KATARZYNA BARTOSIK[1], JOLANTA SZYMAŃSKA[2], ALICJA BUCZEK[1]

Zagrożenie zdrowia ludzi kleszczami *Ixodes ricinus* w odniesieniu do możliwości diagnostycznych i leczniczych w południowo-wschodniej Polsce

Streszczenie

Wstęp. *Ixodes ricinus* – kleszcz o dużym znaczeniu medycznym i weterynaryjnym jest gatunkiem licznie występującym w południowo-wschodniej Polsce. Zagrożeniem dla zdrowia ludzi i zwierząt są zarówno bezpośrednie skutki pasożytowania tych stawonogów jak również ryzyko transmisji mikroorganizmów chorobotwórczych, m.in. *Borrelia burgdorferi*, *Anaplasma phagocytophilum*, wirus kleszczowego zapalenia mózgu, *Rickettsia helvetica* i *Babesia* spp. W ostatnich latach w Polsce wzrasta liczba przypadków boreliozy i KZM. Na badanym terenie w latach 2000-2007 odnotowano ponad 20-krotny wzrost zapadalności na boreliozę w województwie lubelskim i ponad 2-krotny w województwie podkarpackim (odpowiednio 2,24 do 22,8 i 11,47 do 22,8).

Cel. Celem pracy była próba oceny możliwości diagnostycznych chorób odkleszczowych w południowo-wschodniej Polsce jak również oszacowanie ryzyka ataków kleszczy w biotopach zróżnicowanych pod względem biologicznym, często odwiedzanych przez turystów i mieszkańców w celach wypoczynkowych.

Materiał i metody. Badania prowadzono w południowo-wschodniej Polsce, w latach 2003-2006. Kleszcze zbierano metodą flagową. Określono gatunek, płeć i stadium rozwojowe okazów. Dane o placówkach służby zdrowia i personelu medycznym zaangażowanym w diagnozowanie i leczenie chorób odkleszczowych uzyskano z Informatora Statystycznego Ochrony Zdrowia.

Wnioski. Różnice w liczebności populacji *I. ricinus* oraz nimf i postaci dorosłych można tłumaczyć inną strukturą biotopów w badanych siedliskach stwarzającą korzystne warunki dla kleszczy i żywicieli poszczególnych stadiów rozwojowych. Analiza danych o organizacji służby zdrowia i liczbie personelu medycznego (lekarzy ogólnych, dermatologów, internistów i neurologów, diagnostyków oraz pielęgniarek) wskazuje na możliwość pojawienia się trudności z rozpoznaniem i leczeniem chorób odkleszczowych na badanym obszarze.

Słowa kluczowe: *Ixodes ricinus*, zagęszczenie kleszczy, opieka medyczna, struktura populacji.

Risk to human health posed by *Ixodes ricinus* ticks in relation to diagnostic and therapeutic possibilities in south-eastern Poland

Abstract

Introduction. *Ixodes ricinus* – tick of a great medical and veterinary importance is a common species in south-eastern Poland. The major threat is associated with the direct effects of its parasitism, and transmission of numerous pathogens, e.g. *Borrelia burgdorferi*, *Anaplasma phagocytophilum*, tick-borne encephalitis virus, *Rickettsia helvetica* and *Babesia* spp. In recent years, there has been a significant increase in the incidence of Lyme disease and TBE in Poland; in years 2000-2007 there has been a 20-fold and over 2-fold increase in the incidence of Lyme disease in the Lublin Province and in the Podkarpackie Province (2.24 to 22.8 and 11.47 to 22.8 respectively).

Aim. The aim of this study was to evaluate the possibility of tick-borne disease diagnosis in south-eastern Poland, an area of numerous habitats of *Ixodes ricinus*, and to assess the risk of tick attacks in biologically diverse biotopes frequently visited by tourists and residents for recreational purposes.

Material and methods. The investigations were carried out in of south-eastern Poland in the years 2003-2006. Ticks were collected using the flagging method and identified to species, sex and developmental stage. Data on health care facilities and medical staff involved in diagnosis and treatment of tick-borne diseases were obtained from the Statistics Directory of Health Care.

Conclusions. The differences in the abundance of *I. ricinus* populations as well as nymphs and adults can be explained by the different structure of the biotopes in the study habitats that provides favourable conditions for ticks and hosts of their various developmental stages. Analysis of the organization of health services and number of medical staff (general practitioners, dermatologists, internists and neurologists, diagnosticians and nurses) indicates possible difficulties with diagnosis and treatment of tick-borne diseases in the area.

Key words: *Ixodes ricinus*, tick abundance, medical care, population structure.

[1] Chair and Department of Biology and Parasitology, Medical University of Lublin
[2] Department of Paedodontics, Medical University of Lublin

INTRODUCTION

Ixodes ricinus (L.) is the most common tick species in Europe. Its epidemiological significance is associated with transmission of many pathogens, including the tick-borne encephalitis virus, *Borrelia burgdorferi* sensu lato spirochetes, *Anaplasma phagocytophilum* and *Rickettsia helvetica* rickettsiae, and *Babesia* spp. protozoa. Most frequently, ticks infect hosts during blood ingestion. Less commonly, infection is a result of rubbing fragments of tick's body or hemolymph into lesions on the skin of the infected host, or it is passed through regurgitation (expulsion of intestinal contents during questing).

In recent years, increased incidence of tick-borne diseases has been reported, which has encouraged research on occurrence of ticks in different habitats and monitoring the threat of tick-borne diseases, particularly borreliosis, viral encephalitis, anaplasmosis and babesiosis. In this context, providing people with medical care and possibility of early diagnosis and treatment of tick-borne diseases should be a most essential task for health services.

AIM

The aim of this study was to evaluate the possibility of tick-borne disease diagnosis in south-eastern Poland, an area of numerous habitats of *Ixodes ricinus*, and to assess the risk of tick attacks in biologically diverse biotopes frequently visited by tourists and residents for recreational purposes.

MATERIAL AND METHODS

The investigation of tick abundance was conducted in 2003-2006 in the Lubelskie and Podkarpackie Provinces. Ticks were collected with the flagging method during the spring activity peak of *Ixodes ricinus* nymphs and adults (in April and May) at the time of their daily activity peak, i.e. between 3 and 7 p.m. Each collection round involved sweeping 10 to 50 cm-high plants with a flannel cloth for one hour; this allowed determination of the total tick abundance and abundance of nymphs, males and females in the study habitats. The specimens collected were placed in transport containers; next, they were transferred into 70% ethanol in laboratory conditions. Tick species and the stage of development were determined using the key developed by Siuda [1].

During the field research, electronic devices were used to measure temperature with an accuracy of 1°C and humidity with an accuracy of 1% at a height of 5-10 cm above the ground surface.

Data on health care facilities and medical staff involved in diagnosis and treatment of tick-borne diseases were obtained from the Statistics Directory of Health Care. Particular attention was paid to the number of public and non-public hospitals, the number of Health Maintenance Organizations in the Lubelskie and Podkarpackie Provinces, the total number of doctors and specialists in diagnosis and treatment of tick-borne diseases, and the number of medical technicians and nurses employed in the study area.

RESULTS AND DISCUSSION

The abundance of *I. ricinus* ticks varied in the study area (Table 1). Most ticks were found near Krosno in the Podkarpackie Province (Krosno district) (locality I): 103-142 (average 122.2) specimens of *I. ricinus* were collected within an hour. A considerable number of ticks were found in Kazimierz Dolny (Puławy district) (locality II). Here, 24-59 (average 47.7) specimens were collected during one round (Table 1). The tick abundance in Kozłówka (Lubartów district) (locality III) was significantly lower (8-11, average 9.7).

The study localities displayed differences in the structure of *I. ricinus* populations. Nymphs dominated in locality I, constituting as much as 87.73% of all the specimens. Localities II and III were dominated by adults. Males and females accounted for 74.99 and 46.14% of all the collected ticks (Table 1).

Differences in the abundance and activity of *I. ricinus* nymphs and adults are determined by numerous environmental factors. Although the temperature and humidity at the collection time did not differ significantly, the greatest numbers of ticks were found in localities situated in mixed forests with dense understory and rich groundcover; such conditions ensure reduced water evaporation and facilitate water absorption from the atmosphere, which prevents desiccation of ticks [2]. High humidity in habitats is also beneficial for a proper process of female maturation and oviposition as well as for all stages of extraembryonic development (own unpublished studies). The conditions prevailing in locality III situated in a forest dominated by conifers, mainly pine

TABLE 1. Total number of ticks, population structure, and temperature and humidity in the individual localities.

Locality and collection time	Tree stand	Number of collection rounds	Temperature (°C) Range (mean)	Humidity (%) Range (mean)	Total number of ticks Density*	Population structure		
						Nymphs (%) Density*	Males (%) Density*	Females (%) Density*
I Wietrzno (Krosno district) 16.04-29.05. 2003	Mixed forests with domination of beech anf fir, rarely pin	3	19-23 (21.3)	32-72 (58.6)	367 122.2*	322 (87.73) 107.3*	15 (4.08) 5.0*	30 (8.17) 10.0*
II Kazimierz Dolny (Puławy district) 16.04-28.05. 2005	Mixed forests with domination of fir, birch, hornbeam, spruce, alder, beech, maple, rowan, aspen, and ash	4	12-20 (16.5)	66-89 (77.5)	188 47.0*	47 (25) 11.7*	68 (36.17) 17.8*	73 (38.82) 18.2*
III Kozłówka (Lubartów district) 15.04-27.05. 2006	Mixed forests with domination of old pine, and oak, aspen, hornbeam, linden, and spruce	4	14-21 (17.7)	44-60 (52.5)	39 9.7*	21 (53.84) 5.2*	12 (30.76) 3.0*	6 (15.38) 1.5*

(Pinus silvestris), and having no understory or groundcover vegetation, proved the least favourable to ticks. Host composition affects the distribution of *I. ricinus* ticks. Juvenile stages parasitize mainly small mammals and birds, whereas adult ticks infest large and medium-sized wild and domestic mammals [1]. Many species of these animals are reservoirs of pathogens and thus play an important role in maintaining natural tick-borne disease foci [3-5].

The study area is varied in terms of topography and vegetation, which may exert an effect on the distribution of nymphs and adult ticks and on the host species composition. Research conducted in different regions of Europe has confirmed the relationship between tick abundance and activity and many co-factors, including biotope type; presence of hosts; humidity, temperature and insolation, and weather and climate changes [6-9]. Anthropogenic activities (planting trees in urban and suburban areas, animal breeding, and heat islands in the area of industrial plants and other heat sources) have contributed to shifting the range of *I. ricinus* ticks toward cities, where they occur in squares, parks and allotments. As indicated by investigations carried out in urban and industrialized areas, the risk of pathogen infection is comparable to that in forest biotopes [10,11]. The high abundance of *I. ricinus* nymphs and females in south-eastern Poland contributes to the increase in the number of patients with local and systemic symptoms of tick bites [12]. It also led to an over 20-fold and over 2-fold increase in the incidence of Lyme disease in the Lublin Province and in the Podkarpackie Province, respectively, in 2000-2007. In the study area, approximately 2.0-22.25%, 0.7-10.2% and 0.4-6.6% of *I. ricinus* specimens were infected with *Borrelia burgdorferi* sensu lato, *Anaplasma phagocytophilum* and *Babesia microti* protozoa, respectively [13], and 1.6-4.2% – with the tick-borne encephalitis virus [14].

The elevated risk of tick-borne diseases in south-eastern Poland poses a challenge for health services. Statistical data on the number of clinics and medical personnel indicate that the needs of local residents and tourists in terms of diagnosis and treatment of tick-borne diseases are not satisfactorily met in this region. In the Lubelskie and Podkarpackie provinces, there are only 37 and 31 hospitals and 890 and 833 Health Care Facilities, respectively (Table 2).

The study area is characterized by a low index of employment of general practitioners, specialists in internal medicine, infectious diseases, dermatology and venereology, neurology, cardiology, and family practice doctors specializing in treatment of tick-borne diseases (Table 2). The numbers of specialists in these areas of medicine employed in the Lubelskie and Podkarpackie Provinces are similar. However, the employment rate for all doctors and all specialists is lower in the Podkarpackie Province than in the Lubelskie Province and is, respectively, 17.9 and 15.5, and 22.2 and 19.09 per 10 thousand inhabitants. In the study area, the employment rate ranges between 50.60 and 54.10 for nurses and 0.54-0.76 for medical analysis technicians per 10 thousand inhabitants. The insufficient number of medical personnel in south-eastern Poland significantly impedes patients' access to doctors and diagnosticians dealing with diagnosis and treatment of tick-borne diseases. (Table 2)

TABLE 2. Hospitals, health care facilities and medical personnel per 10 thousand inhabitants in the Lubelskie and Podkarpackie Provinces (as on 31/12/2007, after Ministry of Health Statistical Bulletin 2008 and Mz-89 reports and databases of local CSO, excluding other departments such as Defence, Ministry of Interior and the Ministry of Justice).

	Lubelskie province	Podkarpackie province
Total number of hospitals [a]	37	31
Public Health Maintenance Organizations	167	290
Non-public Health Maintenance Organizations	723	543
Medical Doctors	22.2	17.9
Specialists [b]	19.09	15.50
Internists	2.32	2.16
Infectious diseases doctors	0.16	0.20
Dermatologists and venerologists	0.35	0.32
Neurologists	0.86	0.70
Cardiologists	0.37	0.31
Family practice doctors	2.16	1.27
Nurses	54.10	50.60
Medical analysis technicians	0.54	0.76

[a] data concerning public and non-public hospitals;
[b] data concerning doctors of all specialities

CONCLUSIONS

South-eastern Poland is an area of high risk of tick attacks, which emphasized the necessity to disseminate the principles of prevention of tick-borne diseases among locals and tourists residing in the area.

1. The differences in the tick density in south-eastern Poland prove the need for conducting further research in various habitats (especially in places often visited by people and animals) in order to identify areas of the greatest ticks threat and to inform the public about the results of the research.
2. The low number of doctors, nurses and diagnosticians employed in the Lubelskie and Podkarpackie Provinces necessitates intensive efforts to improve the organizational structure of health services in order to provide patients with the help of specialists in tick-borne diseases.

REFERENCES

2. Siuda K. Ticks of Poland (Acari: Ixodida). Part II. Systematics and distribution. Warsaw: PTP; 1993.
3. Buczek A. Physiology of ticks (Ixodida) in non-parasitic phase of life cycle. Wiad Parazytol. 1999;45(2):151-9.
4. Stanko M, Miklisová D. Interactions of small mammal communities of windbreaks and adjacent fields with respect to epidemiological aspects. Ekológia (Bratislava). 1995;14(1):3-16.
5. Michalik J, Hofman T, Buczek A, Skoracki M, Sikora B. *Borrelia burgdorferi* s.l. in *Ixodes ricinus* (Acari: Ixodidae) ticks collected from vegetation and small rodents in recteational areas of the city of Poznań. J Med Entomol. 2003;40(5):690-7.
6. Siński E, Pawełczyk A, Bajer A, Behnke JM. Abundance of wild rodents, ticks and environmental risk of Lyme borreliosis: a longitudinal study in an area of Mazury Lakes district of Poland. Ann Agric Environ Med. 2006;13(2):295-300.
7. Perret JL, Rais O, Gern L. Influence of climate on the proportion of *Ixodes ricinus* nymphs and adults questing in a tick population. J Med Entomol. 2004;41(3):361-5.
8. Hubálek Z, Halouzka J, Juricová Z, Sikutová S, Rudolf I. Effect of forest clearing on the abundance of *Ixodes ricinus* ticks and the prevalence of *Borrelia burgdorferi* s.l. Med Vet Entomol. 2006;20(2):166-72.

9. Bartosik K, Lachowska-Kotowska P, Szymańska J, Pabis A, Buczek A. Lyme borreliosis in south-eastern Poland: relationships with environmental factors and medical attention standards. Ann Agric Environ Med. 2011;18(1):131-7.
10. Bartosik K, Lachowska-Kotowska P, Szymańska J, Wójcik-Fatla A, Pabis A, Buczek A. 2011b. Environmental conditioning of incidence of tick-borne encephalitis in the south-eastern Poland in 1996-2006. Ann Agric Environ Med. 2011;18(1):119-26.
11. Stańczak J, Gabre RM, Kruminis-Łozowska W, Racewicz M, Kubica-Biernat B. *Ixodes ricinus* as a vector of *Borrelia burgdorferi* sensu lato, *Anaplasma phagocytophilum* and *Babesia microti* in urban and suburban forests. Ann Agric Environ Med. 2004;11(1):109-14.
12. Maetzel D, Maier WA, Kampen H. *Borrelia burgdorferi* infection prevalence in questing *Ixodes ricinus* ticks (Acari: Ixodidae) in urban and suburban Bonn, western Germany. Parasitol Res. 2005;95(1):5-12.
13. Bartosik K, Sitarz M, Szymańska J, Buczek A. Tick bites on humans in the agricultural and recreational areas in south-eastern Poland. Ann Agric Environ Med. 2011;18(1):151-7.
14. Wójcik-Fatla A, Szymańska J, Wdowiak L, Buczek A, Dutkiewicz J. Coincidence of three pathogens (*Borrelia burgdorferi* sensu lato, *Anaplasma phagocytophilum* and *Babesia microti*) in *Ixodes ricinus* ticks in the Lublin macroregion. Ann Agric Environ Med. 2009;16(1):151-8.
15. Cisak E, Chmielewska-Badora J, Rajtar B, Zwoliński J, Jabłonski L, Dutkiewicz J. Study on the occurrence of *Borrelia burgdorferi* sensu lato and tick-borne encephalitis virus (TBEV) in ticks collected in Lublin region (eastern Poland). Ann Agric Environ Med. 2002;9(1):105-10.

Informacje o Autorkach
Dr n. med. Katarzyna Bartosik – asystent, Katedra i Zakład Biologii i Parazytologii, Uniwersytet Medyczny w Lublinie; dr hab. n. med. Jolanta Szymańska – adiunkt, Katedra i Zakład Stomatologii Wieku Rozwojowego, Uniwersytet Medyczny w Lublinie; prof. dr hab. Alicja Buczek – kierownik, Katedra i Zakład Biologii i Parazytologii, Uniwersytet Medyczny w Lublinie.

Adres do korespondencji
Katarzyna Bartosik
Katedra i Zakład Biologii i Parazytologii,
Uniwersytet Medyczny w Lublinie
ul. Radziwiłłowska 11, 20-080 Lublin
tel/fax 81 528 84 63
e-mail: katarzyna.bartosik@umlub.pl