538</b> | <b>192</b> | <b>194</b> | <b>119</b> | <b>27</b> | <b>2</b> | <b>1511</b> |

\**H. aegyptium* nymphs, \*\**R. sanguineus* group: *R. sanguineus* and *R. turanicus*

## DISCUSSION

About the tick profile of Turkey it was stated that there were 32 tick species and of these *Haemaphysalis*, *Hyalomma*, *Boophilus*, *Dermacentor*, *Rhipicephalus* and *Argas* species were common. Although 20 tick species are found in Marmara Region involving our study area<sup>14</sup>, 14 species were determined in this study. Indeed, variety of the species was found similar to the results of other studies carried out in humans in Turkey<sup>9,15</sup>, except *B. annulatus* and *O. megnini*. The unexistence of some species such as *Hyalomma anatolicum* on human, could be explain with high host specificity. But, human infestation of *B. annulatus* which is highly host specific<sup>13</sup>, is unexpected. On the other hand, it could be accepted because it is only one case, and gender of the tick is male. It is known that male ticks could be change their attachment side to another place or to different host, to enhance the chance of mating<sup>4</sup>. As a result of this behavior, male ticks could be found in higher percentage on human except *Ixodes* spp. because of special biology of this species. *O. megnini* was reported from East Anatolia in animals up to the present<sup>14</sup>. This species was encountered from the animals such as cattle, sheep, goats, horses and donkeys in most of the countries worldwide and it was also reported that sometimes humans who are in close contact with affected animals become infested,

especially in endemic areas<sup>13,16</sup>.

It was reported that factors such as temperature, humidity, vegetation, altitude and rainfall closely affect activities of ticks in a given regions<sup>9,15,17</sup>. In this study, although almost same tick species were encountered in two provinces examined, these species distinctively diversified in abundance. Furthermore, seasonal abundance of total ticks also altered in the provinces, since every tick species prefer certain parts of the year. Central city of the Kocaeli province is located on a lowland where is highly affected from the climate of Marmara Sea. The province has appropriate condition for some ticks species, especially tortoise ticks, *H. aegyptium*, which has very high human preference, predominantly at nymphal stages<sup>15</sup>. On the other hand, Sakarya province is located on a lowland which reaches to the Black Sea along with the river, and this province is covered by high mountains on the south which is side of the Marmara Sea. So the province is predominantly under effect of Black Sea climate. Such rainy and forested areas are very favorable for *I. ricinus*, and dominant tick of Sakarya is this species as expected.

This study showed that the risk of tick bites or characteristic of this risk in a region could vary distinctly in terms of sub-regions which have some specific sub-conditions.

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