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Burden of tuberculosis trends in a Brazilian southern state

Tendência da carga da tuberculose em um estado do sul do Brasil

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ABSTRACT: ***Introduction:*** The burden of tuberculosis has been scarcely explored in developing countries. ***Objective:*** To estimate the trend of the burden of tuberculosis in the state of Santa Catarina, southern Brazil, from 2007 to 2011. ***Methods:*** Epidemiological time-series study on tuberculosis notifications and deaths reported in the Disease Notification System and the Mortality Information System between 2007 and 2011. Crude rates of Disability-Adjusted Life Years (DALY) and subcomponents were calculated and standardized by gender and age groups. Segmented linear regression was used to estimate the trends for burden of tuberculosis during the study period. ***Results:*** There were 696 deaths and 8,598 notifications during the study period. The highest rate was found in 2009, with 91.8 DALY / 100,000 inhabitants, and the lowest in 2007, with 67.2 DALY / 100,000 inhabitants. The highest burden was among men in economically active age groups. The study showed a non-significant increase of 3.8% per year in DALY rates. ***Conclusion:*** The burden of tuberculosis remained stable in Santa Catarina, Brazil between 2007 and 2011.

Keywords: Tuberculosis. Burden of disease. Epidemiology. Mortality. Morbidity. Impact.

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RESUMO: ***Introdução:*** A carga da tuberculose vem sendo pouco estudada nos países em desenvolvimento. ***Objetivo:*** Estimar a tendência da carga da tuberculose no estado de Santa Catarina no período de 2007 a 2011. ***Métodos:*** Estudo epidemiológico de séries temporais realizado com base em dados de óbitos e notificações por tuberculose reportadas no Sistema de Informação de Mortalidade e no Sistema de Informação de Agravos de Notificação dos residentes no estado de Santa Catarina entre 2007 e 2011. Taxas brutas de anos de vida perdidos ajustados por incapacidade (DALY) e seus subcomponentes foram calculadas e posteriormente padronizadas segundo sexo e faixas etárias. Foi feita análise de regressão linear segmentada para estimar a tendência da carga no período estudado. ***Resultados:*** Foram observados 696 óbitos e 8.598 notificações de tuberculose nos anos em estudo. A maior taxa deu-se no ano de 2009, com 91,8 DALY/100 mil habitantes, e a menor, no ano de 2007, com 67,2 DALY/100 mil habitantes. Maior carga de tuberculose foi verificada no sexo masculino e em faixas etárias economicamente ativas. Encontrou-se aumento não significativo de 3,8% ao ano nas taxas de DALY no estado no período estudado. ***Conclusão:*** A carga da tuberculose manteve-se estável em Santa Catarina entre 2007 e 2011.

Palavras-chave: Tuberculose. Carga da doença. Epidemiologia. Mortalidade. Morbidade. Ambiente.

INTRODUCTION

Tuberculosis affects all age groups, but predominantly men in economically active age groups[1]. In 2011, out of 8.7 million who fell ill with tuberculosis, 1.4 million people died worldwide[1]. A study published recently, however, has described the reduction in incidence, prevalence, and mortality rates of tuberculosis in Brazil, the Americas, and worldwide over a period of 20 years. The results showed that mortality was reduced by 70.8, 70.7, and 40.0%, respectively[2].

According to data from 2010, Brazil ranks 17 among 22 countries with the highest incidence of tuberculosis[1]. In the state of Santa Catarina, there were 1,700 new cases that year, and the capital city of Florianópolis held the largest number[3]. According to the Brazilian Ministry of Health, tuberculosis mortality rates decreased by 31% in the country between 1990 and 2006[4]. Another study conducted in 2012 also showed a mortality rate reduction in the state of Santa Catarina from 2002 to 2009[5].

Moreover, the major challenge for public health services around the world is to consider not only mortality, but also disability caused by a disease. A proposal that takes into account both mortality and disability is the notion of disease burden of developed by Murray and López[6]. The concept reflects the impact of mortality and health problems that affect quality of life of individuals, which can be measured using the indicator Disability-Adjusted Life Years (DALY)[6].

According to the 2010 Global Burden of Disease Study (GBD)[7] the main changes from 1990 to 2010 were reductions in components related to infectious diseases mainly in children, and increased rates of HIV/AIDS and tuberculosis. Tuberculosis proved to be a major cause of DALY among men aged 15–39 years. However, the burden of tuberculosis had a

37.9% drop in 2010 as compared to 1990; nonetheless, there was an increase of 250.5% in burden of tuberculosis/HIV co-infection over the same period[7].

The epidemiology of tuberculosis has been analyzed by different methods in order to provide better understanding of its behavior. However, epidemiological studies that estimate its burden are scarce, especially in developing countries such as Brazil. In addition to the studies developed by the Brazilian National School of Public Health for Brazil[8] and for the state of Minas Gerais[9], no other studies with the same methodology were found, particularly regarding tuberculosis. An exception to this is the study by Ferrer et al.[10], which has estimated the burden of tuberculosis in the state of Santa Catarina in 2009. However, there are no studies assessing temporal trends at national or regional level.

The objective of this study was to estimate burden of tuberculosis trends in the state of Santa Catarina over 2007–2011.

METHODS

Epidemiological time-series study on tuberculosis notification data and death registrations for residents of Santa Catarina state from 2007 to 2011. Data were collected records of individuals diagnosed with pulmonary and extrapulmonary tuberculosis (ICD-10 A15 to A19) from the Information System for Notifiable Diseases (Sinan) and deaths caused by the disease, from the Mortality Information System (SIM/SUS). Intercensal estimates of total population released by the Brazilian Institute of Geography and Statistics (IBGE) for the years 2007, 2008, 2009, and 2011, as well as data from the 2010 census were used to calculate rates.

DALY were estimated by summing the subcomponents YLL (Years of Life Lost) and YLD (Years Lived with Disability)[6,7,9]. YLL for each case of death were calculated by the difference between the age at which death occurred and life expectancy, standardized at 80 years for men and 86 for women[11,12]. YLD were calculated as the product of disease burden predefined by the GBD 2010 (0.331 for tuberculosis and 0.399 for tuberculosis/HIV coinfection)[13] and its duration, based on cases reported. Duration of disease was the same as reported by the Brazilian Global Burden of Disease Study[8], i.e., one year for tuberculosis/HIV and 1.5 year for tuberculosis not associated with HIV infection.

After calculation of absolute numbers, crude rates by gender and age groups were calculated by the ratio between each indicator and the estimated population on July 1st in each year of the series, per 100,000 inhabitants. Then, crude rates were age-standardized by direct method, the world's population being used as standard[14].

The standardized rates of YLL, YLD, and DALY were used to analyze the burden of tuberculosis trend in the state of Santa Catarina as a whole and by age groups, through estimated regression equations. For modeling purposes, standard rates of YLL, YLD, and DALY by age group (y) were considered as dependent variables, and the years comprised in the study period as the independent variables (x).

The Joinpoint software, version 4.1.1.5 (Statistical Research and Applications Branch, National Cancer Institute, United States of America), provided by the North-American National Cancer Institute, was used to calculate the annual rate variations from 2007 to 2011. The software executes a segmented linear regression (*jointpoint regression*) to estimate annual percent change and identify the points at which there is a trend modification. Models were successively adjusted, each time a different number of trend change "points" being assumed. The model chosen had the highest number of points in which the statistical significance ($p < 0.05$) was maintained. The annual percent change (APC) was calculated from the estimated slope for each line segment (regression coefficient). Statistical significance was estimated by the method of least squares in a generalized linear model, assuming that the rates followed a Poisson distribution and that variations in rates were not constant over the period. For each line segment with estimated slope, 95% confidence intervals (95%CI) were calculated.

Following the Resolution by the Brazilian National Health Council (CNS 466/12), the principles of autonomy, beneficence, non-maleficence, justice, and equity were preserved. This study analyzed secondary non-nominal data of public access, presented on a consolidated basis, with no possibility of harming individuals or institutions. Furthermore, the study was approved by the Research Ethics Committee of Universidade do Sul de Santa Catarina (Committee Opinion No. 474110).

RESULTS

The year 2009 was shown to have the highest number of deaths (n = 161) and notifications (n = 1,701), as well as crude DALY rates (106.5 DALY/100,000 inhabitants).

YLL rates were higher among men in all years of study. The highest rate was that of 2009 (108.1 YLL/100,000 male inhabitants) and the lowest in 2007 (74.1 YLL/100,000 male inhabitants), as shown in Table 1. Age groups 40–44 and 35–39 had the highest YLL rates (Table 1).

YLD rates were higher among men in all years of study. The uppermost rate was in 2011 (16.9 YLD/100,000 male inhabitants), and the lowest in 2007 (15.1 YLD/100,000 male inhabitants), as shown in Table 2. The 15–29 age range had the highest YLD rates in most years of the study period, except for 2011, in which both the 25–29 and 30–34 age groups had the highest YLD rates (1.4 YLD/ 100,000 inhabitants), as Table 2 also displays.

DALY rates were higher among men in all years of study. The highest rate was from 2011 (116.3 DALY/100,000 male inhabitants), and the lowest in 2009 (81.5 DALY/100,000 male inhabitants), as presented in Table 3. The 40–45 age group had the highest DALY rates (18.2 DALY/100,000 inhabitants), as shown also in Table 3.

The results of time-series studies are shown in Table 4. A non-significant increase of 4.5% per year (95%CI -9.0 – 20.0) in the YLL rates can be seen for the state of Santa Catarina

Table 1. YLL/100,000 inhabitants, according to gender and age range. Santa Catarina, Brazil, 2007–2011.

Variables	2007			2008			2009			2010			2011		
	YLL*	%	Rate	YLL*	%	Rate	YLL*	%	Rate	YLL*	%	Rate	YLL*	%	Rate
Gender															
Male	2,544	66.3	74.1	2.125	66.9	91.2	3,804	66.0	108.1	3,101	58.2	84.4	3.573	70.9	99.5
Female	1,293	33.7	37.1	1.543	33.1	42.9	1,960	34.0	49.6	2,231	41.8	60.9	1.470	29.1	40.4
Age range (years)															
< 5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5–9	-	-	-	73.0	1.6	1.6	-	-	-	-	-	-	-	-	-
10–14	-	-	-	-	-	-	69.0	1.2	1.2	75.0	1.4	1.3	-	-	-
15–19	-	-	-	-	-	-	67.0	1.2	1.1	139.0	2.6	2.3	-	-	-
20–24	248.0	6.5	3.7	297.0	6.4	4.4	178.0	3.1	2.6	368.0	6.9	5.2	295.0	4.1	4.1
25–29	510.0	13.3	7.6	279.0	6.0	4.1	707.0	12.3	10.2	556.0	10.4	7.9	783.0	10.9	10.9
30–34	853.0	22.2	10.7	696.0	14.9	8.7	1,015.0	17.6	12.5	1,046.0	19.6	12.8	548.0	6.6	6.6
35–39	534.0	13.9	6.7	1,037.0	22.2	12.9	756.0	13.1	9.3	858.0	16.1	10.5	853.0	10.3	10.3
40–44	710.0	18.5	10.3	771.0	16.5	10.8	1,236.0	21.4	16.8	800.0	15.0	10.6	907.0	11.7	11.7
45–49	368.0	9.6	5.3	520.0	11.1	7.3	828.0	14.4	11.3	650.0	12.2	8.6	655.0	8.4	8.4
50–54	140.0	3.6	2.4	519.0	11.1	8.6	378.0	6.6	6.0	148.0	2.8	2.2	421.0	6.1	6.1
55–59	170.0	4.4	2.4	248.0	5.3	3.3	173.0	3.0	2.2	328.0	6.2	4.0	185.0	2.1	2.1
60–64	129.0	3.4	3.1	96.0	2.1	2.2	190.0	3.3	4.2	205.0	3.8	4.3	231.0	4.7	4.7
65–69	75.0	2.0	1.3	62.0	1.3	1.1	87.0	1.5	1.4	105.0	2.0	1.7	90.0	1.4	1.4
70–74	72.0	1.9	1.7	42.0	0.9	0.9	63.0	1.1	1.3	37.0	0.7	0.8	43.0	0.9	0.9
75–79	28.0	0.7	0.3	22.0	0.5	0.2	17.0	0.3	0.2	8.0	0.2	0.1	2.0	0.0	0.0
80 and older	-	-	-	6.0	0.1	0.1	-	-	-	9.0	0.2	0.1	6.0	0.1	0.1
Santa Catarina	3,837.0	100.0	55.5	4,668.0	100.0	66.2	5,764.0	100.0	80.3	5,332.0	100.0	72.2	5,019.0	100.0	67.2

*Years of life lost.

Table 2. YLD/100,000 inhabitants according to gender and age range in Santa Catarina, Brazil, 2007–2011.

Variables	2007			2008			2009			2010			2011		
	YLD*	%	Rate	YLD*	%	Rate	YLD*	%	Rate	YLD*	%	Rate	YLD*	%	Rate
Gender															
Male	490.4	64.2	15.1	542.1	66.0	16.6	523.7	66.5	15.5	523	65.4	15.2	598.5	68.3	16.9
Female	273.4	35.8	8.2	279.6	34.0	8.2	263.3	33.5	7.0	276.7	34.6	7.9	277.3	31.7	8.9
Age range (years)															
< 5	6.2	0.8	0.2	6.3	0.8	0.2	7.5	0.9	0.2	7.0	0.9	0.2	9.3	1.1	0.3
5–9	3.5	0.5	0.1	3.0	0.4	0.1	2.3	0.3	0.1	3.3	0.4	0.1	5.3	0.6	0.1
10–14	7.7	1.0	0.1	11.1	1.4	0.2	7.5	0.9	0.1	13.1	1.6	0.2	13.0	1.5	0.2
15–19	34.1	4.5	0.6	44.2	5.4	0.7	42.9	5.5	0.7	42.9	5.4	0.7	41.2	4.7	0.7
20–24	83.0	10.9	1.2	81.9	10.0	1.2	84.4	10.7	1.2	88.3	11.0	1.2	93.7	10.7	1.3
25–29	101.5	13.3	1.5	108.1	13.2	1.6	107.3	13.3	1.5	99.0	12.4	1.4	103.4	11.8	1.4
30–34	78.5	10.3	1.0	91.0	11.1	1.1	79.6	10.1	1.0	86.0	10.8	1.1	117.0	13.4	1.4
35–39	90.0	11.8	1.1	87.6	10.7	1.1	76.7	9.8	0.9	89.2	11.2	1.1	96.0	11.0	1.2
40–44	91.5	12.0	1.3	91.9	11.2	1.3	100.3	12.7	1.4	80.3	10.0	1.1	94.9	10.8	1.2
45–49	78.3	10.3	1.1	89.1	10.8	1.2	82.5	10.5	1.1	84.2	10.5	1.1	83.1	9.5	1.1
50–54	57.0	7.5	1.0	69.3	8.4	1.1	69.8	8.9	1.1	60.0	7.5	0.9	74.0	8.5	1.1
55–59	44.1	5.8	0.6	44.6	5.4	0.6	45.3	5.8	0.6	47.8	6.0	0.6	53.2	6.1	0.6
60–64	30.6	4.0	0.7	32.4	3.9	0.7	26.9	3.4	0.6	39.4	4.9	0.8	35.4	4.0	0.7
65–69	24.7	3.2	0.4	20.0	2.4	0.3	18.3	2.3	0.3	20.2	2.5	0.3	18.7	2.1	0.3
70–74	17.3	2.3	0.4	13.8	1.7	0.3	13.4	1.7	0.3	18.1	2.3	0.4	15.2	1.7	0.3
75–79	7.0	0.9	0.1	8.9	1.1	0.1	6.5	0.8	0.1	9.4	1.2	0.1	10.4	1.2	0.0
80 and older	8.7	1.1	0.1	19.1	2.3	0.3	15.9	2.0	0.2	11.6	1.5	0.1	11.8	1.3	0.1
Santa Catarina	763.8	100.0	11.7	822.1	100.0	12.2	786.9	100.0	11.4	799.7	100.0	11.4	875.8	100.0	12.0

*Years lived with disability.

Table 3. DALY/100,000 inhabitants according to gender and age range in Santa Catarina, Brazil, 2007–2011.

Variables	2007			2008			2009			2010			2011		
	DALY*	%	Rate	DALY*	%	Rate	DALY*	%	Rate	DALY*	%	Rate	DALY*	%	Rate
Gender															
Male	3,034.4	66.0	89.2	3,667.1	66.8	107.8	4,327.7	66.1	81.5	3,624.0	59.1	99.5	4,171.5	70.5	116.3
Female	1,566.4	34.0	72.9	1,822.6	33.2	51.1	2,223.3	33.9	56.6	2,507.7	40.9	68.8	1,747.3	29.5	49.3
Age range (years)															
< 5	6.2	0.1	0.2	6.3	0.1	0.2	7.5	0.1	0.2	7.0	0.1	0.2	9.3	0.2	0.3
5–9	3.5	0.1	0.1	76.0	1.4	1.7	2.3	0.0	0.1	3.3	0.1	0.1	5.3	0.1	0.1
10–14	7.7	0.2	0.1	11.1	0.2	0.2	76.5	1.2	1.3	88.1	1.4	1.5	13.0	0.2	0.2
15–19	34.1	0.7	0.6	44.2	0.8	0.7	109.9	1.7	1.8	181.9	3.0	3.0	41.2	0.7	0.7
20–24	331.0	7.2	5.0	378.9	6.9	5.6	262.4	4.0	3.8	456.3	7.4	6.4	388.7	6.6	5.4
25–29	611.5	13.3	9.1	387.1	7.1	5.7	814.3	12.4	11.7	655.0	10.7	9.3	886.4	15.0	12.3
30–34	931.5	20.2	11.7	787.0	14.3	9.8	1,094.6	16.7	13.5	1,132.0	18.5	13.8	665.0	11.3	8.1
35–39	624.0	13.6	7.8	1,124.6	20.5	14.0	832.7	12.7	10.3	947.2	15.4	11.6	949.0	16.1	11.5
40–44	801.5	17.4	11.6	862.9	15.7	12.1	1,336.3	20.4	18.2	880.3	14.4	11.7	1,001.9	17.0	12.9
45–49	446.3	9.7	6.5	609.1	11.1	8.5	910.5	13.9	12.4	734.2	12.0	9.7	738.1	12.5	9.5
50–54	197.0	4.3	3.4	588.3	10.7	9.7	447.8	6.8	7.1	208.0	3.4	3.1	495.0	8.4	7.1
55–59	214.1	4.7	3.0	292.6	5.3	3.9	218.3	3.3	2.8	375.8	6.1	4.5	238.2	4.0	2.7
60–64	159.6	3.5	3.8	128.4	2.3	2.9	216.9	3.3	4.7	244.4	4.0	5.1	266.4	4.5	5.4
65–69	99.7	2.2	1.8	82.0	1.5	1.4	105.3	1.6	1.7	125.2	2.0	2.0	108.7	1.8	1.6
70–74	89.3	1.9	2.1	55.8	1.0	1.2	76.4	1.2	1.6	55.1	0.9	1.1	58.2	1.0	1.2
75–79	35.0	0.8	0.4	30.9	0.6	0.3	23.5	0.4	0.3	17.4	0.3	0.2	12.4	0.2	0.0
80 and older	8.7	0.2	0.1	25.1	0.5	0.3	15.9	0.2	0.2	20.6	0.3	0.3	17.8	0.3	0.2
Santa Catarina	4,600.8	100.0	67.2	5,490.1	100.0	78.4	6,550.9	100.0	91.8	6,131.7	100.0	83.6	5,894.8	100.0	79.3

*Disability-adjusted life years.

during the study period. No statistically significant changes in YLL rates were observed between age groups for the years comprised in the research. There was also a non-significant decline of 0.2% per year (95%CI -3.6 – 3.4) in YLD rates. No statistically significant changes in YLD rates were observed throughout the study period. A non-significant increase of 3.8% per year (95%CI -7.4 – 16.4) in DALY rates was also pointed out. No statistically significant changes were observed in DALY rates when comparing age groups over the period of study. The overall behavior of YLL, YLD and DALY standardized rates by gender are displayed in Figure 1.

Table 4. Annual percent change of YLL, YLD, and DALY rates/100,000 inhabitants according to gender and age range in Santa Catarina, Brazil, 2007–2011.

Age range (years)	APC* – YLL/ 100,000 inhabitants	95%CI	APC* – YLD/ 100,000 inhabitants	95%CI	APC* – DALY/ 100,000 inhabitants	95%CI
< 5	-	-	9.8	-5.2 – 27.2	9.8	-5.2 – 27.2
5–9	-20.1	-60.5 – 66.0	-	-	-56.4	-94.1 – 224.2
10–14	14.9	-39.4 – 117.8	11.8	-20.3 – 56.9	37.9	-72.0 – 579.6
15–19	39.0	-53.2 – 312.5	12.9	-2.7 – 8.9	34.3	-46.0 – 239.4
20–24	4.2	-19.8 – 35:4	1.7	-1.3 – 4.7	3.2	-15.5 – 26.0
25–29	12.1	-17.1 – 51.5	-2.7	-6.8 – 1.6	10.0	-14.4 – 41.5
30–34	-2.6	-28.5 – 32.7	7.5	-2.7 – 18.8	-1.9	-24.2 – 26.9
35–39	3.5	-20.5 – 34.8	1.9	-8.7 – 13.6	3.5	-18.3 – 31.5
40–44	2.1	-22.0 – 33.8	-3.1	-11.3 – 5.9	1.7	-20.9 – 30.8
45–49	9.2	-18.3 – 46.0	-0.9	-5.1 – 3.5	7.8	-15.9 – 38.0
50–54	-1.5	-47.6 – 85.2	0.1	-9.4 – 10.6	-1.0	-42.4 – 70.3
55–59	1.6	-28.6 – 44.7	-	-	0.7	-3.8 – 33.1
60–64	17.3	-3.3 – 42.3	1.5	-9.3 – 13.7	14.9	-1.4 – 33.9
65–69	6.0	-8.6 – 23.1	-6.2	-15.5 – 4.2	1.2	-13.0 – 17.6
70–74	-14.5	-33.1 – 9.4	-2.9	-18.5 – 15.8	-12.7	-29.1 – 7.4
75–79	15.2	-29.7 – 88.8	60.5	-4.7 – 170.5	4.6	-25.5 – 46.7
80 and older	-25.4	-67.0 – 68.9	-16.9	-56.7 – 59.6	6.3	-33.2 – 69.1
Santa Catarina	4.5	-9.0 – 20.0	-0.2	-3.6 – 3.4	3.8	-7.4 – 16.4

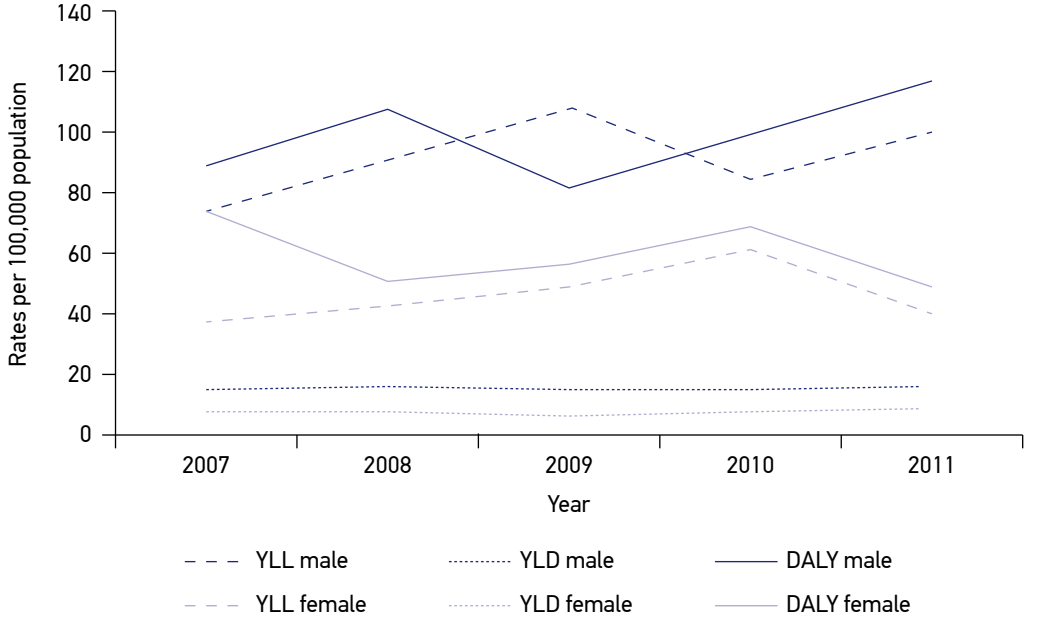
*Annual percent change; CI: confidence interval.

DISCUSSION

Although the epidemiology of tuberculosis has been assessed by different methodologies, there are few studies in Brazil measuring the burden generated by the disease. Furthermore, no other known study has assessed the temporal behavior of DALY rates in Brazil. This study may contribute to better understanding the behavior of tuberculosis effects in the southern state of Santa Catarina, in terms of early mortality and disability.

The highest DALY rate was observed in 2009 (91.8 DALY/100,000 inhabitants) and the lowest in 2007 (67.2 DALYs/100,000 inhabitants). According to the GBD (2010), tuberculosis ranked 11 among the leading causes of premature death and generated a rate of 11.2 YLL/100,000 inhabitants[15]. The disease accounted for 98 YLD/100,000 inhabitants[16]. Therefore, tuberculosis accounted for 2% of total DALY in 2010[9]. In Arab countries, the number of DALY increased over the years from 105,415 in 1990 to 112,053 in 2010[17].

Within 1992–2002, the burden of tuberculosis in Serbia generated the following rates: 0.094 YLD/1,000 inhabitants, 0.864 YLL/1,000 inhabitants, and 0.958 DALY/1,000 inhabitants[18]. In Thailand, tuberculosis accounted for 1.4% of overall DALY in 2009[19]. In Mexico, tuberculosis ranked 18 among the causes of premature death in 1990 (1.2% of total YLL), and 26 in 2010[20], which represents a significant drop in the ranking of burden-generating



DALY: disability-adjusted life years; YLL: years of life lost; YLD: years lived with disability.

Figure 1. YLL, YLD, and DALY rates/100,000 inhabitants according to gender in Santa Catarina, Brazil, 2007–2011.

causes. In 2009, a study also conducted in the state of Santa Catarina reported a rate of 92.25 DALY / 100,000 inhabitants[10]. The findings of our study are, for the most part, lower to those reported by other authors. It should be noted that burden rates found by other authors differ from ours due to different methods used.

As it was expected, the burden of tuberculosis in Santa Catarina was higher among men than among women, which agrees with previously published epidemiological studies[7,10,20]. Mexico experienced a 56% incidence of tuberculosis among men in 1990–2010[20], whereas in the Brazilian state of Minas Gerais, the rate was even higher (60.6%)[9]. In Serbia, the incidence rate was 72.7% among men in 1992–2002[18].

It is worth noting that, in developing countries, 80% of people with tuberculosis are in the 15-59-year range[21], most of them being men framed in the economically active population, has and so there is a negative impact on economic growth and social development, generating poverty and social exclusion[21]. According to a study conducted in Santa Catarina, the age range 30–44 was most affected[10], whereas GBD 2010 reported the age group 15–49 years as the most affected[7]. In the Arab world, people mostly affected were aged 30–39 years[17], and in Thailand, 30–59 years[21]. In this study, the most affected group was composed of people aged 30–44 years, giving support to the findings of Ferrer et al.[10].

Trends in the burden of tuberculosis were stable, given that no statistically significant differences were found, which is in line with a study conducted in Thailand[19] and GDB estimates for 1990–2020[22]. Another study conducted in Santa Catarina on mortality analysis between 2002 and 2009 showed two distinct trends: first, a reduction by 5.9% in mortality rate per year, between 2002–2007, and second, a non-significant increase by 2% annually, between 2007–2009[5].

Increased rates of HIV / AIDS and tuberculosis were noted[7]. In a spatial analysis in Brazil, high incidence of co-infections was reported in southern and southeastern coastal areas[23]. In Santa Catarina, there was an increase in the number of cases until 2001, followed by a reduction. However, the authors[23] emphasize that this should not be seen as a control of the opportunistic disease, but as lack of follow-up of patients infected by HIV. This factor may contribute to the non-reduction in the burden of tuberculosis.

One of the factors that may have interfered with incidence and mortality rates of tuberculosis was the implementation of the so-called Directly Observed Treatment in Brazil. This model is essential for the control of tuberculosis. It aims at increasing patient compliance and cure, detecting sources of infection, standardizing treatment, and monitoring disease progress[4]. In addition, the Brazilian National Program for Tuberculosis Control and Monitoring Visits[24] may be contributing to tuberculosis control through improved access of vulnerable populations to prevention, diagnosis, and treatment[24].

Tuberculosis is a social problem, and most patients have poor education. Although treatment is available in the public health system, there are still some barriers, for example, poor access to transportation to health facilities and lost workdays[25,26]. In addition, adherence to the incorporation of Directly Observed Treatment approach by primary care professionals

is low (named in Brazil as "Family Health Strategy")[27,28]. In Santa Catarina, only 66.9% of the new cases identified were accompanied by the Directly Observed Treatment approach[29], while the recommendation of the Ministry of Health is 100%[30]. There are, however, differences in the commitment of state's health macro-regions management to face this disease[31]. Nevertheless, it is important to note that the Directly Observed Treatment approach can be effective, especially if there is a guardian-supervised Directly Observed Treatment, usually a member of the family. A study conducted in Vitória/ES pointed out a 9-time greater chance of cure when compared to standard Directly Observed Treatment (community health worker supervised)[32].

A survey carried out in several Brazilian cities showed that tuberculosis-related decentralized actions by primary health care approach did not produce satisfactory results as to access to disease diagnosis and treatment[26]. There is a need for better integration between the Family Health Strategy and the Directly Observed Treatment approach to ensure effective access to diagnosis and treatment[25]. These can be some of the factors that have influenced the trend of keeping the disease burden stable, not declining, in the present study, as noted worldwide.

CONCLUSIONS

The burden of tuberculosis in the state of Santa Catarina, southern Brazil, remained stable during the study, given that no significant changes in YLL, YLD, and DALY rates were observed in 2007–2011.

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