

Ticks biting humans in the urban area of Istanbul

Z. Vatansever · A. Gargili · N. S. Aysul · G. Sengoz ·
A. Estrada-Peña

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Abstract A passive surveillance for tick bites in humans was undertaken in the city of Istanbul (Turkey) in the summer and autumn of 2006. From 1,054 reported tick bites, most were females of *Ixodes ricinus* (27%) and nymphs of *Hyalomma aegyptium* (50%). A few adults of *Hyalomma m. marginatum*, *Rhipicephalus sanguineus* and *Dermacentor marginatus* were also recorded. We investigated potential risk factors for *I. ricinus* and *H. aegyptium* with spatial statistics. Climate features at 1-km resolution (monthly minimum temperatures in late summer and autumn and rainfall) and vegetation features at high resolution (density and heterogeneity of forest-type vegetation as well as distance of reporting site to these vegetation features) are

useful variables explaining high reporting clusters for both *Ixodes* and *Hyalomma*. While *Ixodes* is highly reported in dense highly heterogeneous vegetation patches, *Hyalomma* is commonly found in areas far from forest-type features and in the small, relatively dry vegetation patches within the urban fabric.

Ticks are important pests of domestic animals and prominent parasites of humans. Literally, dozens of health-threatening agents can be transmitted to humans by tick bites (Estrada-Peña and Jongejan 1999). The risk of ticks transmitting diseases is dependent upon several parameters, like the prevalent tick species, its abundance and their preferences towards humans as hosts. All these variable features are further complicated by the social habits in a given area, the presence of dense populations of hosts for immature stages and the climate and vegetation features, which define the degree of environmental adequacy for the tick populations. The purpose of this study is to know the species of ticks biting humans in the urban area of Istanbul (Turkey) and surrounding zones. Previous studies in the area were restricted to collections of ticks from vegetation or feeding on animals (Çalisir et al. 2000, 2003) but no surveys of ticks from humans have been conducted. An additional aim is to capture the variables involved in the presence of clusters (“hot spots”) of tick bites reporting.

The city of Istanbul is located at 41° N, 28° E. The area of study includes a dense urban fabric with more than fifteen million people. Public parks of variable sizes are interspersed within the city. In the southern parts of the region of study, there is a belt of bush with short and relatively dry vegetation and some culture fields. In the north of the city, and extending towards east and west, there are dense deciduous, humid forests. Passive surveillance

Z. Vatansever
Faculty of Veterinary Medicine, Kafkas University,
Kars, Turkey

A. Gargili
Cerrahpasa Medical Faculty, Istanbul University,
Istanbul, Turkey

N. S. Aysul
Faculty of Veterinary Medicine, Istanbul University,
Istanbul, Turkey

G. Sengoz
Ministry of Health, Istanbul Branch,
Istanbul, Turkey

A. Estrada-Peña
Faculty of Veterinary Medicine, Zaragoza University,
Saragossa, Spain

A. Estrada-Peña (✉)
Department of Parasitology, Veterinary Faculty,
Miguel Servet 177,
50013 Saragossa, Spain
e-mail: aestrada@unizar.es

was carried out between June and October 2006. The Istanbul branch of the Ministry of Health of Turkey asked hospitals to submit ticks found by the public in the area of study. The survey was centralised in the Microbiology and Clinical Microbiology Department, Cerrahpasa Medical Faculty, Istanbul University. In most cases, the ticks were removed from the patients by medical staff. People were asked about the location where they acquired the tick to accurately geo-reference the site for further research. Ticks were determined using keys by Pomerantsev (1950), Apanaskevich (2003, 2004) and Estrada-Peña et al. (2004). The survey reported 1,054 ticks from humans in the urban, outskirts and rural areas close to the city of Istanbul.

Table 1 shows the species of ticks removed from humans and their relative importance. The most prevalent ticks are nymphs of *Hyalomma aegyptium* (more than the 50% of the reported ticks) and females of *Ixodes ricinus* (more than 25%). The low prevalence of *Rhipicephalus* spp. as well as the presence of some adults of *Hyalomma detritum* is noteworthy. We must stress the presence of *Hyalomma m. marginatum*, as this tick is a recognised vector of the Crimean–Congo haemorrhagic fever virus. The recent epidemic of this disease in Turkey (Bakir et al. 2005; Karti et al. 2004) raises the question of whether populations of the tick exist in the city or rather they are imported by passerine birds into the many small vegetation patches existing within the urban fabric. The records of *H. aegyptium* on humans are remarkable, as reported hosts for adults are turtles (Petney and Al-Yaman 1985) while several species of mammals, birds and reptiles have been recorded as hosts for immatures (Apanaskevich 2004). The reports of tick on humans raise the question about its importance as a vector of pathogens. A spirochete, *Borrelia turcica*, has been detected on ticks of

this species collected from turtles in the same area (Guner et al. 2004). Neither implications as human pathogen nor the reservoir hosts for that spirochete have been reported so far. The importance of *H. aegyptium* for humans should be further studied in its distribution range. While *H. m. marginatum* is commonly reported as a human-biting tick (Estrada-Peña and Jongejan 1999), nothing is known about its potential role as an emerging parasite for humans. Most of the *Ixodes* spp. collected in this study were females of *I. ricinus* and not nymphs. Nymphs of this species are commonly active in autumn in its wide distribution range (Gray 2002). The focus of the survey in summer months seems to have precluded an adequate overview of other *Ixodes* stages attacking humans in the region. The low numbers of *Rhipicephalus* spp. recorded in this survey is noteworthy. *Rhipicephalus sanguineus* is an endophilous tick commonly found in human constructions because of its association with the domestic dogs but has been scarcely collected in this study. Other species, as *Rhipicephalus bursa* and *Dermacentor marginatus*, represent only accidental records.

Clusters of high tick reporting are an indication of risky areas. Potential causes leading to these clusters may be high human densities (and thence biasing the clusters) or a series of special habitat characteristics allowing for such a cluster of tick activity. Of the total number of ticks, 479 were unambiguously geo-referenced; the rest of the patients cannot provide with adequate details about the place they visited when bitten by the tick. The potential for clustering in tick records was examined using Oden's method (Oden 1995). Only records for *I. ricinus* and *H. aegyptium* were used because they accounted for more than 75% of samples. We used already described protocols for the identification of clusters of high tick reporting as well as climate and vegetation variables defining such a clustering of reports (Estrada-Peña et al. 2007). Observed clusters of reports for these two species are independent of the human population density ($p < 0.001$). Ticks are underreported in eastern parts of the urban area ($p < 0.005$) while sharing the same characteristics of vegetation and climate ($p = 0.392$). While the tick over-reporting seems to be connected with an adequate habitat, sites of underreporting may be coupled with the lack of specimens received from some hospitals in the Asian side of the city. Clusters of *I. ricinus* are common around forest-type vegetation ($p < 0.001$) associated to highly heterogeneous vegetation patches ($p < 0.005$) or found at short distances of these heterogeneous forest-type patches ($p < 0.001$). However, clusters of *H. aegyptium* are frequent in areas of bush-type vegetation ($p < 0.001$) with low heterogeneity ($p < 0.001$) and far from heterogeneous forest patches ($p < 0.001$). Records of the latter area from the urban fabric largely coincide spatially with the many gardens and the scattered and abundant cemeteries through-

Table 1 Ticks species and stages collected from humans in the area of the city of Istanbul and surroundings

Species	M	F	L	N
<i>I. ricinus</i>	0.09	27.13	0.00	0.09
<i>Ixodes</i> sp.	0.00	0.09	2.94	9.11
<i>Ixodes</i> spp.	0.09	27.23	2.94	9.20
<i>H. m. marginatum</i>	1.04	0.38	0.00	0.00
<i>H. aegyptium</i>	0.38	0.28	0.00	52.19
<i>H. detritum</i>	0.09	0.00	0.00	0.00
<i>Hyalomma</i> spp.	0.47	0.66	0.19	52.19
<i>R. bursa</i>	0.47	0.19	0.00	0.00
<i>R. sanguineus</i>	1.61	2.28	0.00	0.00
<i>Rhipicephalus</i> sp.	0.00	0.09	0.00	1.33
<i>Rhipicephalus</i> spp.	2.09	2.56	0.00	1.33
<i>D. marginatus</i>	0.19	0.57	0.00	0.00
<i>Dermacentor</i> sp.	0.00	0.00	0.00	0.28
<i>Dermacentor</i> spp.	0.19	0.57	0.00	0.28

Rows in bold typeface refer to data for the genera.
M Males, F females, L larvae, N nymphs

out the study area (a common place for picnic or sporting activities by the inhabitants), both sites supporting dense populations of turtles and passerine birds. Because of the characteristics of the habitat and abundance of hosts for immatures of *Hyalomma* ticks, there are probably permanent populations of *H. aegyptium*. The presence of *I. ricinus* through the urban fabric seems to be derived from the small patches of vegetation, which are an adequate resting place for passerine birds. This results in a sustained flow of engorged immatures from surrounding forests into, probably, non-permanent population of *Ixodes*.

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