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RESEARCH ARTICLE

Evaluation of Ticks Biting Humans in Thrace Province, Turkey

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Summary

This study examined 1478 tick samples taken from humans who applied to the hospitals with tick bites in the provinces of Tekirdag, Kirklareli and Edirne in Thrace region of Turkey between May and November, 2007. The samples were evaluated in terms of species, developmental stage, gender, season and locality. The ticks were identified as Hyalomma spp. (76.05%), *Rhipicephalus* spp. (11.71%), *Ixodes* spp. (10.55%), *Haemaphysalis* spp. (1.48%), *Dermacentor* spp. (0.07%), *Ornithodoros* spp. (0.07%), and *Argas* spp. (0.07%). Majority of the tick samples were *Hyalomma aegyptium* nymphs (68.54%). According to the hospital application dates, tick bite cases occurred in August at most (30.11%). Tick bites by *Ixodes* spp. were abundant in the Black Sea coasts of the region. Based on localities, majority of the cases were reported from the urbanized areas (61.30%).

Keywords: *Tick, Thrace, Turkey, Human*

Trakya İllerinde İnsanları Tutan Kenelerin Değerlendirilmesi

Özet

Bu çalışmada, 2007 yılı Mayıs ve Kasım ayları arasında, Trakya Yöresindeki Tekirdağ, Kırklareli ve Edirne illerinde kene tutunma şikayeti ile hastanelere başvuran insanlardan alınan 1478 kene örneği incelenmiştir. Örnekler tür, gelişim dönemi, cinsiyet, tutunma zamanı ve bölgesi yönünden değerlendirilmiştir. Teşhis edilen keneler *Hyalomma* spp. (%76.05), *Rhipicephalus* spp. (%11.71), *Ixodes* spp. (%10.55), *Haemaphysalis* spp. (%1.48), *Dermacentor* spp. (%0.07), *Ornithodoros* spp. (%0.07) ve *Argas* spp. (%0.07)'dir. En fazla *Hyalomma aegyptium* nimflerine (%68.54) rastlanmıştır. Hastaneye başvuru zamanı bakımından, kene tutunma olguları en çok Ağustos ayında (%30.11) gerçekleşmiştir. *Ixodes* spp. kaynaklı olgular bölgenin Karadeniz kıyısında yoğunlaşmıştır. Olguların büyük çoğunluğu (%61.30) şehirsel alanlardan gelmiştir.

Anahtar sözcükler: *Kene, Trakya, Türkiye, İnsan*

INTRODUCTION

Distributed worldwide, there are some 899 described tick species (Argasidae, Ixodidae and Nuttalliellidae consisting of 185, 713 and 1 species, respectively), 10% of which significantly impact human and animal health, by transmitting pathogens of around 200 diseases [1,2].

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Ticks exhibit varying degrees of host selection, depending on species and developmental stages. However, they use different animals as host when they could not quest for their own appropriate host. Although there is not a known tick species which tends to complete its life cycle on humans, it is reported that around 200 tick species, can attach to and feed on humans. Among these, 28 species can play a direct role in transmission of several diseases [3,4].

Risk of tick attachment and related tick-borne diseases in a given region are certainly related to vector tick abundance and human activities. Also, geographic and climatic conditions, and presence and habitat preferences of host animals are closely related with the risk factors [4-6].

In the present study, tick bite cases were evaluated in terms of tick species, seasonal activity and characteristics of locality in Thrace region between May and November, when the most tick species were active, in 2007.

MATERIAL and METHODS

Description of the Study Area

Thrace region constitutes the European part of Turkey. It is bounded on the west by Greece and Bulgaria, on the east by Bosphorus strait, on the north by the Black Sea, on the south by the Sea of Marmara, and on the southwest by the Aegean Sea. Of the study provinces, Tekirdag is situated on the northern coast of the Sea of Marmara, Kirklareli is located along the Bulgarian border and on the west coast of the Black Sea, and Edirne which is in Eastern Thrace bordering the Aegean Sea to the south, Bulgaria to the north and Greece to the west. Large plains and hilly surfaces occupy the interior and south parts of the region. Thrace has high mountains to the north, which run parallel to the Black Sea, and are densely forested. The second largest longos forest in Europe is in this region. Vegetation is composed of steppe predominantly, and maquis in places, and forests in highlands, while the interior and south parts of the region contain cultivable areas. The diverse and transitional weather conditions are the results of the interplay of the different climatic zones in the region; coasts are affected by the climate of the sea nearby, whereas inland exhibits continental climate to some degree. The summers are generally hot (average temperature 27°C) and moderately rainy, except the Black Sea coast receiving high precipitation. The winters are cold (average temperature 4°C) and rainy, especially inland experiencing heavy snow and freezing temperatures below 0°C in places. Total population of the region is 1.502.358 (Tekirdag: 521.554; Edirne: 262.039; Kirklareli: 218.071), and population density is 79.23 per km^2 (Tekirdag: 122.09 per km^2; Edirne: 64.72 per km^2; Kirklareli: 51.44 per km^2) in 2008. The percentage of the total population living in urban areas is 66.67%, while rural population is 33.33%.

Tick Collection and Identification

Ticks were obtained from humans who applied to the regional hospitals with complaints of tick bites between the dates of 01.05.2007 and 30.11.2007. Ticks were removed from the patients by the physicians and sent to our laboratory for identification. Adult ticks were identified to the species level, while larvae and nymphs to the genus level with the exception of *Hyalomma aegyptium* nymphs which could be identified to the species level. Identification was done using taxonomic keys [7-10].

Determination of Seasonal and Regional Distribution of Tick Bites

Tick bites were recorded for each case, based on species and developmental stage of the tick, and date and place of the attachment. From the anamnesis records, possible attachment localities were further determined, and those localities were classified as rural and urban areas.

RESULTS

Data on Tick Species and Developmental Stages

A total of 1478 tick samples were obtained from the overall tick bite cases. Based on developmental stages and numbers, distribution of the species is given in Table 1. In most cases, ticks were in the nymphal stage (74.77%), while adults (23.54%) and larvae (1.69%) succeeded respectively *(Table 1)*.

Data on Localities Where Tick Bites Occurred

Of 1478 cases, 572 were reported from rural areas including villages, farms, grasslands and picnic sites (38.70%), whereas 906 from urban areas (61.30%). While *H. aegyptium* nymphs led to cases of bites in the latter mainly (72.26%), adults of *H. marginatum, H. aegyptium, R. bursa* and *I. ricinus,* and nymphs of *Ixodes spp.* bite humans in rural areas (76.67%, 53.57%, 68.18%, 71.43% and 71.43%, respectively). The number of biting cases by *Rhipicephalus sanguineus* group ticks *(R. sanguineus* and *R. turanicus*) was almost the same for urban and rural areas (51.46% and 58.54% respectively). Tick species, of which number of samples was less than 25, were not taken into account for this evaluation *(Table 2)*.

Table 1. *Species, developmental stages and numbers of the ticks detached from humans*
Tablo 1. *İnsanlardan toplanan kenelerin tür, gelişme dönemi ve sayıları*

Total	Number of Larvae	Number of Nymphs	Number of Adults	Total
Hyalomma spp.	16	-	-	16
H. marginatum	-	-	60	60
H. aegyptium	-	1013	28	1041
H. detritum	-	-	7	7
Ixodes spp.	9	84	-	93
I. ricinus	-	-	63	63
Rhipicephalus spp.	-	4	-	4
R. sanguineus gr.	-	-	103	103
R. bursa	-	-	66	66
Haemaphysalis spp.	-	4	-	4
H. parva	-	-	15	15
H. punctata	-	-	2	2
H. sulcata	-	-	1	1
Dermacentor marginatus	-	-	1	1
Ornithodorus sp.	-	-	1	1
Argas sp.	-	-	1	1
Total	25	1105	348	**1478**

Of the 156 *Ixodes spp.* collected, 120 (76.92%) occurred in Kirklareli located on the west coast of the Black Sea, whereas 29 (18.59%) and 7 (4.49%) in Tekirdag and Edirne, respectively, the former being situated on the coast of the Sea of Marmara, and the latter being in the inner of the region. *Table 2* summarizes the related data.

Seasonal Distribution of Cases

During the period from May to November, cases of tick bites were reported each month. Most cases were occurred between June and September, reaching to a peak with 445 cases (30.11%) in August. Larval infestations of *Hyalomma spp.* were occurred between May and September, mostly in June and July with the

Table 2. *Cases of tick bites by species, type of locality and provinces*
Tablo 2. *Tür, tutunma yeri tipi ve illere göre kene tutma olguları*

Tick Species	Tick Numbers				
	Type of Locality		The Provinces		
	Rural Area	Urban Area	Tekirdag	Kirklareli	Edirne
Hyalomma spp. (Larvae)	6	10	9	5	2
H. marginatum	46	14	13	24	23
H. aegyptium (Nymph)	281	732	558	236	219
H. aegyptium	15	13	9	12	7
H. detritum	3	4	1	4	2
Ixodes spp. (Larva)	6	3	3	6	0
Ixodes spp. (Nymph)	60	24	11	68	5
I. ricinus	45	18	15	46	2
Rhipicephalus spp. (Nymph)	2	2	1	3	0
R. sanguineus gr.	50	53	48	38	17
R. bursa	45	21	29	27	10
Haemaphysalis spp. (Nymph)	1	3	2	2	0
H. parva	8	7	11	3	1
H. punctata	1	1	2	0	0
H. sulcata	1	0	1	0	0
Dermacentor marginatus	0	1	0	1	0
Ornithodorus sp. (Adult)	1	0	0	1	0
Argas sp. (Adult)	1	0	0	1	0
Total (1478)	572 (38.70%)	906 (61.30%)	713 (48.24%)	477 (32.27%)	288 (19.49%)

case numbers 6 and 7, respectively. Infestations with *H. aegyptium* nymphs were reported between May and October, and there was a peak in August (394 cases) and September (391 cases), while adults of this species were recorded between June and September with a peak of 13 cases in June. *H. marginatum* adults were seen between May and August, and July showed a peak with 29 cases. Little cases by nymphs of *Haemaphysalis spp.* were occurred between July and September. Fifteen (15) cases of *H. parva* infestation were seen predominantly in autumn months, October being the month in which 7 cases occurred. *Rhipicephalus spp.* were recorded between May and September, especially in June and July. Adults of *I. ricinus* infestations were recorded each month during the study period, and both adults and nymphs were predominant in June and July. *Table 3* summarizes the related data.

Table 3. *Cases of tick bites by months*
Tablo 3. *Aylara göre kene tutma olguları*

Tick Species	Tick Numbers by Months						
	May	June	July	August	September	October	November
Hyalomma spp. (Larva)	1	6	7	1	1	0	0
H. marginatum (Adult)	3	22	29	6	0	0	0
H. aegyptium (Nymph)	1	25	148	394	391	54	0
H. aegyptium (Adult)	0	13	9	4	2	0	0
H. detritum (Adult)	1	3	1	2	0	0	0
Ixodes spp. (Larva)	1	0	5	3	0	0	0
Ixodes spp. (Nymph)	9	41	32	2	0	0	0
I. ricinus (Adult)	6	37	8	4	3	2	3
Rhipicephalus spp. (Nymph)	0	1	1	1	1	0	0
R. sanguineus gr. (Adult)	11	60	23	8	1	0	0
R. bursa (Adult)	1	23	24	16	2	0	0
Haemaphysalis spp. (Nymph)	0	0	1	2	1	0	0
H. parva (Adult)	1	1	0	1	1	7	4
H. punctata (Adult)	0	0	0	0	2	0	0
H. sulcata (Adult)	0	0	0	0	1	0	0
D. marginatus (Adult)	0	0	0	1	0	0	0
Ornithodorus sp. (Adult)	0	1	0	0	0	0	0
Argas sp. (Adult)	0	0	1	0	0	0	0
Total (1478)	35	233	289	445	406	63	7
(%)	(2.37)	(15.76)	(19.55)	(30.11)	(27.47)	(4.26)	(0.47)

DISCUSSION

Throughout Turkey, 32 tick species (28 ixodids and four argasids) have been found so far; of these, 20 species are found in Marmara Region involving Thrace [11]. However, the present study reported 13 tick species from three provinces in Thrace. *Boophilus annulatus (R. annulatus)* and *Hyalomma anatolicum* which are known to frequently attach to livestock in the study area [11] were not encountered in biting cases evaluated with this study. This may suggest that these species indicate high host selectivity, or they do not tend to bite humans. The degree of host selection of *B. annulatus,* a one-host tick found most often on cattle, is known to be high [12]. Thus, it is more likely that this species prefers their primary host, cattle which are abundant in the study area, rather than humans and other animal hosts.

Each tick species possesses a special activity season, and activity period may differ partly, depending on weather conditions and geographical characteristics. Species of Dermacentor and Haemaphysalis are active in early Spring and late Autumn, while *Rhipicephalus spp.* appear in humid and warm months, and Ixodes species become active in cool and humid months [13]. This study revealed that most of tick biting cases occurred in hot summer months, especially in August. Overlap of periods in which a given tick species is active and humans enter the habitat of that tick is one of the most important factors which determines the possibility of human-tick contact. When considering that humans occupy grasslands, pastures and picnic sites in warm seasons, it is clear why Hyalomma species which are active in hot months cause most of biting cases.

According to the species, and even developmental stage, most of the ticks prefer a certain group of hosts. In contrast to adults larvae and nymphs exhibiting less host selectivity and readily attach to rodents and birds [12,14]. With regard to developmental stages, nymphs were

found to be dominant in this study (74.77%), and succeeded by adults and larvae (23.54% and 1.69%, respectively). Additionally, tendency of each species, even each developmental stage to bite human is quite different from each other. While 28 *H. aegyptium* adults were found infesting humans, the number of its' nymphs found on humans was 1013. Similarly, *Ixodes spp.* nymphs found outnumbered the adults (84 and 63, respectively). On the other hand, adults of Rhipicephalus and Haemaphysalis were numerous, and there were no nymphs of *H. marginatum*. Considering the biology of the latter which is a two-host tick, it is not surprising that there were no nymphs at all. But, one cannot say the same thing for Rhipicephalus and Haemaphysalis species which are three-host ticks, since there may be several different factors affecting the attachment of immature forms of these ticks to humans. 1013 *H. aegyptium* nymphs constituted the biggest portion (68.54%) of total ticks collected during the study. However, adults of this species were less in number (28 adults composing 1.89% of total ticks). Another interesting finding is that nymphs were mostly from urban areas (72.26%), whereas adults from rural areas (53.57%). It is reported that *H. aegyptium,* a three-host tick, uses turtles, other reptiles and mammals as host [8], turtles are the primary host of each of three developmental stages [15], being the first preference of the adults [16]. Larvae and nymphs may prefer also other reptiles, mammals and birds rather than turtles [7,8]. Conserving natural structure to some extent (eg. small city parks, cemetaries), urban areas in the study area possess turtles overly. This situation and the current literature may explain the abundance of *H. aegyptium* nymphs leading to human infestations. Yet, outnumbered nymphs compared to adults may be correlated to the density in environment and flexibility in host selection. However, these cannot be explanation for the adults causing biting cases in rural areas. Our observations showed that turtles in urban areas tend not to leave their limited habitat. Thereby, instead of attempting to find different hosts, huge and crawling Hyalomma adults [9,10] readily find turtles, which travel wide distances, to feed on. But, larvae and nymphs are not easy to find a host, and use the first animal which they find as host without showing host selection. Nevertheless, these assumptions cannot explain why biting cases caused by larvae of both *H. aegyptium* and other species were less in number, compared to the nymphs. On the other hand, larvae possibly prefer small animals rather than humans as host since it will be difficult for them to crawl up bigger hosts. In addition, due to their small size, larvae attached to human body might be overlooked.

Although *R. bursa* caused more biting cases in rural areas (68.18%), the number of the cases by *R. sanguineus* group was almost the same in rural and urban areas (48.54% and 51.46% respectively). The reason for this may be related to the fact that ticks of *R. sanguineus* group are three-hosted and prefer dogs and some other animals [9], and population of stray dogs is enough in both areas to support population of these ticks. On the other hand, *R. bursa* is a two-host species preferring ruminants, and its biology is mostly restricted to rural areas.

Hyalomma marginatum is the known vector of Crimean-Congo hemorrhagic fever in Turkey [17]. This species was reported not to prefer humid areas, and to feed on animals, exhibiting a tendency to use humans as host [4]. Our results also showed that *H. marginatum* is abundant in relatively dry and rural parts of the study area.

Ixodes spp. were seen to be abundant mainly in Kirklareli where rainy Black Sea climate prevails, and partially in neighboring Tekirdag. In fact, this situation is quite accordant with the known bioecological characteristics of the ticks in the genus Ixodes which is well adapted to rainy and cooler geographical areas [13]. Unlike to the fact that nymphs of *Ixodes spp.* are widely seen in Autumn in the regions where these ticks are commonly found [13], both adults and nymphs of *Ixodes spp.* were observed mainly in June and July in our study. Considering that the present study was a passive survey, rather than the actual annual distribution of this tick, the situation can be related to the dense human activity in the natural habitat of this species in summer months.

66.67% and 33.33% of the people live in urban and rural areas respectively in the study area, and the percentages of biting cases were 61.30% for urban and 38.70% for rural areas. As seen from the data, the population density and tick bite cases in the study area are quite parallel to each other.

Factors such as temperature, humidity, precipitation, vegetation and altitude affect activities of ticks substantially [18]. Furthermore, tick infestation, vector potential of the relevant ticks and the accompanying problems are closely connected to some factors including host species, habitat and geographic conditions [4-6,19]. In conclusion, our findings confirmed by current literature reveal that there are many factors which determine level of risk to humans resulting from tick attachment and tick-borne diseases.

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