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Socio-Economic Development and Tuberculosis Mortality in Italy: A Historical Analysis (1887-1955)

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Abstract: *This paper analyzes tuberculosis mortality in Italy (1887–1955) in its correlation with industrialization. The geographical distribution of pulmonary tuberculosis and the effects of regional industrialization are examined using epidemiological data and official mortality statistics. The results show a significant relationship between industrialization and pulmonary tuberculosis mortality, especially in the northern regions during the early stages of industrial development (1891–1911). Over time, mortality declined significantly across the country due to improvements in health care and better living conditions. Furthermore, this study highlights the impact of socioeconomic change on public health and emphasises the need for further research on the socioeconomic factors that historically influenced the spread of tuberculosis.*

1. INTRODUCTION

In the nineteenth and early twentieth centuries, tuberculosis was one of the main causes of death in Europe. It is estimated that a quarter of the adult population fell victim to this disease (Daniel, 2006). It reached its peak during the Industrial Revolution, with respiratory disease accounting for 10 to 25 per cent of deaths in cities such as London, Paris, The Hague and Stockholm (Mackenbach, 2020). Rapid urbanization and overcrowded living conditions favoured the spread of the disease (Dormandy, 1999). Over time, improvements in nutritional standards, and in housing and public health policies, together with herd immunity, contributed to a gradual decline in tuberculosis mortality in the first half of the 20th century (McKeown, 1976). During the world wars, however, there was a resurgence. With the introduction of streptomycin in 1944 and other antibiotics, mortality was further reduced (McKeown, 1976; Livi-Bacci, 1997).

In Italy, tuberculosis began to spread rapidly before the mid-1800s, somewhat later than in other European countries such as Great Britain, France and Belgium where industrialization started earlier (Tognotti, 2012). It is estimated that the highest mortality rate was reached between 1870 and 1882, the period of Italian state building and early industrialization (Tognotti, 2012). Mortality was high, especially in the industrialized and urban areas of the North, where overcrowding, poor health standards, malnutrition and hard factory work favoured the spread of the disease. After the 1880s, mortality rates began to decline, although rates for the pulmonary form of tuberculosis remained stable at a high level until the 1920s (Saporiti, 1984).

This paper examines the relationship between tuberculosis mortality and industrialization across Italian regions. Data on mortality rates from pulmonary tuberculosis were taken from the "Statistica delle Cause di Morte", which reported the causes of death in Italy from 1887 onward. Regional industrialization levels are computed based on the shares of employees in the manufacturing sector, taken from Daniele and Malanima (2014).

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The results show how industrialization rates were related to tuberculosis mortality. Given the territorial differences in industrialization, the northern regions were most affected by the disease.

The paper is divided into five sections. Section 2 examines the geographical distribution of tuberculosis; section 3 analyses the relationship between mortality from pulmonary tuberculosis and the degree of industrialization; section 4 outlines future research directions. Section 5 contains a discussion of the results.

2. THE TUBERCULOSIS IN ITALY, 1887-1955

2.1. The National Trend

The mortality rate, measured by the number of deaths per ten thousand people, is a parameter that provides important information about the health and well-being of a population. Figure 1 shows its trend in Italy over the period 1887-1955. In 1891, around 800,000 deaths were recorded out of a population of 30 million, corresponding to a mortality rate of around 260 deaths per 10,000 inhabitants. On the eve of the First World War, mortality had fallen to 188 deaths per 10,000 inhabitants thanks to the decline in deaths from infectious diseases, particularly exanthematic diseases. However, pulmonary tuberculosis in the North, and gastrointestinal diseases in the South, slowed down the process of health transition towards a modern nosological framework The mortality rate, measured as the number of deaths per ten thousand people, is a parameter that provides important information about the health and well-being of a population. Figure 1 shows its trend in Italy in the period 1887-1955. In 1891, around 800,000 deaths were recorded out of a population of 30 million, which corresponds to a mortality rate of around 260 deaths per 10,000 inhabitants. On the eve of the First World War, mortality had fallen to 188 deaths per 10,000 inhabitants thanks to the decline in deaths from infectious diseases, particularly exanthematic diseases. However, pulmonary tuberculosis in the North and gastrointestinal diseases in the South slowed down the process of health transition and the development towards a modern nosological framework (Tognotti, 2012).

In 1918, mainly due to the Spanish influenza pandemic which caused between 540,000 and 600,000 victims (Mortara, 1925), the mortality rate reached a peak of 330 deaths per 10,000 inhabitants, and then rapidly decreased to 127 in 1939. With the outbreak of the Second World War, mortality rose again, reaching 144 deaths per 10,000 inhabitants in 1944. After the war, considerable improvements in health care contributed to the steady decline in the mortality rate. These improvements, together with socio-economic development, led to a decline in the mortality rate to around 88 deaths per 10,000 inhabitants in 1955.

Tuberculosis mortality followed an analogous trend (Figure 1). Between 1887 and 1955, the number of deaths from tuberculosis decreased by about 80 per cent, from approximately 61,000 to less than 11,000 deaths. In 1887, this disease accounted for about 62,000 deaths out of 829,000, half of which were attributable to the pulmonary form, with an average of 82 deaths per day, with a loss of human lives, especially among the younger and more productive classes (Tognotti, 2012).

Tuberculosis mortality was lower in Italy than in other European countries, thanks in part to the mild climate, which made it possible to live outdoors for much of the year, and the predominantly agricultural population, who were less affected by the disease because they worked outdoors and often in solitude (Bizzozero, 1899; L'Eltore, 1947).

Before the outbreak of the Second World War, Italy had already entered the endemic phase of the tuberculosis epidemiological cycle; it had reached what the hygienist and epidemiologist Adolf Gottstein called the "critical point", beyond which further progress depended on improvements in general living conditions and control measures as well as on the adoption of all available therapeutic options (L'Eltore, 1947).

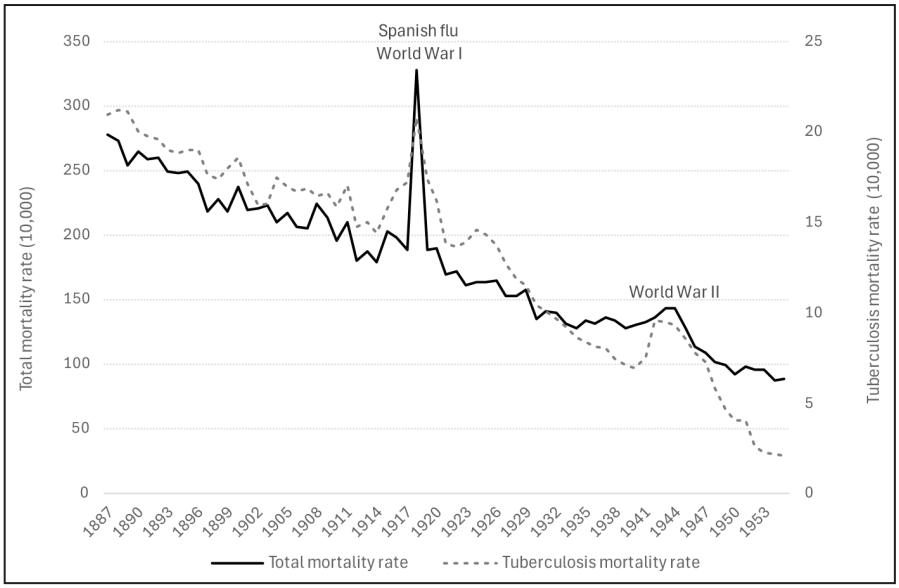

Figure 1. Overall and tuberculosis mortality rate in Italy, 1887-1955
Source: Own calculations on data ISTAT (1958, 1965)

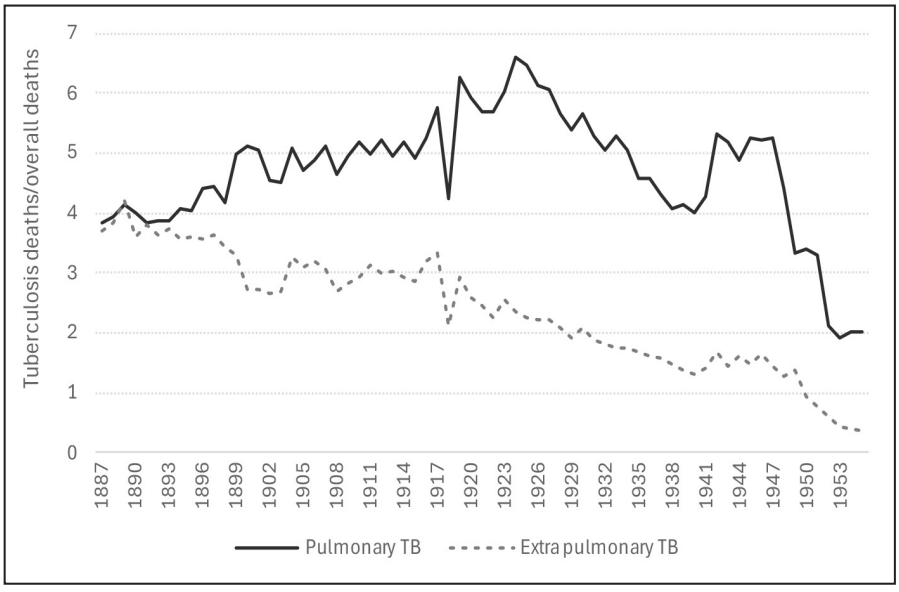

Figure 2. Incidence of tuberculosis on overall mortality in Italy, 1887-1955
Source: own calculations on data ISTAT (1958, 1965)

The incidence of tuberculosis on overall mortality is shown in Figure 2. Mortality for pulmonary tuberculosis rose from 3.8 per 100 in 1891 to 6.6 in 1924, while it halved for the other forms in the same period. Only the mortality rates for the pulmonary form – closely linked to the industrialization process – remained stable until the 1920s (Saporiti, 1984). Between 1887 and the First World War, the period in which the process of modern industrialization began in Italy, there was a

massive migration from the countryside to the cities. During this period, improvements in living conditions and advances in public sanitation were partially offset by the expansion of industry and transportation infrastructure which, by reducing the isolation of many municipalities, facilitated the spread of the disease into previously not affected areas. The Italian railway network rose from 12,102 kilometres in 1886 to 17,375 kilometres in 1912. Furthermore, the number of travellers increased from 64 million in 1906 to 94 million in 1914 (L'Eltore, 1947).

After 1924, excluding the years of the Second World War tuberculosis mortality declined. While the endemic phase was already underway, urban regeneration, social labour protection policies and the distributional effects of economic growth significantly improved the living conditions and levels of health and well-being of the most vulnerable sections of society.

2.2. Regional and Macroregional Disparities

The incidence of tuberculosis mortality, distinguished in pulmonary and extra-pulmonary forms, between the macro-areas of the Italian peninsula was very different (Table 1). The northern regions recorded higher mortality rates for pulmonary tuberculosis, the levels were intermediate in the central regions and lower in the southern ones.

In 1891, about 13 deaths per 10,000 inhabitants were recorded in the North-West, followed by 11.2 in the North-East, 11.6 in the Centre, 6.8 in the South and 7.4 in the islands. This distribution was similar to that of industry, which at the time was relatively concentrated in the North-Western regions, the so-called "Industrial triangle" area (Romeo, 1972; Fenoaltea, 2001, 2006). In the first decade of the twentieth century, economic policies encouraged industrialization. This period was characterised by significant economic and social changes, the expansion of the manufacturing and mining sectors, and the development of infrastructure and transport, which may have facilitated the spread of the disease.

Table 1. Tuberculosis mortality by macro-area in the census years, (x 10,000 inhabitants)

	1891		1911		1936		1951	
	Pulmonary	Extra pulmonary	Pulmonary	Extra pulmonary	Pulmonary	Extra pulmonary	Pulmonary	Extra pulmonary
North-West	12.9	9.3	13.6	6.4	7.3	2.1	4.1	0.7
North-East	11.2	11.2	11.5	8.0	6.8	2.8	3.5	0.7
Centre	11.6	10.0	11.5	6.9	6.8	2.3	3.4	0.7
South	6.8	11.0	7.4	6.3	4.9	2.0	2.7	0.9
Isles	7.4	7.5	8.3	5.4	6.0	2.2	3.0	1.0

Source: Own calculations on data ISTAT (1958, 1965)

By 1911, pulmonary tuberculosis mortality had risen to almost 14 deaths per 10,000 inhabitants in the North-West, while rates stood at 7.4 in the South and 8.3 in the Islands. Mortality levels in the North-East and Centre remained almost unchanged. Between 1911 and 1936, tuberculosis mortality declined across all macro-areas, with the most substantial reduction in the North-West (-46 per cent), followed by the North-East and Centre (-41 per cent), and a smaller decrease in the South (-28 per cent). In 1951 the quotients were halved everywhere and the differences between areas remained very limited.

About the extra-pulmonary group, slight differences were observed. At the beginning of the period under review, mortality was highest in the South and North-East. Lower values were recorded

in the North-West and especially in the Islands. By 1911, there was a clear nationwide reduction, and by 1936, mortality rates had nearly equalized across macro-areas, averaging around 2.5 per 10,000 in the North, 2.3 in the Centre, and 2.1 in the South. In 1951 the quotients were less than 1 in the North and Centre (0.7) and equal to 1 in the South.

The regional distribution of deaths from pulmonary tuberculosis is shown in Table 2. In 1891, half of the deaths from pulmonary tuberculosis were concentrated in the northern regions. Liguria, Tuscany, Lombardy and Piedmont had particularly high mortality rates, ranging between 12.71 and 14.29 deaths per 10,000 inhabitants. On the contrary, the lowest values were recorded in the southern regions, with Basilicata and Calabria among the least affected. In 1911, around 20,000 people died of pulmonary tuberculosis in the North alone. Except for Sardinia[2], which recorded a significant increase in mortality compared to 1891, the most affected regions remained unchanged. Since 1936, a general decline in tuberculosis mortality has been observed throughout the country. Mortality rates decreased significantly in all regions, reaching much lower values in 1951, ranging between 1.41 deaths per 10,000 inhabitants in Basilicata and 4.46 in Liguria.

Table 2. Number of deaths and mortality rate for pulmonary tuberculosis in Italian regions in some census years, (x 10,000 inhabitants)

	1891		1911		1936		1951	
	Deaths	Mortality	Deaths	Mortality	Deaths	Mortality	Deaths	Mortality
Piedmont and Aosta V.	3,935	12.71	4,343	12.70	2,557	7.26	1,387	3.87
Lombardy	5,095	12.79	6,536	13.69	4,062	7.00	2,775	4.26
Veneto	3,104	8.24	4,322	9.49	2,994	5.58	1,592	2.73
Liguria	1,449	14.29	1,900	15.75	1,144	7.71	693	4.46
Emilia-Romagna	2,732	11.65	2,840	10.33	2,118	6.37	982	2.79
Tuscany	3,245	13.98	3,629	13.79	2,344	7.90	1,242	3.96
Umbria	537	10.06	633	10.67	410	5.69	173	2.17
Marche	769	7.76	805	7.37	628	4.98	346	2.56
Latium	1,344	8.89	1,555	8.98	1,733	6.46	1,227	3.70
Abruzzi	842	6.50	974	7.07	702	4.51	368	2.20
Campania	2,218	8.28	2,528	8.39	1,888	5.13	1,400	3.25
Puglia	1,422	7.69	1,874	8.71	1,507	5.70	976	3.05
Basilicata	217	4.74	258	5.44	175	3.25	88	1.41
Calabria	665	5.20	846	6.03	660	3.79	358	1.76
Sicily	2,318	7.03	2,658	7.24	2,043	5.14	1,221	2.74
Sardinia	668	9.03	1,117	13.09	934	9.02	495	3.91
Italy	*30,560*	*9.81*	*36,818*	*10.31*	*25,899*	*6.12*	*15,323*	*3.25*

Source: Own calculations on data ISTAT (1958, 1965)

3. INDUSTRIALIZATION AND TUBERCULOSIS MORTALITY

Tuberculosis is considered the archetypal disease of the industrialization process (Vögele, 2000). The incidence of tuberculosis, particularly in its pulmonary form, is thought to have increased in industrialized countries between the 18th and 19th centuries, with peaks varying from country to country, from the mid-18th century in Britain to the early decades of the 19th century in Japan (Lönnroth et al., 2009). This growth seems to be related to the rapid industrialization and urbanization of the time. The industrial cities, with their rapid population growth, high population density and poor living conditions and often unhealthy working environments, provided a fertile

[2] According to Collari (1934), the increase in mortality from tuberculosis in Sardinia was due to various factors, including: the lack of an effective anti-tuberculosis strategy, the insufficiency or absence of health and social assistance, overcrowding, poor hygienic conditions in homes, the return of the seriously ill to their homes, poor nutrition, terrible working conditions and the development of the mining industry.

ground for the transmission of diseases. In addition, malnutrition and other risk factors increased the likelihood of tuberculosis infection spreading, especially, among the poorer classes (Aparicio et al., 2002; Grundy, 2005; Shimao, 2003; Hanashima & Tomobe, 2012).

In Italy, modern industrialization began at the end of the 19th century. This first phase marked a period of profound economic and social change, characterized by the expansion of manufacturing industry, the rapid growth of the urban population and the spread of pulmonary tuberculosis.

Employment in manufacturing increased significantly, reaching 26 per cent in the North in 1911, compared to around 20 per cent in the South (Daniele & Malanima, 2014). Initially, this process involved the three regions of the North-West, which formed the 'Industrial triangle', the 'epicentre' of Italian industrial development (Fenoaltea, 2001, 2006). About half of the industrial workforce was concentrated in these regions (Zamagni, 1978). In Lombardy, industrial employment already exceeded 35 per cent, in Liguria 32 per cent, in Tuscany 27.8 per cent and in Piedmont 26.4 per cent. In addition to the differences in industrial employment, there were also differences in structure and production capacity between the North and the South (Daniele & Samà, 2024). Only 10 per cent of companies in the South used motive power, compared to 19 per cent in the central regions and 29 per cent in the northern regions (SVIMEZ, 1961). The concentration of industry in the North continued to increase between the First and Second World Wars, while it declined slightly in the South. The data thus point to an unbalanced geographical distribution of industrialization, which was strongly in favour of the northern regions, a process that intensified between the two world wars and was further consolidated in the post-war period.

Table 3. Percentage of the industrial labour force per region out of the total labour force

	1891	1911	1936	1951		1891	1911	1936	1951
Piedmont	20.5	26.4	31.7	41.4	**Campania**	19.0	23.6	22.6	27.0
Lombardy	28.3	35.6	42.2	49.2	**Basilicata**	8.6	12.1	11.9	15.0
Veneto	18.2	20.5	23.3	31.1	**Puglia**	13.6	20.1	24.9	22.0
Liguria	22.6	32.0	33.7	38.6	**Calabria**	13.1	20.0	15.0	20.1
Emilia	16.9	21.9	18.8	24.3	**Sicily**	18.5	22.9	21.5	22.7
Tuscany	21.5	27.8	25.5	31.9	**Sardinia**	17.1	21.0	19.9	23.5
Umbria	12.9	15.9	17.1	22.5					
Marche	14.6	17.5	16.5	21.5	**Italy**	19.0	24.2	25.6	31.0
Latium	15.6	20.0	20.8	25.2	**North**	20.6	26.0	28.1	34.9
Abruzzi	10.2	11.9	11.3	19.8	**South**	15.6	20.3	19.8	22.7

Source: Daniele and Malanima (2014)

In 1891, the geographical distribution of pulmonary tuberculosis was already clear: in Piedmont, Liguria, Lombardy and Tuscany there were about 14-17 deaths from pulmonary tuberculosis per 10,000 inhabitants; in the other northern regions the quotient was lower (10-12). In the South, the rate was even lower (4-8). In 1911, the mortality rate rose particularly in Liguria and Lombardy, where it was 15.8 and 13.7 deaths per 10,000 inhabitants respectively.

In the late 1880s and early 1900s, the disease affected northern Italy with greater intensity, concentrating mainly on the lower-skilled and poorly paid workers who were at the root of the country's industrialization process and economic development. The spread of the disease was favored by the poor hygienic conditions both in the workplaces, particularly in textile factories, and in the overcrowded and unhealthy living quarters. Thus, tuberculosis was not a disease related solely to the profession, but a social disease brought about by physiological poverty, unhealthy working environments and poor living conditions (Tognotti, 2012). From 1936, due to improvements in health care and better living conditions, there was a general decline in tuberculosis mortality throughout the country.

The relationships between industrialization and pulmonary tuberculosis mortality in 1891 and 1911 are shown in Figures 3 and 4. The degree of industrialization is measured as the proportion of workers in the industrial sector to the total population of the region.

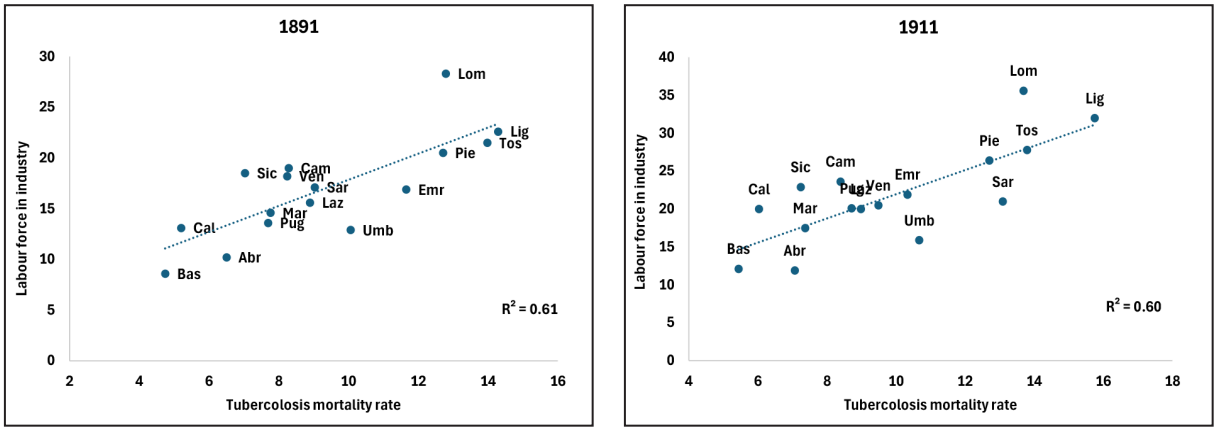

Figure 3. Industrialization and pulmonary tuberculosis mortality in Italian regions in 1891 and 1911

Source: Own processing on data MAIC (1894, 1913)

In 1891 and 1911, the relationship was positive and particularly high. In fact, about 60 per cent of the variance in mortality from pulmonary tuberculosis was explained by the share of industrial workers.

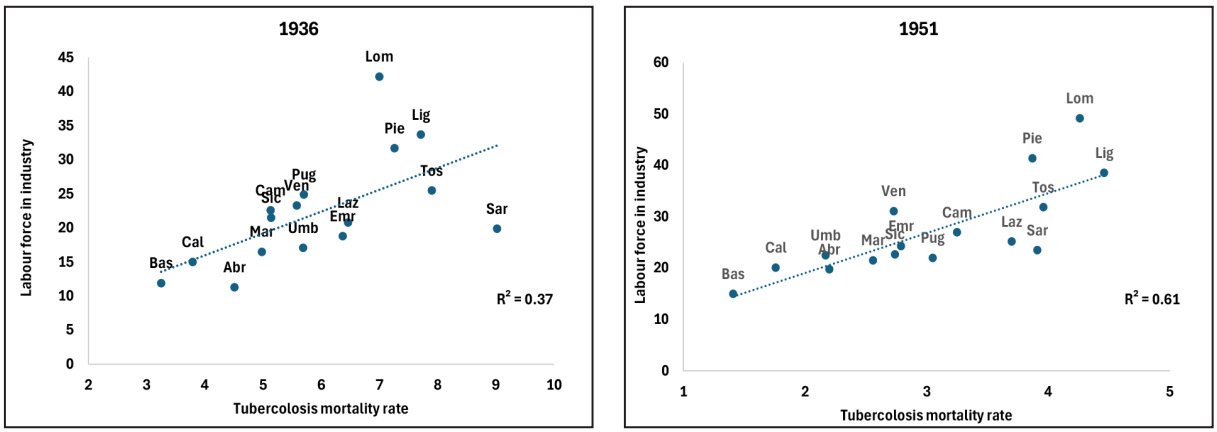

Figure 4. Industrialization and pulmonary tuberculosis mortality in Italian regions in 1936 and 1951

Source: own processing on data MAIC (1937, 1953)

In 1936, the relationship between tuberculosis and industrialization was still positive but much weaker than before. Although pulmonary tuberculosis mortality was certainly influenced by other factors, the level of industrialization was an important determinant. Moreover, the incidence of mortality had now declined throughout the country. In 1951, the relationship is strong again, although TB mortality has continued to decline.

4. FUTURE RESEARCH DIRECTIONS

This paper examines the relationship between tuberculosis and industrialization from a descriptive perspective. The results show a relationship between the two variables and are consistent with the findings of economic and epidemiological studies. However, the analysis deserves further

investigation, which could be carried out using provincial data and regressions to take into account not only the relative level of industrialization of the regions/provinces, but also other socioeconomic variables that may influence the health status of the population and tuberculosis mortality.

This would lead to a more in-depth analysis of the regional distribution and trends in tuberculosis mortality in Italy, and could also offer indications for comparisons with other countries.

5. CONCLUSION

In this study, epidemiological data and official cause of death statistics were used to analyse the regional distribution of pulmonary tuberculosis mortality in Italy, in the period 1887-1955, in relationship with industrialization.

The results show a significant correlation between industrialization levels and pulmonary tuberculosis mortality. In the industrialized northern regions, mortality rates, especially between 1891 and 1911, were notably higher than in the less developed central and southern regions country. When, over time, economic, nutritional and sanitary conditions improved, all over the country mortality rates declined.

As a latecomer to industrialization, Italy has followed a similar pattern to other countries, such as the UK, Germany, Japan and Norway, where mortality rates were initially higher in industrial areas, but were later reduced by advances in sanitation and infrastructure.

In summary, this study highlights the crucial role of industrialization in shaping the regional distribution of pulmonary tuberculosis mortality and slowing its decline during the transition period. However, the impact of other factors such as urbanization and specific geographical conditions, which may have significantly influenced the dynamics of tuberculosis mortality in Italy, needs to be further investigated.

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