

## Epidemiological Analysis of Tuberculosis in the Kingdom of Croatia and Slavonia during 1901-1910

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**Aim.** To analyze data on epidemiology and treatment of tuberculosis from the sources related to the history and epidemiology of tuberculosis in the Kingdom of Croatia and Slavonia in the 1900-1910 period.

**Methods.** Epidemiological data were obtained from the statistical yearbooks of the Kingdom of Croatia and Slavonia for years 1905 and 1910. A number of sources and publications on the history of medicine, especially on the history of tuberculosis in the studied period were analyzed. Mortality ratio, birth rate ratio, and population growth were calculated. Tuberculosis mortality per 100,000 inhabitants was calculated for four major cities and eight counties of the Kingdom of Croatia and Slavonia. The difference in tuberculosis mortality rates between urban and rural areas and socio-economic situation and organization of the health service were analyzed. The incidence, prevalence, and morbidity from tuberculosis were not analyzed because of the lack of data.

**Results.** The tuberculosis mortality ratio per 100,000 inhabitants in the Kingdom of Croatia and Slavonia were constantly high (above 400 on average), with higher mortality ratio in urban than in rural areas. According to the opinion of the Croatian physicians and statistical data of the period, this was due to the constant growth of population, insufficient health care system, and bad living conditions. The highest tuberculosis mortality rates were in the cities of Zemun (600-800) and Zagreb (500-700), and in the counties of Srijem (600-400), Virovitica (600-400), and Lika-Krbava (500-400).

**Conclusion.** There was a concordance between the statistical data and the publications, reports, and articles written in the 19th and 20th century on tuberculosis situation in the Kingdom of Croatia and Slavonia. The analysis showed that tuberculosis was one of the major causes of death in the Kingdom of Croatia and Slavonia from 1901 to 1910. This fact had a significant influence on tuberculosis prevention and eradication efforts in the first half of the 20th century in Croatia and laid basis for further and more elaborate measures against tuberculosis epidemics.

**Key words:** Croatia; epidemiology; history of medicine; tuberculosis; 20<sup>th</sup> century

In the 18th- and 19th-century Europe tuberculosis was a disease of pandemic proportions. In London it reached its peak in 1749, with 890 deaths per 100,000 inhabitants, and in Hamburg in 1830, with 760 deaths per 100,000 inhabitants (1). The spread of tuberculosis was mainly attributed to the poverty and poor living and sanitary conditions, especially among lower classes in large European cities. It spread over the whole continent of Europe by migrations of the working classes (2). Not only were the medical practitioners faced with the problem of tuberculosis but its effects became the subject of many literary and art works (3).

In the 19th century and the beginning of the 20th century, tuberculosis spread to the Austro-Hungarian Empire, at first to its industrialized parts (Austria, Hungary) and in the end to the less industrialized Kingdom of Croatia and Slavonia (today north-wes-

tern and western parts of the Republic of Croatia and the north-western parts of Serbia) (4).

The gradual increase in the significance of tuberculosis as a health threat to Croatian territories is readily visible from the number of Croatian medical texts on tuberculosis from that period. According to data published by distinguished Croatian historian of medicine Dr. Mirko Dražen Grmek (1924-2001) (5,6), until the second half of the 19th century there were only three medical texts related to the subject of tuberculosis, written by Croatian physicians. All three of them were printed in the 18th century (7-9). Afterward, the number of texts on the subject of tuberculosis rose to 55 in the period from the second half of the 19th century until 1918 (6).

Tuberculosis was often discussed at the meetings of the Association of Physicians of the Kingdom of Croatia and Slavonia (*Sbor liječnika kraljevina*

*Hrvatske i Slavonije*) established in 1874 and on the pages of its official journal *Liječnički vjesnik*, which was launched in 1877. The articles in the *Liječnički vjesnik* mainly dealt with etiology, epidemiology, and therapy of tuberculosis, and less with prophylaxis. Here we must mention that the article on tuberculosis by Dr. Robert Koch (1843-1910) was translated and published in *Liječnički vjesnik* in less than a year after its first publication on April 15, 1882 (10-15).

In the 19th century tuberculosis was a serious health problem (16), as described by Dr. Milivoj Dežman (1873-1904), novelist and physician of Health Insurance Treasury Funds for Workers in Zagreb (*Okružna blagajna zagrebačka za osiguranje radnika*). He wrote a number of texts on tuberculosis (17) and founded the first sanatorium, Brestovac, near Zagreb, for the treatment of tuberculosis in 1909 (18). In his work "Tuberculosis – etiology, epidemiology, treatment" from 1902 (19), he described extremely poor living conditions of the industry workers in Zagreb and their influence on tuberculosis epidemics, stating that in the city of Zagreb there were 400 tuberculosis deaths every year and in the whole Kingdom of Croatia and Slavonia more than 9,000. Most tuberculosis deaths occurred among working classes (80%). The main causes for this devastating spread of tuberculosis among the workmen were poor sanitary and living conditions. Dežman was disappointed with the inefficiency of the government in tuberculosis prevention (20).

It is sometimes useful to reach into the past to solve the problems of the future. Today tuberculosis is again a growing health problem especially in the poor and war stricken countries (21), and it seems that the causes of the tuberculosis epidemics were similar throughout the centuries.

## Methods

Methods of descriptive epidemiology were used. The data were collected from the statistical yearbooks of the Kingdom of Croatia and Slavonia from 1905 and 1910 (22,23), which are kept in the Croatian Bureau of Statistics in Zagreb.

We analyzed the mortality ratio, birth rate ratio, and population growth in the Kingdom of Croatia and Slavonia in the period between 1901 and 1910.

The tuberculosis mortality per 100,000 inhabitants was analyzed from 1901 to 1910 for the Kingdom of Croatia and Slavonia, its four major cities (Zagreb, Zemun, Varaždin, Osijek), and its eight counties (Lika-Krbava, Modruš-Rijeka, Zagreb, Varaždin, Bjelovar-Križevci, Požega, Virovitica, and Srijem) (Fig. 1). The difference in tuberculosis mortality rates between urban and rural areas was investigated. The tuberculosis incidence, prevalence, and morbidity were not analyzed because of the lack of data.

The socio-economic situation was assessed with respect to the growth of number of industry workers as a sign of industrialization, average worker's salary, rooms per capita as a sign of the housing situation, and the growth in number of health insurance treasury funds for workers. Organization of the health service was analyzed on the basis of the number of physicians, pharmacists, and midwives per 100,000 inhabitants, number of beds per hospital, number of physicians per hospital, number of hospitals per 100,000 inhabitants, number of deaths of tuberculosis diagnosed by a physician, and number of those who were treated by physician per 100 deaths.

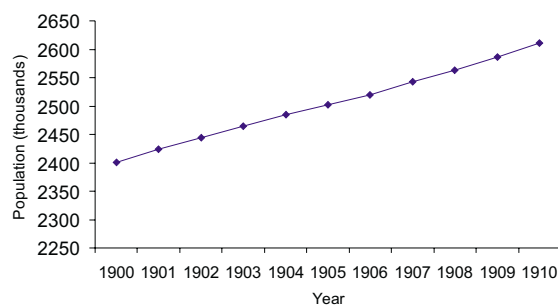


**Figure 1.** Map of the Kingdom of Croatia and Slavonia around 1918, with names and borders of the counties.

## Results

The population of the Kingdom of Croatia and Slavonia was in a constant and rapid growth. From 1901 to 1910 the population augmented for 250,000 (Fig. 2). The birth rate was high and constant (40 on average) (Table 1), whereas the mortality rate was a bit lower but also very high and slightly varying (25-30 on average) (Table 1). This resulted in the constant rate of the population growth (10-15 on average) (Table 1).

The total number of workers in industry was slowly increasing from 22,285 in 1905 to 24,128 in 1910. The average wage was 6-20 Kruna (1 Kruna (*Kronen*) in 1910 had a value of around US\$3 today). The number of health insurance treasury funds for workers also increased from 39,374 in 1901 to 64,716 in 1910. In the beginning of 1874, the Parliament of the Kingdom of Croatia and Slavonia passed laws and regulations effecting the organization of the



**Figure 2.** Population growth in the Kingdom of Croatia and Slavonia, 1901-1910.

**Table 1.** Total birth rate, mortality rate, and population growth rate per 100,000 inhabitants in the Kingdom of Croatia and Slavonia, 1901-1910

Year	Birth rate	Mortality rate	Population growth rate
1901	40.4	27.3	13.1
1902	39.2	27.4	11.8
1903	41.5	27.6	13.9
1904	39.2	26.9	12.3
1905	40.0	26.2	13.8
1906	40.1	30.1	10.0
1907	39.7	26.3	13.3
1908	39.3	25.4	13.8
1909	39.2	27.2	12.0
1910	41.7	26.7	15.0

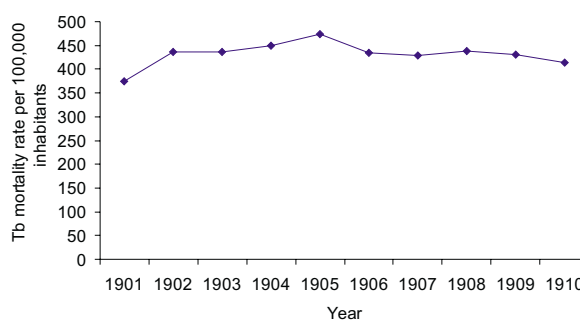
public health system and financing of health care (24). This change was further corroborated by the introduction of health care laws in 1894 and 1905 (25). The new regulations of the health care initiated the process of "medicalization" that was understood as a part of European modernization of health care and health care administration. It brought more accurate knowledge of main causes of illnesses, deaths, and disabilities but did not significantly improve health and health conditions (24). The number of medical personnel stayed more or less constant or slightly increased. It was not sufficient for the needs of a growing number of inhabitants. In 1905, the Kingdom of Croatia and Slavonia had 166 physicians, 191 pharmacists, and 888 midwives. In 1910 there were 196 physicians, 196 pharmacists, and 925 midwives. The number of physicians, pharmacists, and midwives per 100,000 inhabitants remained constant from 1901 to 1910 (40 midwives, 15 physicians, and 5-8 pharmacists on average) (Table 2). Furthermore, the number of hospitals from 1901 to 1910 did not change at all (48 hospitals). The number of beds per hospital increased slightly, from 105 in 1905 to 113 in 1910. The number of hospitals per million inhabitants decreased from 1.6 in 1901 to 1.5 in 1910. The number of physicians per hospital increased slightly from 45 in 1905 to 55 in 1910. A physician treated only 20 to 22 of 100 inhabitants who died. All this, together with poor housing conditions (0.25 rooms per capita in 1901 and 0.30 rooms per capita in 1910), resulted, among other things, in a constant high tuberculosis mortality rate per 100,000 inhabitants (400-500 on average) (Fig. 3). Such a high rate can be compared with the rates from London in 1749 and Hamburg in 1830, when tuberculosis was at its peak (1). For comparison, tuberculosis mortality rate per 100,000 inhabitants for the Republic of Croatia in 1999 was 5.3 (26).

**Table 2.** Number of physicians, midwives, and pharmacists per 100,000 inhabitants in the Kingdom of Croatia and Slavonia, 1901-1910

Year	Physicians	Midwives	Pharmacists
1901	13.6	34.3	5.1
1902	13.8	34.7	5.2
1903	13.8	35.5	5.1
1904	13.8	35.7	5.0
1905	13.7	34.8	5.1
1906	14.3	35.3	5.0
1907	14.8	35.5	5.1
1908	15.2	34.8	5.0
1909	15.0	35.2	5.3
1910	14.7	35.3	5.5

Tuberculosis was the most lethal infectious disease in Kingdom of Croatia and Slavonia from 1900 to 1910, with an average of 10,980 deaths per year, which was five times higher than for any other infectious disease (1,870 deaths per year from whooping cough, 1,850 deaths per year from measles, 1,500 deaths per year from diphtheria, and 1,300 deaths per year from scarlet fever on average). Only one sixth of all tuberculosis deaths were diagnosed by physicians (Table 3).

The tuberculosis was more spread in urban than rural areas. This can be seen from the difference in the tuberculosis mortality rate between the city of Zagreb



**Figure 3.** Tuberculosis mortality rate in the Kingdom of Croatia and Slavonia 1901-1910.

**Table 3.** Number of deaths from tuberculosis and deaths from tuberculosis diagnosed by physicians in the Kingdom of Croatia and Slavonia, 1901-1910

Year	No. of tuberculosis deaths	
	total	diagnosed by physicians (%)
1901	9,160	2,766 (30)
1902	10,781	2,602 (24)
1903	10,914	2,592 (24)
1904	11,408	2,790 (24)
1905	12,575	3,121 (25)
1906	10,928	2,711 (25)
1907	10,893	2,709 (25)
1908	11,246	2,789 (25)
1909	11,147	2,820 (25)
1910	10,828	2,614 (24)

and Zagreb County or the city of Zemun and Srijem County (Tables 4 and 5). Similar tendencies can also be observed between city of Varaždin and Varaždin County and between the city of Osijek and Virovitica County (Tables 4 and 5).

Tuberculosis mortality rate was the highest in the cities of Zemun (600-800) and Zagreb (500-700) and in the Srijem County (600-400), Virovitica County (600-400), and Lika-Krbava County (500-400) (Tables 4 and 5). The differences in mortality rates between counties and cities can be attributed to differences in living conditions and the organization of the health system. For example, high population density in Zagreb (915 inhabitants per square kilometer in 1905 and 1,182 inhabitants per square kilometer in 1910), with the highest population growth rate among the cities in the Kingdom of Croatia and Slavonia (from 1901 to 1910, the population of Zagreb increased for 17,013 inhabitants) and the slow improvement of the health care (91 physicians per 100,000 inhabitants in 1901, and 107 physicians per 100,000 inhabitants in

**Table 4.** Tuberculosis mortality rate per 100,000 inhabitants for the cities of the Kingdom of Croatia and Slavonia, 1901-1910

Year	Zemun	Varaždin	Osijek	Zagreb
1901	613.6	418.1	537.8	529.6
1902	722.2	491.2	561.5	651.0
1903	677.9	487.4	542.7	620.7
1904	731.1	553.6	571.8	702.2
1905	830.3	637.9	559.2	710.8
1906	652.9	557.5	577.9	637.1
1907	662.9	477.4	578.0	613.2
1908	769.8	475.2	395.4	612.0
1909	815.9	406.6	445.0	643.2
1910	519.5	365.7	487.4	657.1

**Table 5.** Tuberculosis mortality rate per 100,000 inhabitants in the counties of the Kingdom Croatia and Slavonia, 1901-1910

Year	Counties of the Kingdom of Croatia and Slavonia						
	Lika-Krbava	Modruš-Rijeka	Zagreb	Varaždin	Požega	Virovitica	Srijem
1901	432.6	390.8	376.6	315.2	363.8	387.6	394.2
1902	495.6	422.7	420.5	340.8	403.1	511.9	514.4
1903	538.4	419.2	412.1	364.7	408.3	493.6	518.5
1904	478.6	471.3	416.6	403.4	428.2	513.5	544.0
1905	528.6	488.6	448.1	400.3	456.9	639.8	635.9
1906	444.1	426.8	389.4	381.9	397.9	481.5	527.5
1907	402.6	426.6	411.0	366.1	400.2	449.8	537.0
1908	451.1	399.8	417.8	326.8	460.6	455.5	549.3
1909	401.1	387.1	410.9	324.1	439.7	540.6	531.8
1910	405.0	386.4	432.7	314.7	315.4	465.5	478.2

1910) contributed to the high tuberculosis mortality rate in Zagreb. The highest population density in the Kingdom of Croatia and Slavonia (307 inhabitants per square kilometer in 1910), a high degree of urbanization (58 towns with more than 2,000 inhabitants), and relatively poor health care organization (55 physicians per 100,000 inhabitants in 1905 and 64 physicians per 100,000 inhabitants in 1910) also had the same impact on the tuberculosis epidemics in Zemun.

The same pattern could be observed for the tuberculosis mortality rate in the Srijem County (high population density: 270 inhabitants per square kilometer in 1905 and 307 in 1910; rapid population growth: over 10,000 inhabitants in 10 years; and unchanged number of physicians: 16 physicians per 100,000 inhabitants in 1905 and in 1910). The high tuberculosis mortality rate in the Lika-Krbava County was related to the inadequate health care service covering County's 6,211 square kilometers (6 physicians per square kilometer in 1905 and 7 physicians per square kilometer in 1910), which was further worsened by dispersed population (34 inhabitants per square kilometer in 1905 and 33 in 1910).

## Discussion

Our descriptive epidemiological analysis showed that tuberculosis had presented a serious health problem in the Kingdom of Croatia and Slavonia.

An article from 1909, "Healthcare service in Croatia and Slavonia in the year 1905", by Dr. Fran Gundrum-Oriovčanin (1856-1919), Croatian health promoter and physician from the town of Križevci (27), offers a critical review of the public health care system. Our findings of insufficient development of the health care system in comparison with the rapid growth of population and bad living conditions were substantiated by Gundrum's analysis. He also used statistical yearbooks from that period for his analysis of the health care system and came to the same conclusions. The number of medical personnel was insufficient for the needs of population. In 1905, the Kingdom of Croatia and Slavonia had 1 physician per 6,948 inhabitants, in comparison with England, which had 1 physician per 1,730 inhabitants or Germany with 2,820 inhabitants per physician. Better prevention and early discovery of tuberculosis among the exposed population could have been achieved with the adequate number of physicians and adequate organization of the health care system.

To prevent the spread of tuberculosis in the population, the Association of Physicians of the

Kingdom of Croatia and Slavonia appointed a special committee to address the issue of tuberculosis in 1903 (28). The government issued a special decree on the measures for prevention of tuberculosis in the Kingdom of Croatia and Slavonia (29).

Poor housing situation, low hygienic standards, and poverty were often mentioned as the causes of high tuberculosis mortality rates among the working class (17). This opinion was also shared by Dr. Vladimir Čepulić (1891-1962), the founder of Croatian phthysiology and very active in the prevention of tuberculosis. He wrote a short overview of tuberculosis situation in Zagreb in 1931 (30,31). In this text, Čepulić estimated that there were 400 tuberculosis deaths per year in Zagreb in the period from 1901 to 1910. This number corresponds to the data we obtained from our epidemiological analysis (Table 4). He also attributed the spread of tuberculosis to poor living conditions among the working class.

Similar tuberculosis situation was present in Dalmatia, the southern part of today's Croatia. In the "Health report for Dalmatia for the years 1903, 1904 i 1905" by Dr. Jakob Gjivanović (1841-1912) (32), Croatian physician from Dubrovnik and the head of health care services in Dalmatia at the beginning of the 20th century, tuberculosis and malaria were reported as the deadliest diseases (1,547 deaths in 1903, 1,688 deaths in 1904, and 1,687 deaths in 1905). From 1903 to 1905, the number of deaths from malaria gradually decreased, while the number of deaths from tuberculosis increased. Tuberculosis was also more present in urban than rural areas (tuberculosis death rate was the highest in regions that included big cities, such as Split and Šibenik). As far as the health care organization was concerned, the number of physicians, pharmacists, and midwives did not substantially increase from 1903 to 1905, whereas the number of beds in hospitals increased by only 28 beds. The housing situation, especially among the working classes, was less than desirable (32).

The tuberculosis situation in the Kingdom of Croatia and Slavonia at the beginning of the 20th century was similar to the one that the other parts of Europe experienced at the beginning of the 19th century (1). The reason for this delay in tuberculosis epidemic may be explained by the late development of industrialization and urbanization.

In conclusion, our analysis showed concordance between the statistical data and the publications, reports, and articles on tuberculosis situation in the

Kingdom of Croatia and Slavonia, written by the Croatian physicians from the 19th and 20th century. The analysis showed that tuberculosis was one of the major causes of death in the Kingdom of Croatia and Slavonia from 1901 to 1910. This was due to insufficient organization of the health care system, poor living conditions – especially among the poor, and rapid growth of population at the time of early industrialization and urbanization in the Kingdom of Croatia and Slavonia. The situation had a significant influence on tuberculosis prevention and eradication efforts in the first half of the 20th century in Croatia and laid basis for further and more elaborate measures against tuberculosis epidemics.

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