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Short communication

Records of ticks on humans in Rio Grande do Sul state, Brazil

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ABSTRACT

More than seventy tick species have been reported in Brazil. Despite the emergence of tick-borne diseases in Neotropical region, there are still limited data available on tick species parasitizing humans in Brazil. Rio Grande do Sul is the southernmost state of Brazil, comprising the only part of Brazilian territory inside the Pampa biome, as well as the transition between subtropical and temperate zones. Here, we report on human parasitism by ticks in Rio Grande do Sul state between 2004 and 2017. Seventy cases of human parasitism by ticks were recorded, with a total of 81 tick specimens collected. These included 11 tick species belonging to three genera of Ixodidae (hard-ticks), *Amblyomma*, *Haemaphysalis* and *Rhipicephalus*; and one genus of Argasidae, *Ornithodoros*. The most prevalent tick species associated to cases of human parasitism were *Amblyomma parkeri* (24%), *Rhipicephalus sanguineus* sensu lato (22%), *Amblyomma aureolatum* (15%) and *Amblyomma ovale* (12%). A spatial analysis showed two major hot spots of human parasitism by ticks in Rio Grande do Sul state. The findings of this study highlight the need for permanent monitoring of human parasitism by ticks in order to provide a better understanding of tick and tick-borne disease eco-epidemiology, and the early identification of potential cases of tick-borne diseases, particularly in spotted fever endemic regions.

1. Introduction

More than seventy tick species, including vectors of pathogens affecting humans and domestic animals, have been reported in Brazil (Gianizella et al., 2018). Tick-borne diseases are emerging in Neotropical region, with a significant increase in the incidence of human cases and in the number of scientific papers published in recent years (de Oliveira et al., 2016). Nevertheless, despite increasing interest in tick borne-diseases such as rickettsiosis and borreliosis, there are still few data available on which tick species parasitize humans in different parts of Latin America (Guglielmone et al., 2006; Lamattina and Nava, 2016; Ramos et al., 2014; Saracho-Bottero et al., 2018).

In Brazil, spotted fever (SF) was classified as a disease of compulsory notification in 2001. In 2014, health authorities considered SF a disease of immediate notification, which means that every single case should be investigated by health authorities (de Oliveira et al., 2016). Even so, for most SF cases recorded, the patient only seeks medical attention after tick removal and ticks are rarely recovered and identified (Health Department of Rio Grande do Sul state, unpublished data). Also, we must take into account that the SF cases are just a minority of all instances of human parasitism by ticks, and that few Brazilian states or municipalities currently officially record human parasitism by ticks.

Rio Grande do Sul (RS) is the southernmost state of Brazil. It is located in the transition between subtropical and temperate zones, and is the only part of the country located inside the Pampa biome. The Pampa biome, also known as the Southern America Grasslands, is considered a particular kind of steppe, characterized by grasslands, with sparse shrub and tree formations. Also, RS state comprises the southern border of the Atlantic Rainforest biome and its unique transition area to Pampa (forest-grassland transition area) (Roesch et al., 2009). To date, 20 species of hard ticks (IXODIDAE) and 2 species of soft ticks (ARGASIDAE) have been recorded in RS state: IXODIDAE, *Amblyomma aureolatum*, *Amblyomma calcaratum*, *Amblyomma dubitatum*, *Amblyomma fuscum*, *Amblyomma incisum*, *Amblyomma longirostre*,

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Amblyomma nodosum, *Amblyomma ovale*, *Amblyomma rotundatum*, *Amblyomma tigrinum*, *Amblyomma triste, Amblyomma yucumense*, *Haemaphysalis juxtakochi*, *Ixodes aragaoi*, *Ixodes auritulus*, *Ixodes fuscipes*, *Ixodes longiscutatus, Ixodes loricatus, Rhipicephalus microplus,* and *Rhipicephalus sanguineus* sensu lato; and ARGASIDAE, *Argas miniatus* and *Ornithodoros brasiliensis* (Brum and Costa, 2003; Evans et al., 2000; Krawczak et al., 2015; Martins et al., 2011; Michel et al., 2017).

The first cases of SF in RS state were recorded in 2005; since then, two genetic variants of *Rickettsia parkeri* have been associated with SF cases in RS: *Rickettsia parkeri* strain Atlantic Rainforest and *R. parkeri* sensu stricto (strain RS) (Krawczak et al., 2016; Voizzoni et al., 2016; Weck et al., 2016; Weck et al., 2017). Despite the growing importance of SF in RS state, few cases of human parasitism by ticks in this state have been reported in the literature (Evans et al., 2000; Guglielmone et al., 2006; Soares et al., 2007; Mentz et al., 2016; Da Silva, 2016). Thus, the aim of this study was to improve the knowledge of human parasitism by ticks in Rio Grande do Sul state, Brazil.

2. Materials and methods

To update the records of ticks parasitizing humans in RS state, we reviewed and compiled tick records deposited in three scientific collections of institutions in RS: "Coleção Científica de Carrapatos Dr. João Ricardo Martins" at Instituto de Pesquisas Veterinárias Desidério Finamor (IPVDF); "Coleção de Ácaros do Museu de Ciências Naturais" at Fundação Zoobotânica do Rio Grande do Sul (FZB-RS); and "Coleção Científica de Carrapatos" at Laboratório Central de Saúde Pública do Rio Grande do Sul (LACEN). All three of the institutions cited above act as reference laboratories for the RS state government, receiving tick samples from municipal health authorities, primary care physicians, veterinarians, ecologists, private laboratories, universities, farmers, and even directly from bitten people. For this work, we considered (i) records of ticks collected by health practitioners, or by one of the authors, attached to humans, and (ii) ticks collected by individuals who reported to health practitioners or to one of the authors that the tick was attached to them. Ticks were identified by morphologic dichotomous keys (Barros-Battesti et al., 2006; Martins et al., 2010). All tick identifications were carried out independently by at least three different researchers. Specimens presented in this work comprise only unpublished reports. Confirmation of the taxonomic status of *O. brasiliensis* nymphs were previously performed by molecular analysis of 16S rRNA gene sequence of DNA extracted from tick legs (Barros-Battesti et al., 2012).

The locations of cases of human parasitism by ticks reported here were plotted using the geographical information system software ArcGIS 10.5 (ESRI, Redlands, CA, USA). The kernel-density interpolation function in the Spatial Analyst extension was used to convert point data into continuous surfaces ("kernel-density themes") expressing the intensity per square km of the occurrence of tick bites. The kernel-density themes were estimated using a bandwidth of 30 km for the bivariate kernel-density function.

3. Results

Seventy cases of human parasitism by ticks were recorded, with a total of 81 ticks. The tick records shown here comprise a 14-year period, between 2004 and 2017. Tick specimens were collected in 42 municipalities of RS state. Almost 70% of cases were from the Atlantic Rainforest biome, in contrast to 30% from the Pampa biome. An overview of the spatial distribution of tick bite cases across RS state is shown in Fig. 1.

Cases of human parasitism were related to 11 tick species, belonging to three genera of hard ticks, *Amblyomma*, *Haemaphysalis*, and *Rhipicephalus*; and one soft tick genus, *Ornithodoros*. The most prevalent tick species associated with human parasitism, for the data shown here, were: *Amblyomma parkeri* (24% of cases), *R. sanguineus* sensu lato (22%), *A. aureolatum* (15%) and *A. ovale* (12%). The summary of records of human parasitism by ticks is shown in Table 1.

4. Discussion

For years, human parasitism by ticks was considered a very rare event in RS state, leading some health practitioners to believe that there were no tick species capable of parasitizing humans in RS (Evans et al., 2000; Reck et al., 2013). More recently, with the increase in the incidence of suspected and confirmed cases of SF, as well as evidence of *Rickettsia* spp. circulation in ticks, humans and animals in RS, this situation changed (Weck et al., 2016; Dall'Agnol et al., 2017; Weck et al., 2017; Dall'Agnol et al., 2018).

However, as far as we are aware, only a few cases of human parasitism by ticks were previously reported in RS state. Only two were related to the genus *Amblyomma*; one *A. tigrinum* male collected on a person in Guaíba municipality (Pampa biome) in 1983 (Evans et al., 2000), and another *A. tigrinum* male from Parque Estadual do Espinilho on Barra do Quaraí municipality (Pampa biome) in 2013 (Da Silva, 2016). There were two reports of *R. sanguineus* sensu lato ticks, one male collected in Cachoeira do Sul in 2005, and one female collected in Porto Alegre in 2015 (Guglielmone et al., 2006; Mentz et al., 2016). Also, there is a report of two male *R. microplus* ticks collected from an individual in Santa Maria in 2006 (Soares et al., 2007). For soft ticks, there are a set of papers in the literature describing anecdotal reports of human parasitism by *O. brasiliensis* in RS state (Pinto and di Primio, 1931; Aragão, 1936; di Primio, 1937; Martins et al., 2011; Reck et al., 2013).

Here, we provide a compilation of reports of human parasitism by ticks in RS state for a 14-year period. The spatial distribution analysis of human parasitism by ticks showed that cases occur in several parts of RS state, including municipalities from both the Pampa and Atlantic Rainforest biomes. Also, it is possible to identify at least two regions with a high frequency of tick bite cases (Fig. 1). The first one, the greater hot spot on the map, comprises the two major cities of RS state (Porto Alegre and Caxias do Sul) and nearby towns. The analysis of incidence rates (Fig. 1, lower map) shown that the hot spots seem not directly related to the size of human population. Indeed, in recent years, this region has experienced a growth in the deforestation process, which in turn has been successively associated with the emergence of tick parasitism and tick-borne diseases (Londoño et al., 2017; Ogrzewalska et al., 2011; Scinachi et al., 2017). While the loss of natural habitats in the Atlantic Rainforest is mainly related to the expansion of cities and human habitations, in the Pampa, this process is linked to the expansion of agriculture (Overbeck et al., 2007; Ribeiro et al., 2009). Still regarding this hot spot, since it comprises the main cities of RS state, we cannot rule out that people in this region could have easier access to health care facilities, which could facilitate the identification of cases of tick parasitism. The other hot spot on the map is in the northwest of RS state. This is the region of RS where the first case of SF was reported in 2005 (de Oliveira, 2017). Indeed, it was the first part of RS in which health care practitioners were trained to handle tick-borne disease cases, which could increase the data of passive surveillance for ticks.

Surprisingly, the most prevalent tick species associated with human parasitism in our study was *A. parkeri*, a tick species that has not been previously reported in RS state. To date, *A. parkeri* has not been considered a tick species commonly associated to human parasitism. The only report of this tick species parasitizing humans is a nymph collected in São Paulo in 2012 (Martins et al., 2013). It is noteworthy that all 17 cases of parasitism by *A. parkeri* ticks reported here were associated with nymphs. Since a taxonomic key for the identification of *Amblyomma* spp. nymphs from Brazil only became available few years ago (Martins et al., 2010), it is possible that some tick records previously identified as *Amblyomma* sp. in the great part of Brazilian tick collections actually belonged to *A. parkeri*. All cases of *A. parkeri* parasitism registered here were from the Atlantic Rainforest biome. Indeed, there