

## PREVENTION OF TICK BITES AND PROTECTION AGAINST TICK-BORNE DISEASES IN SOUTH-EASTERN POLAND

Katarzyna Bartosik, Tomasz Kubrak, Tomasz Olszewski, Monika Jung, Alicja Buczek

Chair and Department of Biology and Parasitology, Medical University of Lublin, Lublin, Poland

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**Abstract:** The objective of this survey was to obtain information on the level of knowledge of prophylactic behaviour as a protection against fundamental tick-borne diseases among inhabitants of south-eastern Poland, and to determine whether the professions that increase the probability of tick contact, as well as previous contact with ticks, influenced the knowledge on tick-borne diseases and prophylactic behaviour of the respondents. The questionnaire included questions about gender of respondents, their place of residence and preventive behaviour against tick bite. The respondents were asked about the occupational hazard of working in tick infested areas, history of tick bites, awareness of diseases transmitted by ticks and the sources of their knowledge. The research was carried out in 2005. The most frequent preventive measures used were tick repellents (38%) and wearing protective clothing (35%). According to the questionnaire survey, 21% of respondents did not take any preventive measures. The practice and form of prophylaxis was associated with the place of residence. In contrast to individuals from rural areas, a relatively low percentage of urban inhabitants used simple methods for protecting themselves against tick bites. Our survey indicates that the awareness of the Lublin region inhabitants concerning methods of tick bite prevention is still low and greater efforts are needed in promoting basic methods of protection and disseminating knowledge about these arthropods.

**Address for correspondence:** Chair and Department of Biology and Parasitology, Medical University of Lublin, Radziwiłłowska 11, 20-080 Lublin, Poland.  
E-mail: katarzyna.bartosik@am.lublin.pl

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### INTRODUCTION

Tick-borne diseases are a serious and topical epidemiological problem in numerous European countries, including Poland. The most common cases include borreliosis (LD), tick-borne encephalitis (TBE), and to a lesser extent, ehrlichiosis, babesiosis, and Q-fever.

Alongside the tick's role as a vector for the above-mentioned diseases, the toxins of this arthropod cause serious damage. They may cause numerous pathological or pathophysiological changes in the host, leading to disorders in physiological functions of various organs. Among recorded clinical symptoms, tick-borne paralysis is the most hazardous toxicosis [2, 12, 13, 25].

The increase in the incidence of tick-borne diseases observed in recent years relates to the prevalence of the poor level of common knowledge on the basic preventive methods against the tick. As the ticks occur mainly in forest areas (forest trails, paths, clearings), meadows, and tourist trails, the greatest risk of contact with the arthropod concerns people whose work involves entering these areas (i.e. farmers, foresters), as well as those visiting them for recreational purposes [6, 28, 29, 31, 33]. Recently, the occurrence of ticks has also been observed in parks and gardens of urban agglomerations, as well as in fruit and vegetable gardening areas, which may significantly increase the danger of human infestation [30]. A number of tick species, of which the most dangerous is *Ixodes ricinus*

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(L.), have been observed in the eastern and south-eastern regions of Poland. Due to particularly favourable environmental conditions in the region the population of *I. ricinus* remains quite large. The area studied covers 557.256 hectares (21%) covered by forests, which constitute an ideal environment for *I. ricinus*. In the area studied, the prevalence of *Borrelia burgdorferi* sensu lato in *I. ricinus* ranged between 3.4–13.8%, and the estimated prevalence of tick-borne encephalitis virus (TBE) was 1.8% [5, 7, 29].

The objective of the survey was to determine whether the occupational hazard of working in tick infested areas, as well as previous contacts with the ticks, influenced the awareness and behaviour of the respondents.

**MATERIALS AND METHODS**

The research was conducted in 2004–2005 in south-eastern Poland, in the Lublin macroregion territory near the Ukraine border. The research material was a questionnaire survey performed on a group of 300 respondents. In the group studied, 100 respondents were inhabitants of rural areas and 200 respondents were inhabitants of urban areas. In the research group, 88 people were professionally involved in working in ticks' natural habitats (foresters, farmers), while 212 were not professionally in danger of contact with the arthropod and its pathogens.

The survey examined gender, place of residence and preventive behaviour against tick bite of respondents. The respondents were also questioned about the occupational hazard of working in tick occupied areas, history of tick bites, methods of tick removal, knowledge of diseases transmitted by ticks, and sources of knowledge of the parasites. The results were analysed for the whole group of respondents and also in cross-sections (urban vs. rural area inhabitants, bitten vs. non-bitten persons, foresters and farmers vs. other respondents, male vs. female).

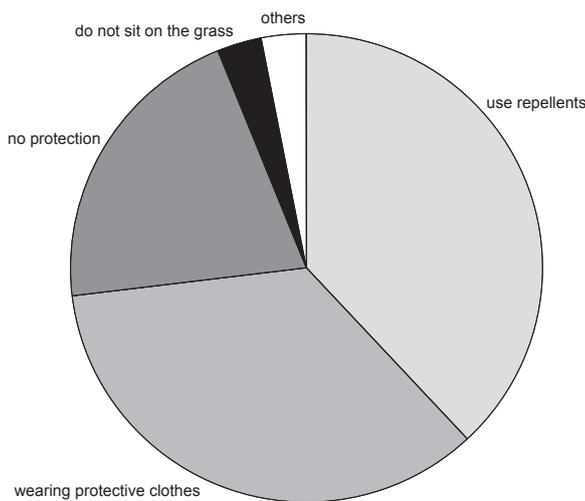


Figure 1. Methods of prevention.

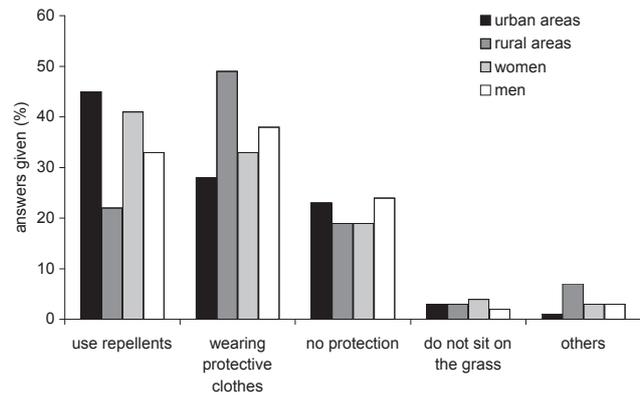


Figure 2. Differences in preventive behaviours activity against tick bite associated with place of residence and gender.

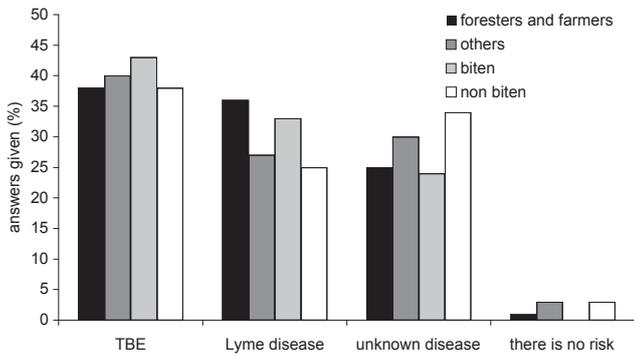
Two-sample test for proportion with one-tailed alternative hypothesis was used to prove whether analysed category occurs more frequently or more rarely in one group than in the other one. The chi-square test of independence was used to prove whether there are differences in given answers between groups. Significance level 0–0.05 was assumed in all statistical tests.

**RESULTS**

In the examined group, the most popular preventive behaviour was using tick repellents (38%) followed by wearing protective clothing (35%) and no preventive measures (21%). 3% of people studied declared other methods of prevention, e.g. smearing the body with gasoline or ethereal oils and smoking cigarettes when entering tick habitats (Fig. 1).

The survey indicates that people attach greater importance to checking their body than clothing after visiting tick-infested areas (43% and 34%, respectively) ( $u=2.27$ ;  $p=0.011748$ ).

Statistically significant differences in measures of tick bite prevention were observed between inhabitants of cities and villages ( $\chi^2=26.34$ ;  $p=0.000027$ ). Using chemical protection is more popular in urban than in rural areas, 45% of people from urban areas and 22% people from rural areas declare using tick repellents. In contrast to respondents from rural areas, a relatively low percentage of respondents from urban areas wear protective clothing (49% and 28%, respectively) (Fig. 2). Our questionnaire also reveals that urban inhabitants check their body for ticks more frequently than individuals from rural areas (32% and 69%, respectively). Only 4% of people from rural areas and 30% of the urban inhabitants do not check themselves for ticks after entering tick habitats ( $\chi^2=44.06$ ;  $p=0.000000$ ). Gender based differences were noted, but they were not statistically significant ( $\chi^2=3.01$ ;  $p=0.556815$ ). Repellents are used by 41% of females and 33% of males. More males than females protect themselves by using protective clothing (38% and 33%, respectively). 24% of males and 19%



**Figure 3.** Knowledge of tick-borne diseases among those occupationally exposed to tick bites and others, bitten and non-bitten individuals.

of females do not practice preventive behaviour against tick bite (Fig. 2).

Among the respondents working in the tick natural habitats, i.e. foresters and farmers, the percentage of tick bites was significantly higher than in the group where the profession did not result in a direct contact with ticks, 66% and 26%, respectively ( $u=6.50$ ;  $p=0.000000$ ).

In the group of respondents whose profession affected the likelihood of tick contact, and people not exposed to the professional hazard, 1% and 3% respectively had no knowledge of the fact that ticks can transmit diseases; 25% and 30% respectively were aware of the fact, but they could not identify the diseases; 36% and 27% named Lyme disease ( $u=1.64$ ;  $p=0.050000$ ); while the greatest number of respondents identified tick-borne encephalitis (TBE) as the major threat posed by ticks, 38% and 40% respectively (except for Lyme disease, other differences were not statistically significant  $p>0.05$ ) (Fig. 3).

In the group which declared being bitten by a tick in the past, all the respondents were aware of the danger of

pathogenic microorganism contagion, while in those never bitten before, 3% were unaware of the tick being a pathogen vector. 24% of the bitten and 34% of the non-bitten respondents understood the risk, but were unable to name the tick-borne diseases. Lyme disease was known to 33% and 25% respectively, while the greatest percentage in both groups identified tick-borne encephalitis, 43% and 38% respectively ( $\chi^2=6.19$ ;  $p=0.045169$ ) (Fig. 3).

38% of all the respondents declared using repellents as the means of tick bite prevention. The method was popular mostly in the group not involved professionally with tick habitats – 63% ( $u=1.94$ ;  $p=0.026163$ ), and in people bitten at least once in the past – 60% ( $u=0.50$ ;  $p=0.307303$ ).

The respondents were also asked to choose (from options given) a method for removing an attached tick (Fig. 4). It is noteworthy, that only 19% of the studied people used the safest and recommended method of tick removal with tweezers, and the most popular method was pulling it out with fingers 44%. 5% of the respondents declared a different method of removing the tick, i.e. covering the attached tick with gasoline, alcohol, salt, or lemon juice, as well as burning it with a match or cigarette. The rarest method mentioned was visiting a doctor – 3%.

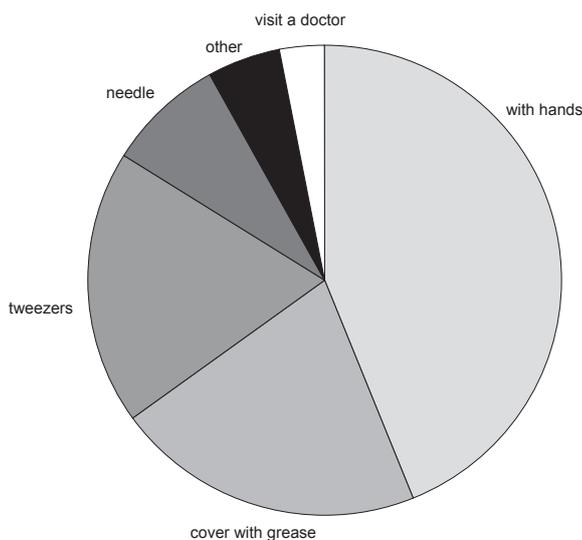
The respondents were also asked to reveal their sources of information about ticks, the related health hazards, and methods of prevention. The respondents identified the media as the most popular source of information (28% and 21% of the answers, respectively). Friends, school, radio, broadcasting and family were chosen respectively by 15%, 12%, 10% and 8% of respondents. The least popular source of information on ticks was the Internet (only 6% respondents).

## DISCUSSION

The recent epidemiological studies confirm that there is a connection between the incidence of tick-borne diseases and the profession and place of residence of the potential tick bite sufferers. The high risk group consists of farmers and forestry workers, in whom the bites are the most common [1, 18]. Potential risk of the tick-born infection for humans occurs not only in large natural woodlands but also in a forested recreational areas situated in towns or in suburbs [8, 10, 17, 19, 20, 24, 26, 32].

A high prevalence of antibodies against pathogens transmitted by ticks (*Borrelia burgdorferi*, *Anaplasma phagocytophilum*, TBE virus) was found in forestry workers and farmers in eastern Poland, compared to control groups of unexposed people [3, 6, 28]. The presence of these pathogens was found also in ticks collected in this region [4, 5, 11, 14].

The mentioned data did not always correlate with the preventive behaviour of the forest-related groups of people. The research by Buczek *et al.* [1] proved that the residents of the Lublin Province do not facilitate the most basic, yet highly effective, methods of protection against ticks, such



**Figure 4.** Methods of tick removal.

as proper clothing and behaviour in the potentially dangerous areas.

Investigations conducted on Massachusetts residents reveal that 86% of individuals choose only a single method of prevention. The most frequent was visual inspection of exposed skin (80%), then properly used protective clothing (53%). Avoiding areas where ticks are present (34%) and using repellents (12%) were also chosen [27]. The questionnaire showed that the practice of preventive behaviour significantly correlated with the aforementioned variables: gender, age and place of residence. Our survey indicated that rural inhabitants chose typical methods of protection such as proper clothing; moreover, this group which lives in the countryside have their own solutions, for example: smoking cigarettes and using gasoline. In conclusion, in the Lublin macroregion the influence of socioeconomic factors (monthly income per person, unemployment rate) on practicing and forming tick-borne diseases prophylactic behaviour is noted. Preferences of the Lublin macroregion inhabitants show age-proportional decrease in the popularity of repellents, followed by an increase in traditional methods. Distinctively, the elderly do not care about tick bite preventive behaviour. It is notable that the most popular preventive methods are: the use of protective clothing and the use of chemical tick repellents, especially in the case of people already attacked by the arthropod in the past, and women.

Most of the respondents surveyed in our research declared the mass media as the primary source of information about ticks, which clearly indicates the influence of advertising on the choice of the repellent used. Unfortunately, no data is available on the harmful side-effects of many chemical compounds used as pesticides. Such data would help to establish the degree to which the awareness of the poisoning hazard influences the use rate of such products as insecticides, acaricides, and repellents. Some chemical compounds used for protecting humans and animals may cause acute intoxication and remote effects [15, 21].

Our studies showed that the citizens of the Lublin macroregion demonstrated quite extensive knowledge about tick-borne diseases in comparison with the research by Mawby and Lovett [23]. In the studied population, detailed knowledge on the disease agents (mainly LD) was greater in respondents from the high risk group (forestry workers, farmers) and in the group with a history of at least one bite in the past. Worldwide data also indicate that the knowledge about various tick-borne diseases depends on self-reported tick bites, and differs among respondents living in or visiting farms, pet owners, forestry workers, etc. from others [18]. Therefore, further education in this respect is necessary, particularly at the schooling level, which was confirmed by the survey results, indicating low involvement of this information medium in the education of the respondents.

Ticks, before they start feeding, search for a convenient spot to attach themselves to human skin. In adults, most of

the bites take place on legs, buttocks, groin, and stomach. In children, on the other hand, up to 70% of the infestations take place on the head and its vicinity (behind the ears, on the hair line, neck). A thorough examination of the body after returning home allows removal of the tick before it inserts the hypostome into the skin, or in the early phase of its feeding (before the body is infected with pathogenic microorganisms). Infected ticks must remain attached into host skin for at least 48 hours to transmit the spirochete; after this time, about 50% of ticks transmit the infection. After 72 hours, almost 100% of infected ticks transmit these pathogens to their host [1, 22].

The best method of removing the tick is to hold it with tweezers at the skin level and pull it out carefully, thus the tick's body is not damaged, and there is no risk of spilling the hemocoel contents with the contained microorganisms. It is notable that the main studies indicate an increase in the likelihood of pathogen transmission from tick into the host during regurgitation of the gut contents [9].

The regions where an increasing number of ticks infected with tick-borne diseases was noted should remain under careful scrutiny [16, 34]. It is crucial to publish information on tick bite prevention, which would surely reduce the incidence of direct parasitic contact (skin and systemic changes, toxicoses) and the occurrence of transmissible diseases.

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