

# THE KNOWLEDGE ON LYME BORRELIOSIS AND OTHER TICK-BORNE DISEASES AMONG NURSING STUDENTS FROM POLAND AND SLOVAKIA

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**Abstract.** *Tick-borne diseases are infectious diseases transmitted by the bites of infected ticks. The most common vector-borne disease in Europe is Lyme borreliosis (LB). The number of the reported cases of LB has been steadily increasing. For this reason, it is important to undertake educational activities in the field of tick-borne diseases. The aim of the study was to investigate the level and scope of knowledge on tick-borne diseases among nursing students from Poland and Slovakia. The study sample consisted of 428 nursing students (192 students of the State School of Higher Education in Biała Podlaska, Poland and 236 students of the University in Presov, Slovakia). The knowledge of the surveyed students on tick-borne diseases is limited. Polish students demonstrated greater knowledge about LB, while students from Slovakia showed greater awareness of the threat posed by tick-borne encephalitis. Particularly worrying is the lack of knowledge on proper way of removal of a tick attached to the skin. Students recognize the need to broaden their knowledge on tick-borne diseases, which should be taken into consideration in realized studies curricula.*

**Keywords:** *Lyme borreliosis; Poland; Slovakia; Students; Tick-borne diseases.*

## Introduction

In European countries, the main vector of pathogens responsible for causing Lyme borreliosis (LB), tick-borne encephalitis (TBE), granulocytic anaplasmosis and babesiosis are the ticks *Ixodes ricinus* (Rizzoli et al., 2014; Tokarska-Rodak,

2016; Bartosik et al., 2011). Deciduous and mixed forests are the natural habitats of ticks, but many populations of these mites are also found in the immediate human environment in parks and urban green areas, gardens, squares and green suburban areas. Such a widespread of ticks results in an increase in the risk of acquiring human tick-borne diseases. Exposure to tick bites is dependent on a several regionally changeable socio-economic factors such as a professional activity of a man, social awareness and tourism, and availability in a case of TBE vaccination (Rizzoli et al., 2014).

In Europe, the highest incidence of Lyme disease occur in Germany, Austria, Slovenia, Sweden and Poland (Pancewicz et al., 2015). The number of cases of Lyme borreliosis in Poland has been steadily increasing. In 2015, 13,625 cases were recorded (incidence of 35.4/100,000), while in 2014, 13,863 cases (incidence of 36.0/100,000) (National Institute of Public Health - National Institute of Hygiene, 2016). Slovakia recorded lower rates of incidence of Lyme borreliosis in comparison to Poland. The number of registered cases of Lyme borreliosis in Slovakia in 2015 amounted to 913 (incidence 16.84/100,000) and in 2014 - 680 (incidence 12.55/100,000) (Epidemiological Information System in Slovakia).

The second most commonly diagnosed disease transmitted by ticks *I. ricinus* in Europe, is tick-borne encephalitis. In the years 1990-2007 in Europe 157,584 cases were found, which accounted for an average of 8,755 cases per year (Pancewicz et al., 2015). In Poland in 2015 the number of registered cases of TBE was 150 (incidence 0.39/100,000) and was lower compared to 2014, when recorded 195 cases (incidence rate: 0.51/100,000) (National Institute of Public Health - National Institute of Hygiene, 2016). In Slovakia in 2015 there were registered 84 cases of TBE incidence and incidence rate was 1.55/100,000), while a year earlier registered 116 cases (incidence 2.14/100,000) (Epidemiological Information System in Slovakia).

The quoted epidemiological data indicate that both in the area of Poland and Slovakia pathogens transmitted by ticks are an important issue of public health. For this reason, it is important to undertake educational activities in the field of prevention of tick-borne diseases. The aim of the study was to investigate the level and scope of knowledge on tick-borne diseases among nursing students from Poland and Slovakia.

## **Material and method**

The study sample consisted of 428 nursing students from Poland (192 students of the Pope John Paul II State School of Higher Education in Biała Podlaska: 1<sup>st</sup> year 35 persons, 2<sup>nd</sup> year 59 persons, 3<sup>rd</sup> year 98 persons) and Slovakia (236 students of the University in Presov: 1<sup>st</sup> year 84 persons, 2<sup>nd</sup> year

76 persons, 3<sup>rd</sup> year 76 persons). The average age of Polish students was 23.3 years (SD = 4.36), while Slovakian 22.2 (SD = 2.26).

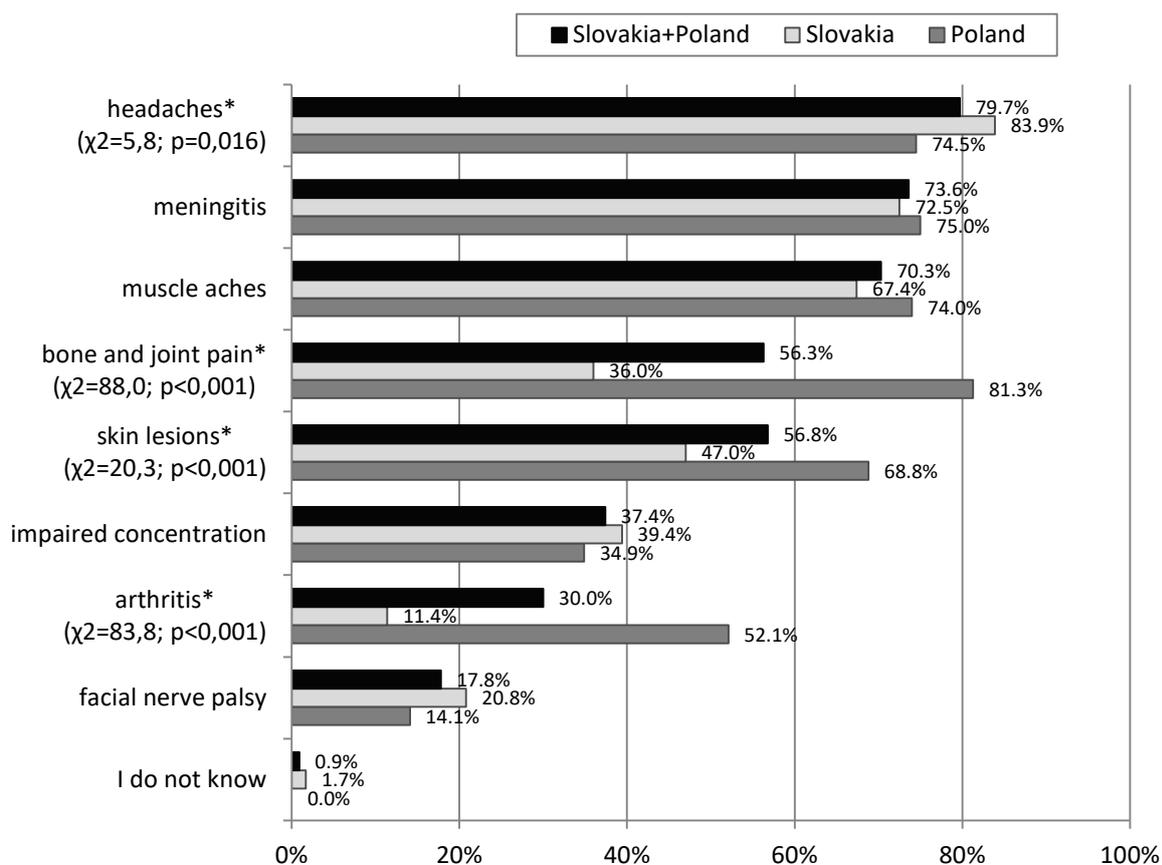
The applied research tool was the authors' questionnaire. It consisted of 16 questions checking knowledge on Lyme borreliosis and other tick-borne diseases (13 closed, 2 half-open and 1 open) and questions relating to personal data (age, gender, field and year of study). Closed questions related to knowledge of the etiologic agent of Lyme borreliosis, possible routes of infection, the existence of the early cutaneous manifestations indicating the infection and its diameter and therapeutic treatment in patients diagnosed with erythema migrans, possible symptoms of Lyme disease, the existence of a vaccine against LB and TBE, prevention activities in the field of tick-borne diseases, self-assessment of the knowledge level on Lyme borreliosis and opinion on the need to broaden own knowledge on tick-borne diseases. Half-open questions related to the correct way of removing a tick attached to the skin and the sites where to use tick repellents. Open question related to pathogens transmitted by ticks, which can cause symptoms in humans (except for *B. burgdorferi*). In order to test the hypotheses about the independence of the characteristics the Pearson's chi-squared test ( $\chi^2$ ) was used. In statistical inference, the level of significance was 0.05. Statistical analyses were performed on the basis of the STATISTICA software v. 7.1 (StatSoft, Poland).

## Results

Among the total number of students 52.6 % properly qualified pathogen causing Lyme borreliosis (*Borrelia burgdorferi*) as a bacterium. No significant differences were found between students from Poland and Slovakia as far as providing the correct answers. The most commonly given incorrect answer among students from both countries was the answer that *Borrelia burgdorferi* is a virus (32.9 %).

The correct way of infection of human spirochete *Borrelia burgdorferi*, through bites by infected vector organisms, indicated 73.6 % of all respondents. Students from Poland chose this answer significantly more often compared with students from Slovakia, respectively, 96.9 % and 54.7 % ( $\chi^2=97.1$ ;  $p<0.001$ ).

Among the possible symptoms of Lyme borreliosis surveyed students most often mentioned headaches (79.7 %), meningitis (73.6 %) and muscle pains (70.3 %). Polish students significantly more often mentioned bone and joint pains, arthritis and skin lesions, while students from Slovakia headaches. Detailed results are shown in Fig. 1.



\* - statistically significant differences  $p \leq 0.05$

Figure 1. Possible symptoms of Lyme borreliosis as indicated by the surveyed students

The proper knowledge of the existence of an early symptom of skin (erythema), indicating the infection with *Borrelia burgdorferi*, which does not always occur in people infected with spirochete, showed a 48.8 % of all students. Significantly more correct answers gave Polish students compared with students from Slovakia, respectively, 56.3 % and 42.8 % ( $\chi^2=7.7$ ;  $p=0.006$ ). About the presence of such a symptom at every infection with *Borrelia burgdorferi* were convinced 34.4 % of respondents. The percentage of students from two analyzed countries was in this respect similar and amounted to 37.0 % among students from Poland and 32.2 % in the group of students from Slovakia. The rest of students thought that there is no evidence of a skin infection or they responded that they had no knowledge on the subject.

The knowledge of erythema migrans, as a skin change having a diameter greater than 5 cm, showed 57.7 % of all respondents. Significantly more correct answers gave students from Poland (70.8 %) compared with students from Slovakia (47.0 %) ( $\chi^2=24.6$ ;  $p<0.001$ ).

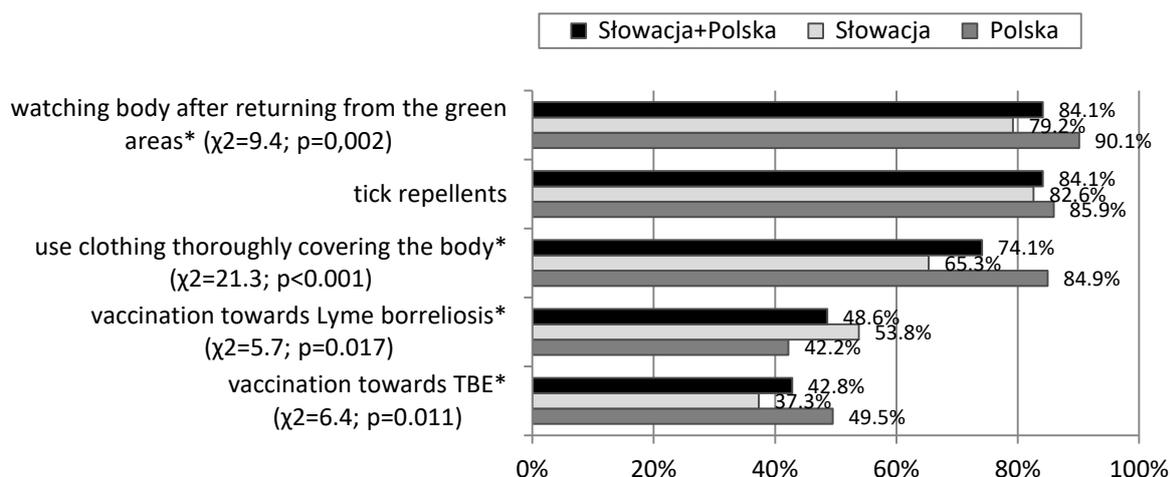
The proper knowledge of the proceedings in case of erythema migrans, which comprises administering antibiotics without the need for serological tests showed 18.2 % of the surveyed students. Percentage of students, who gave the correct answer, with both analyzed countries were almost identical (Poland 17.7 %, Slovakia 18.6 %). Most of the surveyed students (75.7 %) were convinced that, despite the presence of erythema migrans antibiotics should be taken only after obtaining positive results of serological tests (Poland 79.7 %, Slovakia 72.5 %).

The students when asked about the vaccine against Lyme borreliosis in the majority responded that such a vaccine existed or that they had no knowledge on the subject. About the lack of a vaccine against LB was convinced 29.7 % of students. Significantly more often such answer gave students from Poland (43.2 %), compared with students from Slovakia (18.7 %) ( $\chi^2=30.7$ ;  $p<0.001$ ).

The knowledge of other pathogens transmitted by ticks, which can cause symptoms, showed a 44.4 % of the surveyed students. Significantly more often they were students from Slovakia 75.4 % ( $\chi^2=205.2$ ;  $p<0.001$ ), who pointed to the pathogen responsible for tick-borne encephalitis. Among Polish students only 6.3 % indicated other pathogens that are transmitted by ticks. Most often mentioned was the tick-borne encephalitis virus, and individuals were able to point to other pathogens.

About the existence of a vaccine against TBE knew 53.7 % of all respondents. No significant differences were found in the knowledge of the subject among students from both analyzed countries (Poland 53.7 %, Slovakia 53.8 %).

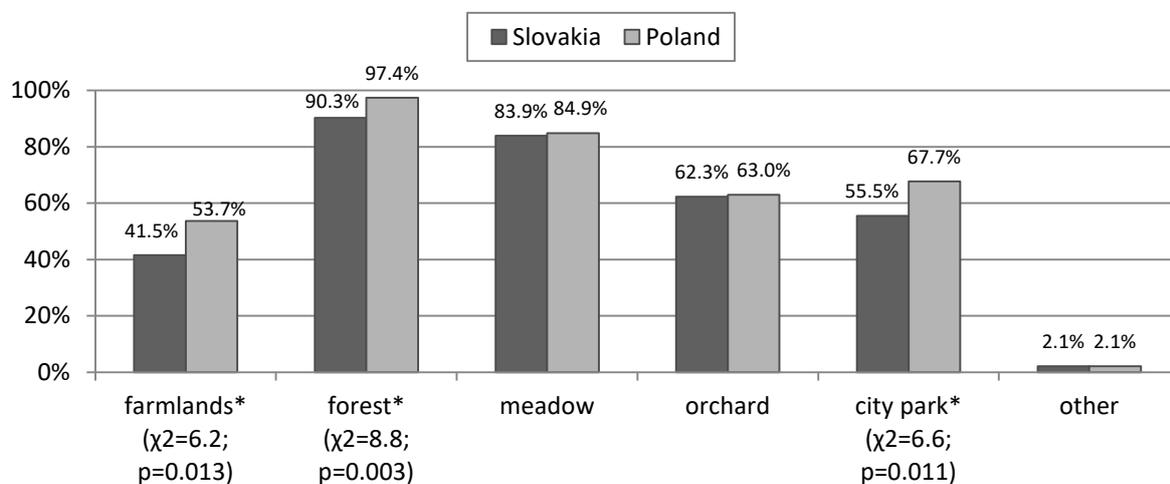
Among the various methods of prevention of tick-borne diseases surveyed students most often indicated watching the body after returning from the green areas (84.1 %) and use of tick repellents (84.1 %). Watching the body was significantly more often chosen by students from Poland, as well as the use of clothing covering the body and vaccination against tick-borne encephalitis. Almost half of all respondents (48.6 %) incorrectly pointed to vaccinations in the direction of Lyme borreliosis. Detailed summary of the results is given in Fig. 2.



\* - statistically significant differences  $p \leq 0.05$

Figure 2. Prevention methods of tick-borne diseases in the opinion of the surveyed students

Among the sites where to use tick repellents surveyed students most frequently mentioned forests and meadows. Polish students significantly more often indicated forests, farmlands and city parks. Detailed results are shown in Fig. 3.

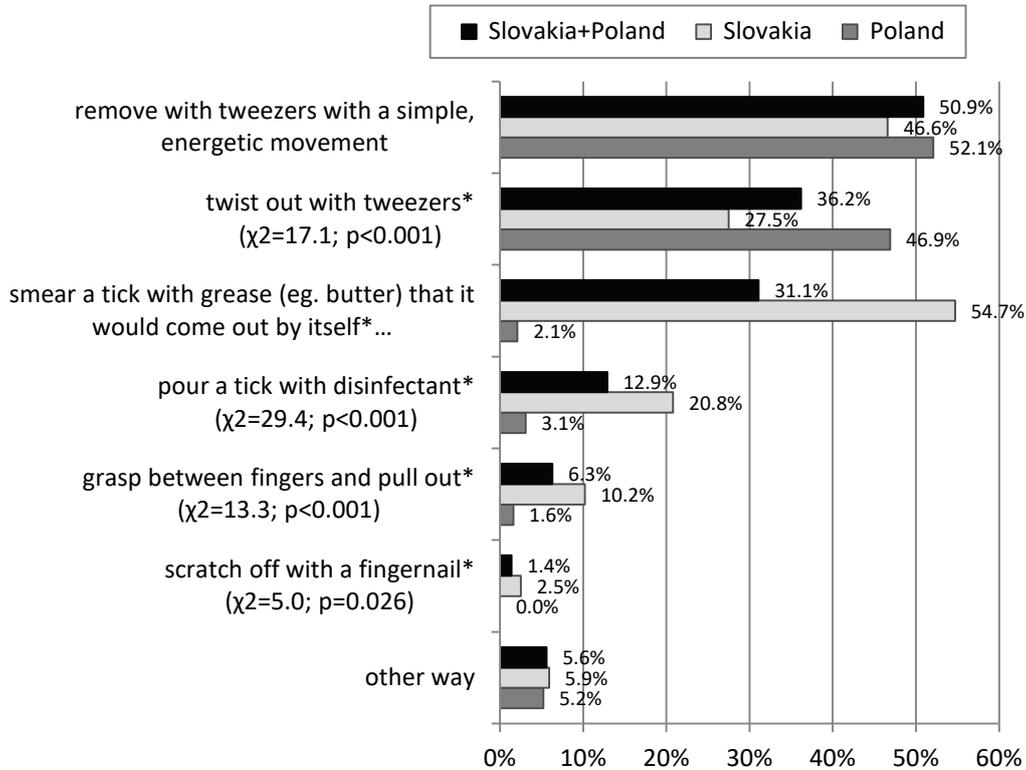


\* - statistically significant differences  $p \leq 0.05$

Figure 3. The sites where to use tick repellents in the opinion of the surveyed

Among the various ways of removing tick attached to the skin, as a correct method, surveyed students most often pointed to the removal with tweezers with a simple, energetic movement (50.9 %), twisting out with tweezers (36.2 %) and smearing a tick with grease (31.1 %). Students from Poland significantly more often chose the method based on twisting out with tweezers. Students from

Slovakia significantly more often chose smearing a tick with grease, pouring with disinfectant, pulling out by finger and scratching off by a fingernail. A detailed list of results is shown in Fig. 4.



\* - statistically significant differences  $p\leq 0.05$

Figure 4. Proper ways of removing tick attached to the skin in the opinion of the surveyed students

The majority of surveyed students assessed their knowledge on Lyme borreliosis as a minimal or average. Students from Poland assessed higher the level of their knowledge ( $\chi^2=61.5$ ;  $p<0.001$ ). The obtained results are shown in Fig. 5.

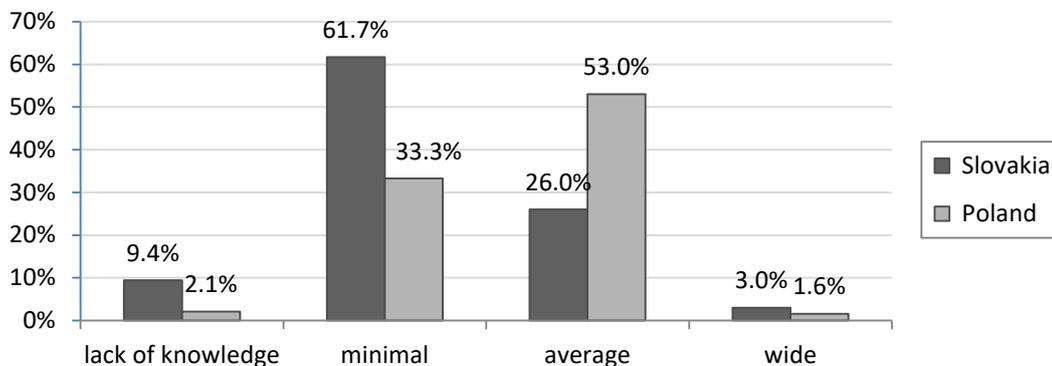


Figure 5. Self-assessment of the knowledge level on Lyme borreliosis among the surveyed students

The majority of all researched students (83.4 %) see the need to broaden their knowledge on tick-borne diseases. In this aspect no significant differences were observed between students from both analyzed countries. The need was reported by 79.7 % students from Slovakia and 88.0 % from Poland.

## Discussion

Lyme borreliosis is the most common tick-borne infectious disease in North America and in countries with moderate climates in Eurasia, including Poland and Slovakia. Lyme borreliosis is caused by spirochaetes of the *Borrelia burgdorferi* sensu lato species complex, which are transmitted by ticks (Stanek et al., 2012). Only 52.6 % of students were able to correctly classify the pathogen causing the bacterium; 32.9 % were convinced that it was a virus. In studies of Kurnatowski et al. (2011), 35.0 % of students of forestry were able to correctly identify the bacteria as the etiologic agent of Lyme borreliosis. The same percentage of respondents felt that these were the ticks, and 30.0 % indicated viruses.

In own research, 73.6 % of students, as the correct route of human infection by spirochete *Borrelia burgdorferi*, indicated bites by infected vector organisms. Students from Poland were significantly more likely to know about that (96.2 %). In a study of forestry students all surveyed knew that a tick-bite is the main cause of Lyme disease infection, and that blood is the main route of pathogen transmission (Kurnatowski et al., 2011).

Lyme borreliosis is a multisystemic disease that can affect many organs, including the heart, joints, central nervous system, and brain, and can result in a large number of diverse symptoms including extreme fatigue, flu-like symptoms, arthritis, peripheral neuropathy, and cognitive dysfunction (Cook, 2015). Among the possible symptoms the surveyed students most often pointed headaches (79.7 %), meningitis (73.6 %) and muscles pain (70.3 %). Polish students significantly more often mentioned bone and joint pains, muscles pains, arthritis and skin lesions, while students from Slovakia headaches. In a study of forestry students following most common symptoms of borreliosis were: arthritis (85.0 %), myalgia (80.0 %) and fever (65.0 %) (Kurnatowski et al., 2011).

The knowledge of erythema migrans is particularly important. Erythema migrans (EM) is clinical evidence of Lyme borreliosis and develops in about 80 % of patients. It is a characteristic symptom of early localized infection and most typically develops in the month following a tick bite. Serological diagnostics has no significant relevance in typical cases of migratory erythema as the presence of a characteristic skin lesion combined with a history of tick bite is sufficient for diagnosis. Erythema of more than 5 cm in diameter is of diagnostic value. Spontaneous regression of erythema within several days up to several weeks (4 weeks on average) is observed in patients not treated with antibiotics

(Pancewicz, 2014; Pancewicz et al., 2015), so it is important that it has not been underplayed. Proper knowledge of the existence of an early symptom of skin (erythema) indicating the infection with *Borrelia burgdorferi*, which does not always occur in people infected with spirochete, showed a 48.8 % of the surveyed students. The fact that the erythema migrans is a skin lesion, having a diameter greater than 5 cm, knew 57.7 % of the student. Students from Poland gave significantly more correct answers for both issues. Most of the surveyed students (75.7 %) were convinced that, despite the presence of erythema migrans, antibiotics should be taken only after obtaining positive results in serological testing.

No vaccine is available to prevent Lyme borreliosis in man (Stanek et al., 2012). Only 29.7 % of the surveyed students knew about that, more students from Poland (43.2 %). Most students were convinced that such a vaccine existed or indicated that they had no knowledge on the subject. In research of students of life sciences faculties (University of Life Sciences in Lublin), who should have a basic knowledge of prevention of tick-borne diseases because of the future occupational exposure to ticks, 30 % of respondents were convinced about the lack of a vaccine against Lyme borreliosis (Kowalczyk et al., 2016).

Ticks (Acari: Ixodidae) transmit a wide variety of pathogens to vertebrates including viruses, bacteria, protozoa and helminthes. Tick-borne pathogens are believed to be responsible for more than 100,000 cases of illness in humans throughout the world (de la Fuente et al., 2008). Among the surveyed students, only 44.4 % were able to name another pathogen (except for *B. burgdorferi*) transmitted by ticks, which can cause symptoms of a disease. Significantly more often students from Slovakia (75.4 %) pointed to the virus responsible for a tick-borne encephalitis. In Europe, tick-borne encephalitis (TBE) is the second most commonly reported disease transmitted by *I. ricinus* ticks (Pancewicz et al., 2015). A large knowledge of tick-borne diseases other than Lyme borreliosis, showed students of life sciences. In a study conducted at the University of Life Sciences in Lublin it was not a student who would not mention at least one tick-borne disease (except for Lyme borreliosis). Among the most frequently mentioned disease entities there were tick-borne encephalitis and Rocky Mountain spotted fever (Kowalczyk et al., 2016). In research of students of the faculties of life sciences from Poland and the Czech Republic LB was the best known tick-transmitted disease, 41 % of the females and 92 % of the males of the Czech participants and 46 % of the females and 21 % of the males of the Poles were aware of TBE. Significantly lower knowledge was observed in awareness of ehrlichiosis and Q fever. Knowledge of any other diseases, such as tularemia, bartonellosis, babesiosis, etc., was detected only rarely (Nejezchlebova et al., 2016).

TBE vaccines are accessible. Encepur and FSME IMMUN, vaccines against TBE, are effective, safe and highly immunogenic. They induce the production of neutralizing antibodies, presenting cross-reactivity to various virus strains in Europe and Asia (including Siberian and Far Eastern subtypes). Vaccine schedule, which is employed correctly, results in a sustained protective immunity in case of 98 % of vaccinated persons (Pancewicz et al., 2015). About the existence of a vaccine against TBE knew half of the surveyed students (53.7 %).

Among the various methods of prevention of tick-borne diseases surveyed students most often mentioned watching the body after returning from the green areas (84.1 %), use of tick repellents (84.1 %) and clothing thoroughly covering the body (74.1 %). These methods significantly more often were chosen by students from Poland. Among the students of forestry the most important preventive measures involved checking the body for ticks and wearing proper shoes and protective clothes; this opinion was shared by 87.5 % of the students. The second prophylactic measure reported by them was using tick or insect repellents (62,5 %) and removing the attached ticks within the first 24 hours (60.0 %) (Kurnatowski et al., 2011).

Among the sites where it is worth to use tick repellents surveyed students most often indicated the forest and meadows. Less frequently there were mentioned orchards, city parks and farmlands. Biological properties of *I. ricinus*, its high ecological plasticity, including the lack of specificity of the host, enable a wide dissemination in the environment. Increasingly, the presence of *I. ricinus* is confirmed in urban and suburban areas, parks, squares, urban recreational areas, gardens, on private properties, fallows (Kiewra, 2014), which increases the risk of being bitten by these arthropods.

An important element in the prevention of Lyme borreliosis is to remove correctly a feeding tick as soon as possible, because the longer the infected tick feeds, the more the risk of infection increases (Steere et al., 2004; Zajkowska, 2008; Rizzoli et al., 2011; Stanek et al., 2012). The use of incorrect ways to remove a tick also increases the risk of transmission of pathogens from the body of the tick to the skin. Most often it is recommended to grab it with tweezers, as close to the skin and pull out with a simple and energetic movement perpendicularly to the skin. The place after removing the tick must be disinfected (Zajkowska, 2008; Rizzoli et al., 2011). Among the various ways of removing a tick attached to the skin students most often indicated the proper way (removing by tweezers with a simple, energetic movement) (50.9 %). Students from Slovakia frequently mentioned the inappropriate method of removing a tick. Particularly worrying is the high percentage of students from Slovakia who believe that the tick should be smeared with grease (eg. butter) that it would come out by itself (54.7 %). Ticks should never be covered with such substances as butter, petroleum jelly, kerosene, petrol or nail varnish, as the suffocating tick introduces pathogens

into the skin along with its vomit (Tylewska-Wierzbanowska & Chmielewski, 2017). In the research on life sciences students in Poland, 58.15 % of respondents when asked to indicate the proper procedure in case of being bitten by a tick, answered that the tick should be removed with tweezers, disinfect and watch the bite site (Kowalczyk et al., 2015).

The results of the study indicate that the knowledge of the surveyed students on Lyme borreliosis and other tick-borne diseases was rather limited. It has been observed that more often correct answers about Lyme borreliosis were given by students from Poland. This may be associated with a higher risk of the disease. In Poland, the recorded incidence of Lyme borreliosis is clearly higher. In 2015, the incidence rate reached more than twice as much higher compared with Slovakia (National Institute of Public Health - National Institute of Hygiene, 2016; Epidemiological Information System in Slovakia). The students from Slovakia showed a greater awareness of the threat of TBE. This tick-borne disease in turn, is more often recognized in Slovakia (National Institute of Public Health - National Institute of Hygiene, 2016; Epidemiological Information System in Slovakia). As part of the conducted self-assessment, most of the surveyed students from Slovakia evaluated their knowledge on Lyme borreliosis as minimal, while Polish students as an average. Students from Poland also assessed higher the knowledge of Polish society about the disease, although dominated the responses that it was minimal. Among the respondents, 83.4 % of students see the need to broaden their knowledge on tick-borne diseases. Therefore, it is worth to extend the subject matter on tick-borne diseases in the currently realized curricula on medical fields of studies to better prepare future medical staff to undertake educational and awareness-raising activities in a society in terms of tick-borne diseases. From the point of view of public health, a more frequently recorded presence of ticks within city boundaries and industrial areas (Wójcik-Fatla et al., 2009; Rizzoli et al., 2014), and systematically increasing number of registered cases of Lyme borreliosis are highly disturbing phenomena.

### **Conclusions**

The knowledge of the surveyed students on tick-borne diseases is limited. Polish students demonstrated greater knowledge about Lyme borreliosis, while students from Slovakia showed greater awareness of the threat posed by tick-borne encephalitis. Particularly worrying is the lack of knowledge on proper way of removal of a tick attached to the skin. Nearly half of the surveyed students from Slovakia believes that the correct way of removing a tick is to smear it with grease that it will come out by itself. Students recognize the need to broaden their knowledge on tick-borne diseases, which should be taken into consideration in realized studies curricula.

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