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Epidemiological Characteristics of Brucellosis in Federation of Bosnia and Herzegovina

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Aim To analyze the frequency and distribution of human brucellosis in the Federation of Bosnia and Herzegovina in the period 2001-2008, and measures and activities undertaken for prevention and control of the disease.

Method In this descriptive, retrospective study, we used official reports on infectious diseases from public health institutes at the federal and cantonal level, as well as epidemiological surveys. For comparison with animal brucellosis cases, we used the distribution data from veterinary surveillance.

Results Since 2001, the number of infected people has rapidly increased and brucellosis has become a very important public health problem. In the period 2001-2008, there were 1639 human brucellosis cases and the number of cases increased every year. The morbidity rate over the study period ranged from 3.8 to 33.4 per 100 000 inhabitants. According to epidemiological surveys, in villages human brucellosis was transmitted mostly by contact with infected animals and their products, and in cities by consumption of dairy products made from contaminated, unpasteurized milk. When test-and-slaughter control approach was used, the prevalence of seropositive livestock was 4.6% and approximately 70 000 animals were slaughtered after testing between 2001 and 2008. From 1 June 2009, this approach was replaced with mass vaccination of sheep and goats.

Conclusion The large number of human brucellosis cases and seropositive livestock poses a very serious problem for Bosnia and Herzegovina. The solution may be the introduction of mass vaccination.

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Brucellosis is a zoonosis caused by the bacterial species *Brucella* spp. Different types of *Brucella* infect different, primarily domestic animals, and are reservoirs for human infections: *B. melitensis* infects sheep and goats, *B. abortus* cattle, *B. canis* dogs, and *B. suis* pigs (1,2).

In the Mediterranean countries and Bosnia and Herzegovina, *Brucella melitensis*, which affects different animals, but most frequently sheep and goats, is most commonly isolated *Brucella* species (3,4). The principal route of human infection is consumption of raw or unpasteurized milk and related dairy products, especially cheese. This is the dominant mode of infection in Bosnia and Herzegovina (5,6). Another major infection route is through occupational exposure to infected livestock, ie, inhalation of contaminated secretions of infected animals or contamination through skin cuts or abrasions (7,8).

Brucellosis causes systemic symptoms and can involve many organs and tissues (9). There are different symptoms of brucellosis, including undulant fever, headache, night sweats, joint and muscle pain, hepatomegaly, and splenomegaly (8,10).

Clinically, brucellosis can be classified into subclinical, acute, subacute, and chronic relapsing forms. Clinical polymorphism is very common and for this reason brucellosis is often unrecognized in primary health care settings (11). Exact diagnosis is based on the clinical picture, epidemiological data, and different laboratory tests, such as bacterial culture, agglutination, and polymerase chain reaction (12-14).

Brucellosis can inflict high costs to the economy in terms of medical tests, treatment, and employee absenteeism, which makes it also a considerable social problem, especially in poor countries. It also induces panic and fear in the public, which can affect the country's economy, tourism, and trade (15). Also, *Brucella* species are considered to be biologic agents for terrorism (16).

Brucellosis is distributed throughout the world, with approximately 500 000 new cases occurring each year. Foci of brucellosis have been identified in the Mediterranean basin, Central Asia, and Latin America (17). In Europe, the greatest number of infected people has been registered in the Mediterranean and Balkan countries, in some of which the disease is endemic. In the former Yugoslavia, a large number of infected people was registered immediately after the World War II. This number significantly decreased with the implementation of eradication

measures and in the 1980s and 1990s, the disease became very rare (5,6). Bosnia and Herzegovina was free of brucellosis from 1980 until 2000. Since then, the number of infected people in the country has rapidly increased, and infections have been recorded at almost the entire territory. In the recent years, brucellosis has been present continuously, with a changing morbidity rate and an overall tendency to increase. Thus, it has become an important public health problem in the country (18-20).

Bosnia and Herzegovina is a small country, with an area of 51 200 km² and an estimated population of 3.8 million. It consists of the Federation of Bosnia and Herzegovina (FBH) and the Republic of Srpska (RS), and a separate entity of Brčko District. FBH has 10 administrative units called cantons. Public health is administered at the county level in RS and at the canton level in FBH, with only one coordinating body at the national level. This decentralized organization poses a large problem for the implementation of necessary measures for the control of human and animal brucellosis.

Controlling brucellosis requires planning at the national level, better cooperation between the veterinary and health sectors, financial resources, and health education for health professionals, veterinarian professionals, and the general population (12,21,22). The first measures for brucellosis control in animals in FBH were implemented in 2001. They were based on the test-and-slaughter control approach, in which serological testing is carried out to detect asymptomatic occurrence of the disease in livestock, and then positive animals are slaughtered. This proved to be a costly approach that did not yield satisfactory results (23). On June 1, 2009, it was replaced by a mass sheep and goats vaccination program (24-28), but it is still too early to determine the effectiveness of the new program.

The present study aims to analyze epidemiological characteristics of human brucellosis and assess its dimensions as a public health problem in FBH. It examines the frequency of cases reported per year and per month, and the distribution of cases by location, age, and sex during the period 2001-2008. The study also aims to present prevention and treatment measures and guidelines for the veterinary sector.

METHODS

In this retrospective study, we used a descriptive epidemiological method. We made a retrospective analysis of human brucellosis in FBH for the period 2001-2008. In FBH, all cases of brucellosis must be reported to public health

authorities. Report sheets are regularly collected from primary and secondary health care facilities and are sent to the respective cantonal public health institute. The public health institutes of all 10 cantons analyze the data using the EPI Info program (Centers for Disease Control and Prevention, Atlanta, GA, USA) and generate reports, which are sent to the national public health institute. We used these official reports to analyze the characteristics of infected people. Incidence values were expressed in terms of 1:100 000 inhabitants.

We also used official surveys of human brucellosis carried out among people hospitalized for brucellosis, to investigate their other epidemiological characteristics, such as the place of residence, modes of transmission, contact with animals, and presence of brucellosis among the family members.

This study also included data from the veterinary sector, collected from public veterinary agencies and private veterinary practices. Data were collected in the course of routine veterinary practice and include information on the number of registered animals, tested animals, and *Brucella* spp.-positive animals

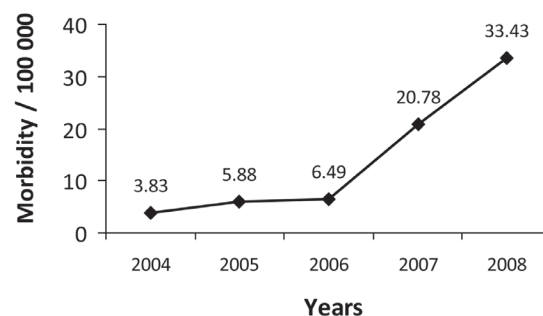
RESULTS

The total number of human brucellosis cases reported in the period 2001-2008 in FBH was 1708. From 2001-2003, only 64 (3.7%) cases were reported, but this number increased from 90 (5.4%) in 2004 to 778 (46%) in 2008 (Figure 1). The morbidity rate ranged from 3.83 to 33.4 per 100 000 people (Figure 2). Cases of human brucellosis were report-

ed across nearly the entire territory, except in the canton 2. The greatest number of *Brucella* spp. cases was reported in the cantons 6 and 4 (Figure 3).

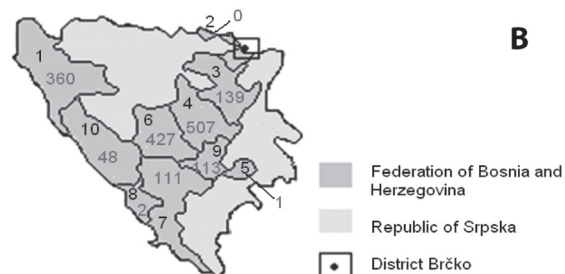
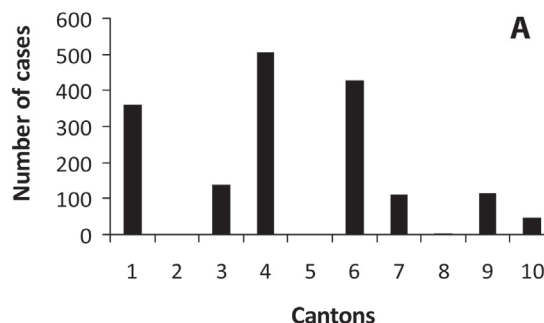
Of the 1708 cases reported during the study period, 778 (46%) were reported in 2008. That year, the morbidity rate differed by canton, and the highest rate of 63.37 per 100 000

Figure 2.



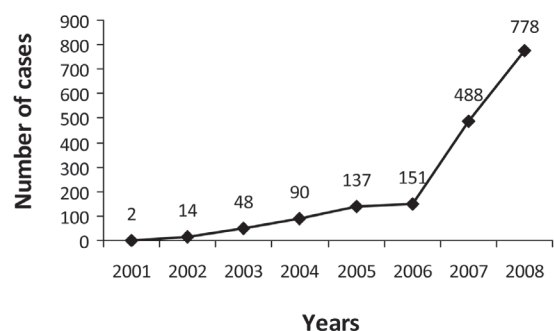
Morbidity rate of human brucellosis in Federation Bosnia and Herzegovina, 2004-2008.

Figure 3.



(A) The total number of brucellosis cases by cantons in the Federation Bosnia and Herzegovina, 2001-2008. (B) Distribution of brucellosis in the cantons. The cantons are numbered according to (A). The number of brucellosis cases in individual cantons is shown in grey.

Figure 1.



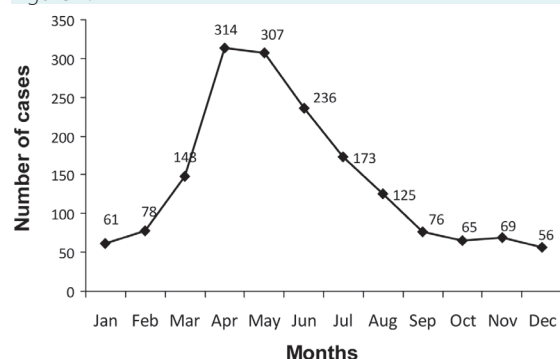
The number of brucellosis cases reported in Federation Bosnia and Herzegovina, 2001-2008. The number of reported cases refers only to new cases reported each year.

was recorded in the canton 6. In the same year, no cases were reported in the cantons 5, 8, or 2.

Seven outbreaks were reported, involving 437 cases or 26% of the total of 1708. Two occurred in 2007, 1 in the canton 6, involving 143 (33%) cases, and another in the canton 1, involving 209 (48%) cases. Five outbreaks occurred in 2008: 3 in the canton 4, involving 28 (6.4%) cases, 1 in canton, 6 involving 23 (5.3%) cases, and 1 in canton 1, involving 34 (7.8%) cases.

The greatest number of human brucellosis cases was in April, May, and June (Figure 4).

Figure 4.



Human brucellosis cases by month in Federation Bosnia and Herzegovina, 2001-2008.

Men accounted for 1212 (71%) of 1708 human brucellosis cases. Infection was reported in all age groups, but the age group of 35-45 years accounted for 788 cases (46%). It is interesting to note that brucellosis was also reported among children under 1 year. The oldest patient was 76 years old.

DISCUSSION

This study showed that brucellosis was a reemerging zoonosis in FBH. It also showed that the infection occurred in different age groups and that, in addition to occupational exposure, an important mode of transmission was consumption of unpasteurized milk products. These facts are important for creating prevention programs, which still do not exist in Bosnia and Herzegovina.

The division of the public health management between the entities in Bosnia and Herzegovina (RS, FBH, and the District of Brčko) makes the surveillance of infectious diseases such as brucellosis very difficult.

The first cases of human brucellosis in Bosnia and Herzegovina were reported in 1999-2000 among refugees in the area of Trebinje, RS (6). Human and animal brucellosis has become an important problem in FBH after 2001, and the epidemiological situation is very similar to that in other Balkan countries (3,4). In FBH, as in other Mediterranean and Middle Eastern countries, brucellosis is caused mostly by *Brucella melitensis* (1,2). The number of human brucellosis cases in Bosnia and Herzegovina corresponds to the level of brucellosis infection in animals, especially brucellosis in small ruminants such as sheep and goats. Thus, human cases are autochthonous cases (16).

The human brucellosis morbidity rate grew throughout the study period. The majority of human brucellosis cases occurred in men, as observed in other Balkan countries (4,8). Infections were reported in all age groups, but they occurred predominantly in the 35-45 years group. This shows that infection occurs through occupational exposure and farm workers are predominantly men belonging to this age group.

This sharp increase in the number of infections reported in 2006-2008 compared with the number reported in 2001-2006 can be partly explained by improvement in surveillance methods, so that cases that previously went unreported are now routinely detected. Indeed, the fact that brucellosis has become an important public health issue, discussed widely in the media, may mean that physicians take a more serious approach to brucellosis and order more diagnostic tests for suspicious cases.

Consistent with previous research (7), our study found that the principal modes of transmission were consumption of dairy products made from unpasteurized milk and occupational contact with infected animals.

Brucellosis is a zoonosis, so in order to avoid human infections it is very important to implement measures in the veterinary sector, as well as perform public health education activities. At the beginning of 2001, a control program was introduced in Bosnia and Herzegovina based on the "test-and-slaughter" policy. Testing of livestock showed a prevalence of seropositive animals of 4.6%. After testing, approximately 70 000 animals, mostly sheep, were slaughtered. The financial damage was approximately €7.5 million. From June 1, 2009, this approach was replaced by a mass vaccination program, using Rev 1 vaccine for small ruminants. This program has been very successful in many other countries, including Spain, Israel,

and Greece (24-26). As of September 2009, 643 000 sheep and goats have been vaccinated in FBH. This program will be continued during the next 8 years and it is expected that the implementation of measures will yield good results (27,28).

In addition to vaccination, the general population should be educated about the dangers of contact with infected animals and consumption of raw milk and milk products.

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