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## ORIGINAL PAPER

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# Epidemiological Insight of Pertussis in Bosnia and Herzegovina

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## ABSTRACT

**Background:** Pertussis is an infectious respiratory disease caused by the bacterium *Bordetella pertussis*. The bacterium releases toxins that can lead to complications on the respiratory and nervous systems and even death. The disease occurs in people of all ages, but it is most severe in children under the age of five.

**Objective:** To present epidemiological data on this disease in the Federation of Bosnia and Herzegovina (FB&H) from 2018 to 2022, and from Central Bosnia Canton (CBC) for the period February-June 2018. **Methods:** This descriptive epidemiological study collected data from the Institute of Hygiene and Epidemiology of the CBC and the Institute for Public Health of FB&H. **Results:** In the specified period in the FB&H was confirmed 93 cases of Pertussis, 61 cases were reported from CBC, a total of 9 in Bugojno city. Confirmed cases from Bugojno were: 3 newborns, 3 infants, 2 three-year-old children and one 12-year-old child, 5 males and 4 females. Three children received first dose of Diphtheria-Tetanus-Pertussis-Hemophilus influenza type B vaccine, six children were not vaccinated. Children were under the supervision of pediatricians and infectious disease specialists, the disease passed without serious complications. **Conclusions:** Pertussis is a highly contagious respiratory disease that lasts for weeks. Recovery can be complete, but more serious complications are possible, especially in young children. With the discovery of the vaccine, morbidity and mortality from this disease has been significantly reduced. However, the disease is still present worldwide, especially in underdeveloped and developing countries. By educating parents and educating the population on the importance of vaccination and achieving herd immunity, this disease can be completely

eradicated in the near future. In recent years, many American and European countries recommend the immunization of pregnant women in the second half of pregnancy, which provides significant protection to newborns.

**Keywords:** whooping cough, children, prevention, immunization.

## 1. BACKGROUND

Pertussis (whooping cough) is a highly contagious infectious respiratory disease that primarily affects young children. It is characterized by prolonged bouts of coughing that end with a whooping sound. It is still a significant disease in some countries, especially among malnourished children and in impoverished nations, contributing significantly to morbidity and mortality. The disease is caused by the gram-negative bacterium *Bordetella pertussis*. The bacterium releases toxins that can lead to complications in the respiratory and nervous systems, including death (1). The disease can occur in people of all ages, but it is most severe in children under the age of 5. The source of infection is an individual in the incubation period and throughout the illness, which is a lengthy period, allowing for the spread and maintenance of the infection (2).

With the introduction of mandatory pertussis vaccination, the morbidity of children aged 1 to 5 years has significantly decreased. However, an increase in the incidence has been observed in children under one year of age, as well as in adults who have lost vaccine-induced immunity. In recent years, many countries in America and Europe have recommended immunizing pregnant women in the second half of pregnancy, which provides significant protection for newborns (3).

## 2. OBJECTIVE

The aim of this study is to present epidemiological data on pertussis in the municipality of Bugojno and at the level of the Federation of Bosnia and Herzegovina (FB&H) from 2018 until today, and to demonstrate the association between reported cases of pertussis and the vaccination status of the affected individuals.

## 3. MATERIALS AND METHODS

For this descriptive epidemiological study, data were collected from the Hygiene and Epidemiology Service of the Bugojno Health Center and the Institute of Public Health of the FB&H. Data from the competent epidemiological service of the Bugojno Health Center were collected based on the notification of infectious diseases, specifically the protocols maintained by the relevant department. Data for the cantonal and federal levels were obtained from the report available on the website of the Institute of Public Health of the FB&H (4).

## 4. RESULTS

During 2018, the Hygiene and Epidemiology Service of the Bugojno Health Center reported 9 cases of pertussis, while the total number of cases in the CBC was 61, and at the level of the entire Federation of Bosnia and Herzegovina (FB&H), there were 93 cases of pertussis. In the Bugojno municipality, data showed that out of a total of 9 affected children, three were newborns, three were infants, two were three years old, and one child was 12 years old (Table 1). Out of these, five were male and four were female. Three children had received only the first dose of the Diphtheria-Tetanus-Pertussis-Hemophilus influenzae type B vaccine (DTP-HiB), while six children had not been vaccinated at all. All children were under the care of pediatricians and infectious disease specialists, and the illness progressed without serious complications. These results confirmed that the majority of affected individuals were infants, newborns, and young children. Regarding the timing of the disease occurrence in 2018, three children (33.3%) became ill in February, one (11.1%) in March, three (33.3%) in May, and two children (22.2%) in June. After 2018, no further cases of pertussis were reported in the Hygiene and Epidemiology Service of the Bugojno Health Center.

In the FB&H, pertussis has been recorded throughout the period from 2018 to the present day (Table 2). The highest morbidity of pertussis was recorded in 2018 with a total of 93 cases.

The highest morbidity of pertussis in 2018 was recorded in the CBC with a total of 61 cases, including 9 cases in the Bugojno municipality. Reported cases of pertussis ranged from <1 year old to 30 years old. The highest morbidity was observed in the age group of 0-4 years. The highest percentage of affected individuals was unvaccinated (90.32%), followed by those with an unknown vaccination status (5.37%), and those who received only one dose of the vaccine (3.30%).

In the report for the year 2017, a lower immunization coverage than the required values of 95% was recorded for the vaccine against diphtheria, tetanus, and pertussis

Age of children	Nuber of cases
Newborns	3
1-year-old	3
3-year-old	2
12-year-old	1
Total	9

Table 1. Pertussis in the Bugojno municipality in 2018.

Year	Number of cases
2018.	93
2019.	17
2020.	8
2021.	1
2022.	1

Table 2. Pertussis in the FB&H from 2018-2022.

in all cantons of the FB&H. These values indicated a decline in the quality of population herd immunity against these diseases and posed a threat of their resurgence in epidemic form, which indeed occurred during 2017-2018 with an increased number of pertussis cases. The decline in Diphtheria-Tetanus-Pertussis (DTP) vaccine coverage coincided with the introduction of the combined DTWP vaccine with a whole-cell pertussis component, due to a lack of combined DTaP vaccines with an acellular pertussis component in the global market. However, the decline was halted with the introduction of the pentavalent vaccine (DTaP-IPV-HiB) (4).

## 5. DISCUSSION

The results of this study have shown that infectious diseases that have been eradicated in some countries are still present in Bosnia and Herzegovina. Immunization is the best method of prevention for pertussis, which is an extremely contagious disease. The highest number of cases during the period from 2018 to 2022 was recorded in the CBC, with a total of 61 patients. None of the affected children in the Bugojno municipality in 2018 were adequately and fully immunized. Six patients did not receive any vaccines (66%), and three patients had only received the primary vaccination (33%). Based on these data, immunization emerges as the most valid, cost-effective, and efficient means of protection against this infectious disease. The combined DTP vaccine provides protection against pertussis. In FB&H, it is administered as a primary vaccination in the first year of life in three doses. Vaccination begins in the second month of life, continues in the fourth and sixth months, and as a booster at 18 months and in the fifth year if the child is adequately immunized. The combined vaccine, which contains antigens for diphtheria, tetanus, acellular pertussis, inactivated poliomyelitis, and Haemophilus influenzae type B (DtaP-IPV-HiB), is administered.

Immunization should be fully implemented, as incomplete vaccination generally means inadequate prevention. Although observational studies and population-level studies have shown that the introduction of at least one dose of whole-cell pertussis vaccine within the routine vaccination schedule is associated with better disease protection and longer-lasting immunity (5). However,

based on the presented example of affected children in the Bugojno municipality, CBC and the FB&H, it can be concluded that only fully implemented immunization can provide disease prevention.

In our report from 2018 in the Bugojno municipality, none of the affected children were fully immunized, resulting in the occurrence of this infectious disease. The same situation occurred at the level of the CBC in 2018, where the vaccination status of the affected individuals showed that the highest percentage of cases occurred in unvaccinated or incompletely vaccinated individuals. Regardless of the reasons that led their parents to not vaccinate or incompletely vaccinate their children, they exposed them to the risk of contracting this highly infectious disease, which is a public health concern. The widespread use of the pertussis vaccine has dramatically reduced cases, but concerns about side effects have led to the replacement of standard whole-cell vaccines with acellular pertussis vaccines that contain only selected pertussis antigens and are much less reactogenic. Routine use of acellular pertussis vaccine in combination with diphtheria and tetanus toxoids is recommended in infancy, with booster doses for young children and preschool-aged children, as well as during pregnancy. Immunization in the second half of each pregnancy is crucial for protecting newborns (3, 6).

Similar research worldwide shows that pertussis is still present in many countries, especially among young children and unvaccinated populations. The prevalence of pertussis was 67 (15%) among 449 children aged 3 months to 12 years who participated in a cross-sectional study in Uganda in 2015. It was found that age <23 months had three times higher odds of being associated with pertussis compared to the age group of 24-59 months. The findings also indicate a high prevalence of pertussis in children older than 59 months, suggesting the possibility of waning immunity (7). In Ukraine, 83 infants aged 3-12 months were under surveillance for pertussis in a regional infectious diseases hospital. A significant increase in pertussis incidence was observed among partially vaccinated infants and children who became ill shortly after vaccination (8). A similar study in Spain showed the occurrence of pertussis in infants younger than 6 months who had not started or completed their vaccination schedule, as well as in adolescents and adults due to the loss of natural or vaccine-induced immunity over time (9). A study conducted in South Africa, which included 460 hospitalized children with a mean age of 8 years, showed that *Bordetella* spp. was identified in 23 (5.0%) out of a total of 460 children over a one-year period (10). In England, a prospective cohort study was conducted from October 2001 to March 2005, involving 172 children aged 5-16 years who presented to their general practitioner with a cough lasting 14 days or more and agreed to blood analysis. The results showed that 64 (37.2%) children had serological evidence of recent *Bordetella pertussis* infection (11). In the United States and other industrialized countries, a booster dose of acellular pertussis vaccine for adolescents is recommended due to waning immunity after childhood vaccination, which

can result in a larger number of susceptible adolescents and adults capable of transmitting pertussis to vulnerable unvaccinated or incompletely vaccinated infants.

## 6. CONCLUSION

Pertussis is a highly contagious respiratory disease that can last for weeks, and while patients can fully recover, the disease can also cause serious complications, especially in young children. The discovery of the vaccine has significantly reduced the morbidity and mortality associated with this disease. However, pertussis is still present worldwide, particularly in underdeveloped and developing countries. By educating parents and raising public awareness about the importance of vaccination and achieving herd immunity, the disease could potentially be completely eradicated in the near future. In recent years, many countries in America and Europe have recommended immunizing pregnant women in the second half of pregnancy, providing significant protection to newborns.

- **Authors' contributions:** Conception and design: MLK and ERH; Acquisition, analysis and interpretation of data: SĆ, SAH, BK, MLK and ERH; Drafting the article: ERH; Revising it critically for important intellectual content: SĆ, SAH, BK, MLK and ERH; Approved final version of the manuscript: SĆ, SAH, BK, MLK and ERH.
- **Conflicts of interest:** We declare that we have no conflict of interest.
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