Streszczenie w języku angielskim

Ticks and the pathogens they transmit pose an increasing threat to human and animal health. Although these arachnids are commonly associated with forests and meadows, in the process of urbanization, ticks have largely adapted to life in urban areas, which was confirmed in many scientific reports from cities around the world. The most common species of ticks in Poland are *Ixodes ricinus* (common tick) and *Dermacentor reticulatus* (ornate dog tick). Both species are capable of transmitting a wide variety of microorganisms, including those that are pathogenic to humans.

The aim of this study was to determine the infection rate of *I. ricinus* and *D. reticulatus* ticks collected in recreational areas of Białystok and Augustów with selected pathogens: *Borrelia* spp., *Babesia* spp., *Anaplasma phagocytophilum, Rickettsia* spp., *Coxiella burnetii*, and *Bartonella* spp.

The collection of ticks was carried out in the years 2017-2019 using the flagging method. Thus, 842 *I. ricinus* (460 from Białystok and 382 from Augustów) and 638 *D. reticulatus* ticks (620 from Białystok, 18 from Augustów) were obtained. The collected ticks were identified in terms of species and developmental stage and later subjected to the process of DNA isolation. Afterwards, using the PCR method, the exact percentage of infections with particular pathogens was determined.

The overall infection rate among acquired ticks was 19.4%. The most frequently detected pathogen in *I. ricinus* was *Borrelia* spp. (25.2%). Moreover, *Babesia* spp. (2.0%) and *A. phagocytophilum* (1.2%) were found. In the case of *D. reticulatus*, the highest percentage of ticks were positive for Babesia spp. (8.3%). *A. phagocytophilum* was detected in six individuals (0.9%), and *Borrelia* spp. - in three (0.4%). *Rickettsia* spp., *Bartonella* spp., and *C. burnetii* were not detected in any of the samples. 14 cases of co-infections were detected among *I. ricinus* ticks.

Sequencing analysis showed that in Białystok the majority of *I. ricinus* ticks were infected with *Borrelia afzelii* spirochetes, while *Borrelia garinii* dominated in Augustów. Among common ticks, the presence of *Borrelia burgdorferi* sensu stricto, *Borrelia miyamotoi*, and *Borrelia lusitaniae* was also detected. The majority of *Babesia*-positive samples were identified as *Babesia microti* and the remaining two as *Babesia venatorum*. As for *D. reticulatus*, *Babesia*

canis was the most prevalent pathogen, although the presence of *B. microti* was also detected. Out of the samples positive for *Borrelia* spp., *B. garinii* and *B. afzelii* were identified.

Statistical analysis showed a significantly higher percentage of infections with *Borrelia* spp. and *Babesia* spp. in *I. ricinus* and *D. reticulatus*, respectively. Both of these pathogens were found more frequently in ticks collected from April to July. In the case of *Borrelia* spp., a greater percentage was obtained at temperatures above 20°C, while more ticks infected with *Babesia* spp. were collected at temperatures below 20°C and air humidity below 80%. Moreover, the multivariate logistic regression model revealed that the prevalence of *Borrelia* spp. was influenced not only by the tick species but also by the developmental stage and the sampling year.

The statistical analysis of literature data on the infection of *I. ricinus* ticks from urbanized areas in Europe showed a number of significant differences. It was revealed that the region of Europe, average temperature and air humidity, as well as the climatic zone, had an influence on the frequency of the occurrence of pathogens infected ticks, both in terms of the overall incidence rate and, separately, *Candidatus* Neoehrlichia mikurensis, *A. phagocytophilum* and *Borrelia burgdorferi* sensu lato.

Conclusions

1. *I. ricinus* and *D. reticulatus* ticks living in recreational areas in Białystok and Augustów are infected with at least three pathogens: *Borrelia* spp., *Babesia* spp., and *A. phagocytophilum*.
2. The percentage of infections with particular pathogens obtained in the course of this study is comparable, or higher than the results obtained in other studies in Europe, which underlines the importance of further research in this area.
3. The detected cases of co-infections indicate the need to take this phenomenon into account in the diagnosis of tick-borne diseases, especially in the case of an atypical clinical picture.
4. Climatic conditions such as humidity and temperature influence the occurrence of ticks infected with pathogens such as *Borrelia* spp. and *Babesia* spp.
5. The increasing rate of *Borrelia* spp. detected in the following years of sampling suggests the expansion of this pathogen and indicates the need for further research to monitor the potential risk to humans and animals.