

THE IMPORTANCE OF IMMUNIZATION AS A PREVENTIVE MEASURE IN THE FIGHT AGAINST TUBERCULOSIS

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Abstract. Introduction. Tuberculosis (TB) is an infectious granulomatous disease caused by the human type of bacillus *Mycobacterium tuberculosis*. TB infection begins when mycobacteria reach the pulmonary alveoli, where they penetrate and replicate within the endosomes of alveolar macrophages. Bacilli in the alveoli are phagocytosed by alveolar macrophages, where they multiply and spread to regional lymph glands and through the bloodstream to distant organs (miliary tuberculosis). A scar and a cavern filled with caseous necrotic material are created at the site of the affected tissue. The treatment is carried out with a combination of several drugs, most often with the joint use of rifampicin, isoniazid and pyrazinamide, and lasts six months and continues for three months after Koch's bacillus is not found in the sputum culture. The BCG vaccine is intended for the active immunization of all newborns and high-risk children in order to prevent severe clinical forms of tuberculosis, as well as for the active immunization of adults with a high risk of developing tuberculosis. **The aim of the research work** is the comparison and interpretation of statistically processed data on the success of vaccination against TB on the territory of the Pomoravlje District for the period from 2008-2012. A descriptive study was applied in this research paper. The data were calculated in the SPSS statistics 20 software package. **Results and discussion.** Taking into account the total number of live births (1818) in relation to the number of vaccinated (1775) on the territory of the Pomoravlje District for the calendar year 2008, it is concluded that vaccination was successfully carried out for the specified year on the territory of one district because it amounted to 97.64% (it is greater than 95%). The percentage at the level of the entire district in 2009 is 97.34%, which indicates that immunization with the BCG vaccine was successfully implemented. **Conclusion.** Based on the statistically processed results, a high level of coverage and high success rate of the implemented vaccination for the five-year period from 2008-2012 was observed for the territory of the Pomoravlje District. It is very important to emphasize the essential measures that should be taken in every country of the world with the aim of developing and implementing national programs for the prevention, control and treatment of this disease.

Keywords: tuberculosis, Koch's bacillus, prevention, immunization

1. INTRODUCTION

Tuberculosis TB (Srb. colloq. -jektivka, -sušica; Turk. - verem) is an infectious granulomatous disease caused by the human type of bacillus *Mycobacterium tuberculosis* (discovered on March 24, 1882 by the scientist Robert Koch), which was called *Koch's bacillus*. The cell wall of this bacterium contains a high content of lipids, mycolic acid and polysaccharides, which are responsible for pathohistological changes and immune reactivity of the organism. Humans are most often infected with the tuberculosis bacillus by inhaling an infectious aerosol [1]. Infections rarely occur through the digestive tract or through the penetration of bacilli through the skin. TB infection begins when mycobacteria reach the pulmonary alveoli, where they penetrate and replicate within the endosomes of alveolar macrophages (*Gon's focus*). Bacilli in the alveoli are phagocytosed by alveolar macrophages, where they multiply and spread to the regional lymph glands and bloodstream, and from there to distant organs (liver, spleen, kidneys and bones).

Simon's focus infection is characteristic of the upper part of the lung wing. Tissue destruction and necrosis are often counterbalanced by healing and fibrosis. A scar and a cavern filled with caseous necrotic material are created at the site of the affected tissue. Tuberculosis has always had the characteristics of a social disease [2], because its spread in time and space depended both on the nature of the causative agent and human resistance, as well as on hygienic and socio-economic living conditions. The clinical manifestation of the disease is most often pulmonary tuberculosis. TB sometimes affects the central nervous system, circulatory system (miliary tuberculosis), lymphatic system, kidneys, bones and joints. Classic symptoms of active tuberculosis infection are chronic cough with bloody sputum, fever, night sweats and weight loss.

Chest X-ray, computed tomography of the lungs, tuberculin tests and multiple sputum cultures, as well as microscopic examination and microbiological analysis of body fluids are common tests in addition to history and a detailed clinical examination [3]. The Mantu tuberculin skin test is often used as a screening for people who are at high risk for TB. Nucleic acid

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amplification tests and adenosine deaminase testing can quickly diagnose TB [4]. The combination of rifampicin, isoniazid and pyrazinamide is undoubtedly the most effective tuberculosis chemotherapy [5, 6, 7].

Disease prevention through immunization reduces not only mortality, but also morbidity, as well as direct and indirect costs in healthcare. Protection against tuberculosis with a vaccine has been given special attention in research since the time of Robert Koch [8].

2. THE AIM AND TASKS OF THE RESEARCH WORK

The goal of the research work is the comparison and interpretation of statistically processed data on the success of vaccination against TB on the territory of the Pomoravlje District for the period from 2008-2012.

3. METHODOLOGY OF THE RESEARCH WORK

A descriptive study was applied in this research paper. Previous annual reports on the immunization of children against TB on the territory of the Pomoravlje District were retrospectively analyzed. A special database was created for data entry in the time interval from 2008-2012. The data were calculated in the SPSS statistics 20 software package. The data were presented graphically.

4. RESULTS AND DISCUSSION

Tuberculosis is a classic example of a cellular immune response and (late) type hypersensitivity. Alveolar macrophages, neutrophil leukocytes, B and T lymphocytes (CD_4^+ and CD_8^+) lymphocytes and NK (natural killer) cells and as well as antibodies and antigen-antibody complexes participate in the immune response to *M. tuberculosis*. Tuberculosis is one of the most widespread infectious diseases in the world and is thought to have infected between 2 and 3 billion people [9]. The largest number of people suffering from tuberculosis live in Sub-Saharan Africa, Southeast Asia and South America. One third of all tuberculosis patients in the world live in India. About 9 million people are infected with tuberculosis every year. Ninety percent of all infected people have a latent form of the disease without pronounced symptoms. Antibiotic treatment and a high standard of living almost eliminated tuberculosis in developed countries, but due to the emergence of HIV-infection and large population migration, the number of people suffering from tuberculosis has again increased in these countries. Tuberculosis kills two million people every year, making it the deadliest infectious disease after AIDS.

The first attempts to make a dead vaccine against tuberculosis date back to the beginning of the 20th century. It was not until 1906 that two outstanding French scientists, Calmette and Guerin, began the process of creating a live vaccine with a weakened, but still living, causative agent of mycobacteria. In 1908, professors of the Pasteur Institute in Paris, Calmette and Guerin, succeeded in obtaining the BCG bacillus (*Mycobacterium bovis* BCG) from the bovine type [10]. In 1920, they announced that the vaccine prepared from their strain was completely harmless to humans and had good protective power. After that, experimental and then regular vaccination of children was started, with

excellent results. That's how vaccination started, first in Europe, and then in the whole world [11].

In our country, their student Milutin Ranković brought the original BCG bacillus culture and made the first vaccine at the end of 1926. Mass production began the following year. BCG is a lyophilized vaccine consisting of live, weakened *Mycobacterium bovis*. Vaccination with the BCG vaccine leads to a cell-mediated immune response that provides a variable degree of protection against tuberculosis (the protective effect of vaccination is 40-70%). The BCG vaccine is intended for the active immunization of all newborns and high-risk children in order to prevent severe clinical forms of tuberculosis, as well as for the active immunization of adults with a high risk of developing tuberculosis. The BCG vaccine should only be given to persons who do not have a *Mycobacterium tuberculosis* infection or who have a negative tuberculin reaction and who have not been vaccinated with the BCG vaccine [12].

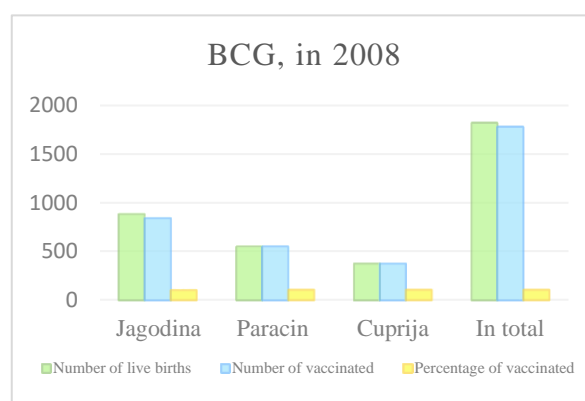


Figure 1. Immunization against tuberculosis carried out on the territory of the Pomoravlje District in the period from 1-12.2008.

In Figure 1, it is noted that on the territory of the municipality of Jagodina, out of the total number of live births, which was 885 inhabitants in 2008, 844 of them were vaccinated, which amounts to less than 96% (more precisely, 95.37%). In the municipality of Paracin, out of 555 live births, 553 were vaccinated, which is 99.64%, and in the municipality of Cuprija, a more than satisfactory result of those vaccinated with the BCG vaccine, out of 378 live births, the same number were vaccinated, i.e. 100%. It is concluded that vaccination was successfully carried out for the specified year on the territory of one district because it amounted to 97.64% (it is greater than 95%). The greatest protective effect of the BCG vaccine is achieved when it is given to newborns, as it induces an immune response before the newborn becomes infected.

From Figure 2, it can be seen that in the municipality of Paracin the number of live births and vaccinated is almost equal and amounts to less than 100% (more precisely 99.43%), in the municipality of Jagodina the percentage of vaccinated compared to live births is slightly lower (96.37%), but satisfactory, as in the municipality of Cuprija, where 404 people were vaccinated out of 418 live births. The percentage at the level of the entire district in 2009 is 97.34%, which indicates that immunization with the BCG vaccine was successfully implemented.

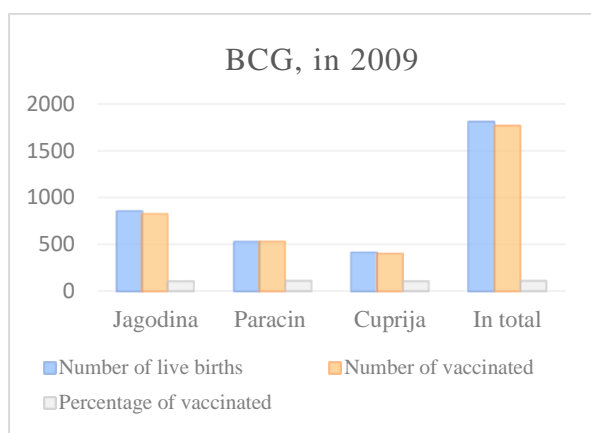


Figure 2. Immunization against tuberculosis carried out on the territory of the Pomoravlje District in 2009

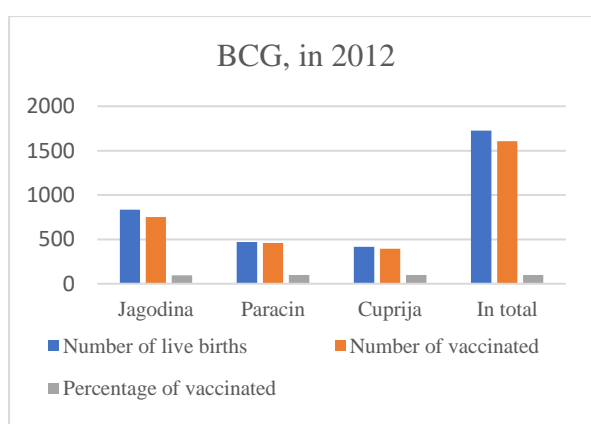


Figure 3. Immunization against tuberculosis carried out on the territory of the Pomoravlje District in 2012

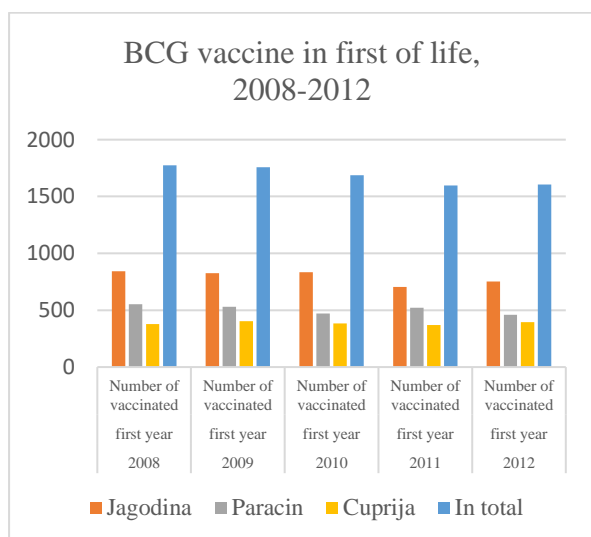


Figure 4. Graphic representation of vaccination against TB with the BSG vaccine in the first year of life on the territory of the Pomoravlje District for the time period from 2008-2012

From Figure 3, it is noted that on the territory of the municipality of Paracin, out of the total number of live births, which is 472 inhabitants in 2012, 460 of them were vaccinated, which is 97.45%. In the municipality of Jagodina, out of 836 live births, 752 were vaccinated, which is significantly less compared to the previous four years, and in the municipality of Cuprija, out of 416 live

births, 394 people were vaccinated with the BCG vaccine (94.71%).

By observing and comparing the statistical data (SPSS Statistics 20) from 2010 and 2011, which can be found in Figure 4, it was noticed that the total number of people vaccinated against tuberculosis in the Pomoravlje District in 2011 was lower compared to 2010.

The most important measure to protect against tuberculosis is the BCG vaccination, which is considered the most important preventive measure in the fight against tuberculosis and is now mandatory in 64 countries and recommended in another 118 countries of the world [13, 14]. The BCG vaccine should also be given in special conditions such as the administration of the vaccine to children in families of tuberculosis parents, together with chemoprophylaxis (tuberculostatics), to persons who are occupationally exposed to tuberculosis infection and in conditions of emergency accommodation and difficult social-economic living conditions [15, 16, 17]. Scars can be a bad indicator of BCG vaccination in early childhood, so it is safer to check the vaccination status through documentation, i.e. a personal vaccination record [18, 19].

5. CONCLUSION

Based on the statistically processed results, a high level of coverage and high success rate of the implemented vaccination for the five-year period from 2008-2012 was observed for the territory of the Pomoravlje District. Disease prevention through immunization (vaccination and chemoprophylaxis) not only reduces mortality, but also morbidity, as well as direct and indirect costs in healthcare. It is very important to emphasize the essential measures that should be taken in every country of the world with the aim of developing and implementing national programs for the prevention, control and treatment of this disease.

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