International Journal of Public Health Science (IJPHS)
Vol. 12, No. 2, June 2023, pp. 486~493
ISSN: 2252-8806, DOI: 10.11591/ijphs.v12i2.21962

An epidemiology study for tuberculosis in the Philippines from 1960 to 2019

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Article Info

Article history:

Received Apr 12, 2022
Revised Feb 18, 2023
Accepted Mar 7, 2023

Keywords:

Age
Epidemiology
Morbidity
Mortality
Region
Sex
Tuberculosis

ABSTRACT

Tuberculosis has long been a public health threat in the Philippines, however, there is still no recent trend study for this country's morbidity and deaths from the said infectious disease. With that, an age-, sex-, and region-specific morbidity and mortality trend study for tuberculosis in the Philippines was conducted for these types of studies significantly help in the surveillance and control of diseases. Data from the Philippine Health Statistics from 1960 to 2019 was mined to assess the morbidity and mortality rates from tuberculosis in terms of age, sex, and regions, which were then visualized through graphs. The results revealed that the mortality rate trend for tuberculosis in the Philippines from 1960 to 2019 declined over time. Also, as for the sex-specific mortality rate trend, it was observed that males consistently had a higher death rate in comparison to females through the years. As for the age-specific mortality rates, it increased with age, showing the direct proportionality of age to the rate of deaths. Lastly, for the region-specific morbidity and mortality rates, it was observed that Region V (Bicol Region) has the highest morbidity rate. On the other hand, Region VI (Western Visayas) has the highest mortality rate from tuberculosis.

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1. INTRODUCTION

Tuberculosis (TB) is a bacterial infection caused by the *Mycobacterium tuberculosis* bacteria that primarily affects the lungs [1]. It is a curable and preventable disease; however, it still remains as a significant public health issue that continues to cause an alarming amount of global morbidity and deaths, despite the widespread belief that it is already a disease of the past [2]–[5]. For that reason, the surveillance and control of the incidence and deaths from tuberculosis is very much important.

In 2020, the WHO Southeast Asian Region, from which our country, the Philippines, belongs, had the highest number of TB cases, accounting for forty-three percent (43%) of all new cases. The WHO African Region follows this with twenty-five percent (25%) and the WHO Eastern Pacific with eighteen percent (18%). Globally, an estimated 10 million individuals fell ill and were comprised 5.6 million males, 3.3 million women, and 1.1 million children in 2020 [1]. On the other hand, on the national level, based on the TB mortality data from the Department of Health, TB is the 6th leading cause of mortality in the

Philippines, with an estimated prevalence rate of 502 per 100,000 population and an incidence rate of 292 per 100,000 population last 2014 [6]. Although the country reached an 84 percent case detection rate in 2012, thousands of cases go undiagnosed, and these missing cases reflect lost chances for effective TB management, implying that the transmission rate in households remains high. The directly observed treatment strategy (DOTS) of the Department of Health has a high cure rate, but there is a need to raise the detection rate to avoid the spread of TB [7].

Mortality and morbidity trend studies are the most common yet reliable assessment used for the surveillance and management of the spread of certain diseases. Through conducting studies about the morbidity and mortality trends from specific diseases, scientists could collect enough reliable data that would enable them to know the exact extent of the impact of a particular disease in a specific population. For instance, through these studies, researchers can tell whether or not there is an increase or decrease in the rate of morbidity and deaths from certain diseases and also know if specific measures were reliable enough in controlling the spread of certain diseases [8], which proves the relevance of conducting such research. However, the problem is that there is still not much recent research on the morbidity and mortality trends for tuberculosis–the number one killer among infectious diseases in the Philippines. With that, an age-, sex-, and region-specific morbidity and mortality study for tuberculosis from 1960 to 2019 was conducted.

The findings of this study would provide helpful decision-making information for the surveillance and control of the spread of tuberculosis [9]. The most vulnerable to tuberculosis in the Philippines in terms of sex, age, and region that they belong to were identified, based on the data from the Philippine Health Statistics [10] from 1960 to 2019. Through this, the data collected was then able to give reliable information that can be used to show the impact of tuberculosis on the morbidity and mortality rate in the Philippines through numerical statistics and graphs, which allowed the identification of the specific sex, ages, and regions that need to be taken into account for the sake of the country's public health.

Data from the Department of Health publication was used explicitly for the data on the morbidity and mortality rates from tuberculosis. This publication is the Philippine Health Statistics, which is actually a readily accessible online data source for births, deaths, and cases of several notifiable diseases in the Philippines [10]. Using the data from this online data source [10], this study was able to formulate the mortality and morbidity trend for tuberculosis in the Philippines from 1960 to 2019. This was done in terms of sex, region, and age, which was shown through cluster bar charts and line graphs, which indicated the increase or decrease of tuberculosis cases and deaths. The data used in this study were tallied using several differing formats through the years. There were years when the Respiratory TB and all other forms of TB were tallied as one, and there were also years when it was tallied independently. With that, the researchers then chose to analyze the data for different forms of TB as one, for the sake of homogeneity.

Another limitation for this study was that death certificates, which are frequently used as the basis for tallying the number of deaths from a specific disease, are not always accurate because the "cause of death" on death certificates can be misclassified at times. This results then lead to the underestimation of the number of people who died of tuberculosis [3]. In addition, the data from the Philippine Health Statistics [10] also have some missing data.

2. RESEARCH METHOD

2.1. Collection of the data

The data used in this study was collected from the Philippine Health Statistics, comprised of the data for the morbidity and deaths from 1960 to 2019 (a total of 59 years). All of the data collected includes the data for the morbidity and deaths caused by diseases and many other reasons, like diseases of the heart, that are insignificant for this study. With that, the data for the morbidity and deaths caused by tuberculosis are the ones that the researchers collected, since this study is solely focused on identifying the morbidity (cases) and mortality (deaths) trends from tuberculosis in the Philippines.

2.1.1. Missing data

There is a considerable amount of missing data on the number of deaths caused by tuberculosis in the Philippines. Specifically, there is not enough data available for years 1970 and 2000. With that, the missing data were imputed by the average of the values of the preceding and succeeding years [11].

2.2. Computation of the morbidity and mortality rates

The researchers calculated the overall morbidity and death rates and the morbidity and mortality rates with respect to age differences, sex differences, and regions in the Philippines. To calculate the morbidity and death rates with respect to different age groups (for babies aging under 1, 1-4 years old, 5-9 years old, 10-14 years old, 15-19 years old, 20-24 years old, 25-29 years old, 30-34 years old, 35-39 years old, 40-44 years old, 45-49 years old, 50-54 years old, 55-59 years old, 60-64 years old, 65-69 years old, and

70 and over), sex (male or female), and region (National Capital Region, Cordillera Administrative Region, Region I, Region II, Region III, Region IV-A, MIMAROPA, Region V, Region VI, Region VII, Region VIII, Region IX, Region X, Region XI, Region XII, Region XIII, and BARMM), from 1960–2019, the researchers made use of the formulas provided by the Philippine Health Statistics [10]. First, the number of morbidity or deaths in a specific age group, sex, or region were divided over the total population, which were then multiplied by 100,000. Consequently, for the calculation of the mortality rates from tuberculosis every passing year from 1960-2019, the researchers divided the sum of the deaths from tuberculosis in a specific year, over the total population in the Philippines for the said year, which was then multiplied by 100,000.

2.3. Making of graphs

To determine the specific regions with the highest and lowest morbidity and mortality rates, cluster bar charts were used. Consequently, the correlation between rates were also depicted. Here, the values used were the average region-specific morbidity and mortality rates from 1960 to 2019. As for the sex-, age- and region-specific morbidity and/or mortality trends, line graphs were used.

3. RESULTS AND DISCUSSION

3.1. Overall TB death rates in the philippines from 1960 to 2019

The Department of Health envisions a TB-free Philippines. With that, certain objectives, like enhancing the quality of TB care and prevention services, were set to make it possible. Based on the graph in figure 1, it can be observed that through the years, the TB death rates in the Philippines gradually declined. This observation can be taken positively as it shows that the efforts of the Department of health, like their TB DOTS program, were adequate in somehow controlling the spread of tuberculosis in the Philippines. Similar results were also observed in the European Region, Eastern Mediterranean Region, as well as in other countries like Angola, Congo, and Papua New Guinea, based on the Global tuberculosis Report of the World Health Organization [12].

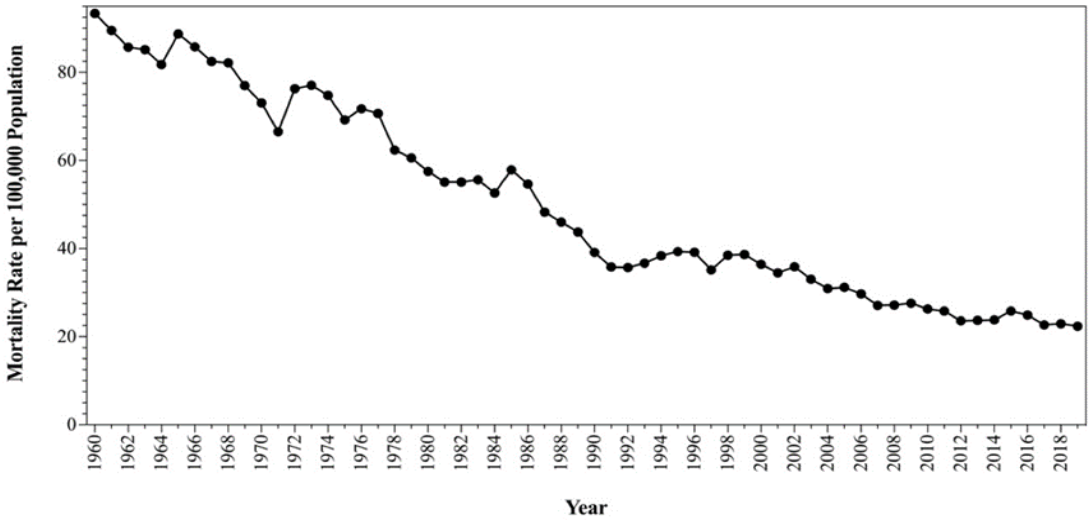

Figure 1. TB death rates in the Philippines from 1960 to 2019

3.2. Sex-specific mortality rates

As for the sex-specific mortality rate trend in Figure 2, males constitute the highest number of TB cases in the Philippines, consistently from 1960 to 2019. This result shows that males are much more vulnerable to tuberculosis than females, which is further proven in Table 1, as the values gathered showed that there is indeed a significant difference between the TB mortality rates for males and females. Similar results were also observed in other countries like America [2], Tunisia [13], India [4], and Japan [14].

Based on other studies, the explanation for this is the presence of several factors, like males smoking more than females, and males being more involved in alcohol abuse than females [15], [16]. In addition, this difference could also be due to the biological or epidemiological difference between the two sexes [17]-[19],

or could also be due to the differences in these sexes' societal roles. Men comprises higher labor force participation than women [19], [20], which then influences their risk of being exposed to the disease [21].

Another reason for this could also be the existing fear of stigma for women in comparison to men when they get infected with the disease, which then leads them not to choose to visit health facilities for treatment [16], [21], [22].

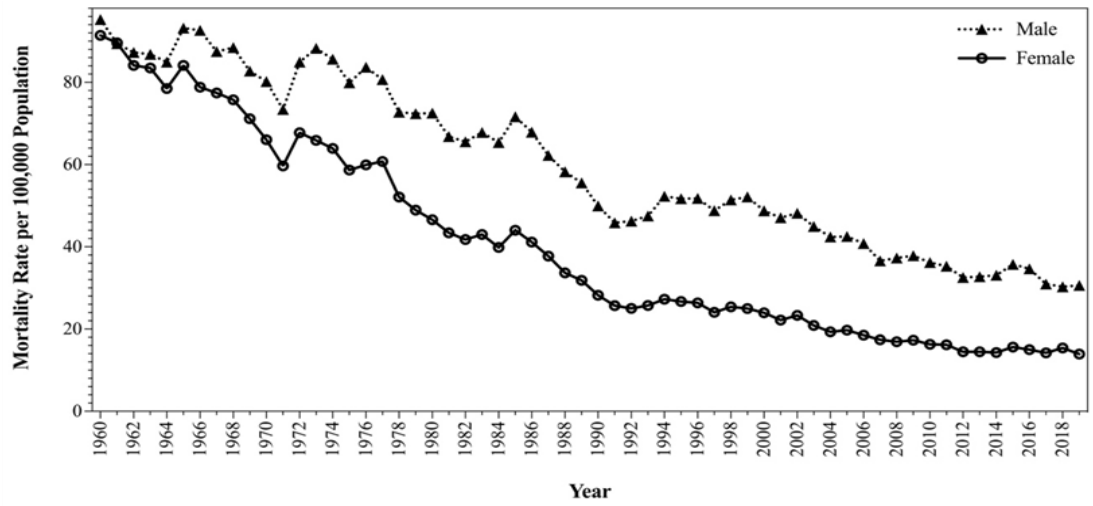

Figure 2. TB sex-specific mortality rate trend (1960-2019)

Table 1. T statistic (t), degrees of freedom (df) and significance probability (sig.) values from a t-test

t	df	Sig
4.496	118	<0.001

3.3. Age-specific mortality rates

Figure 3 shows the average mortality rate per 100,000 population from tuberculosis for every age group from 1960 to 2019. In here, it can be observed that through the years, the mortality rate from this disease increased with age, which shows the direct proportionality of the rate of deaths to age. Specifically, it can be observed that the ones under the 70 and over age group, the elderlies, had the highest mortality rate from tuberculosis from 1960 to 2019, and the age groups 5-9 and 10-14 had the lowest death rates.

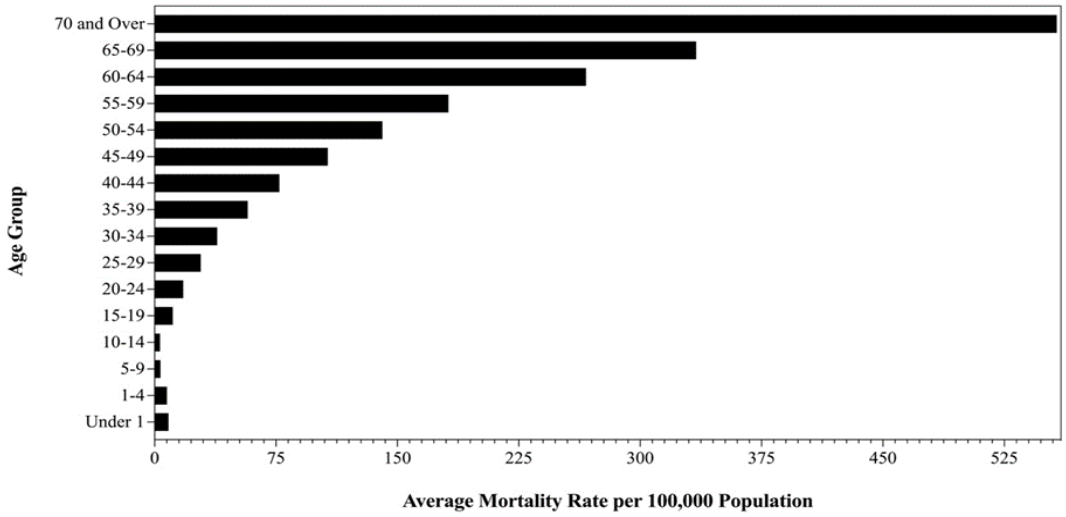

Figure 3. Average mortality rate per age group

The high vulnerability of the elderly to tuberculosis is because immunocompetency declines as we age, which then, unfortunately, increases their chances of getting sick, or worse, dying from it [23]. It could also be observed that the ones aging under one have a low mortality rate, which could be due to the existing vaccine for tuberculosis, which is the Bacille Calmette-Guerin (BGC) [24], [25]. BGC often given to infants and small children in countries where TB is common [26]. However, the thing about this vaccine is that its immunity only lasts about 15 years [27], which explains how the rate of death from ages 15 onwards started to increase consistently.

3.4. Region-specific morbidity and mortality rates

In Figure 4, it can be observed that Region V (Western Visayas) has the highest morbidity rate, while Region VI (Bicol Region) has the highest mortality rate. It can also be seen in Table 2 that we have a significant value of 0.003, which indicates that there is a considerable difference between the morbidity and mortality rates of tuberculosis among the regions in the Philippines.

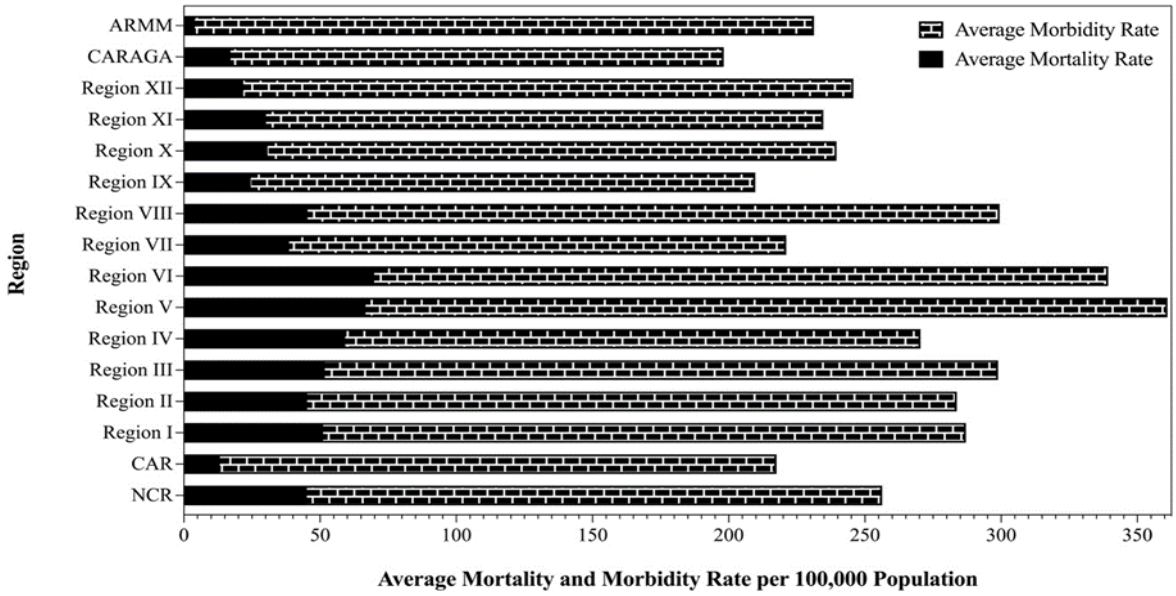

Figure 4. Average morbidity and mortality rates per region for tuberculosis (1960-2019)

Table 2. T Statistic (t), degrees of freedom (df) and significance probability (sig.) values from a t-test

t	df	Sig
3.189	30	0.003

One of the factors for the high morbidity rate for tuberculosis in Region V (Bicol Region) could be due it being the home to one of the active volcanoes in the country, specifically, the Mayon Volcano. This is because exposure to crystalline silica, a particle that is mostly mass-produced by volcanoes when erupting, can cause the recurrence of the formerly silenced tuberculosis in one's lungs. Other than that, studies also show that exposure to volcanic ashes exacerbate pre-existing respiratory problems and actually small, short-term, and reversible decline to affected individuals in their lung function through time [28].

Other factors that may have affected the mortality and morbidity rates could be the magnitude of poor population or poverty threshold in a region [13], [29]. Figure 5 shows that the Cordillera administrative region (CAR) has the lowest magnitude of poor population in the Philippines [30], and at the same time was the region with the highest percent real per capita with gross domestic product (GDP) growth rate of 6.6 in 2021, which may be why it has a low mortality and morbidity rates for tuberculosis. As for the Bicol Region (Region V), it has the highest magnitude of poor population in the country [30], and is also the region with the sixth highest poverty incidence of 36%, which may consequently have caused it being the region with the highest morbidity cases for tuberculosis in the Philippines. As for Region VI, it has the highest mortality rates from tuberculosis. It may also be due to it being ranked as tenth (10^{th}) for the regions in the country with the highest poverty incidence [30].

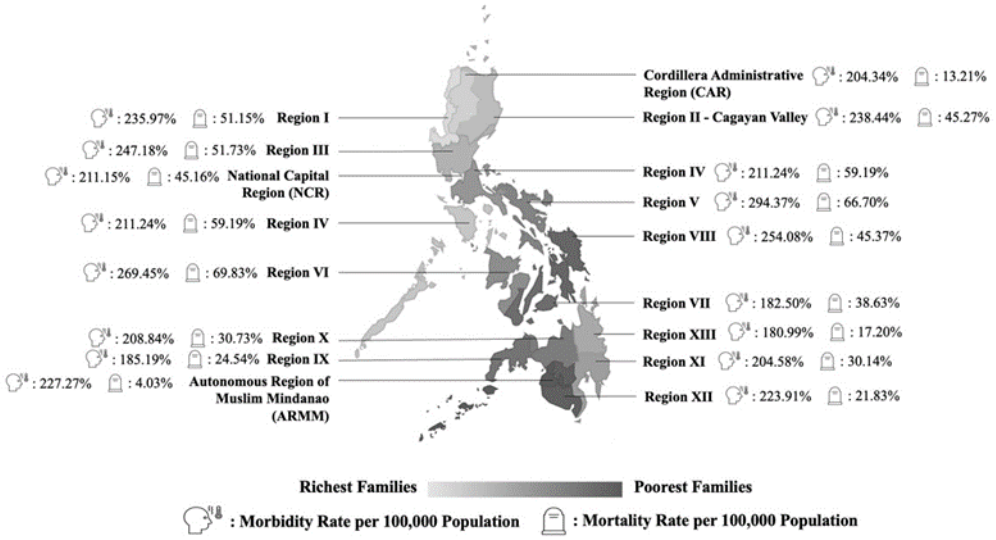

Figure 5. A distribution map showing region-specific data on the economic status and the morbidity and mortality rates from tuberculosis in the Philippines

4. CONCLUSION

Based on the data gathered, the mortality rate trend for tuberculosis in the Philippines from 1960 to 2019 declined over time. Also, as for the sex-specific mortality rate trend, males consistently led the highest death rate through the years. As for the age-specific mortality rates, it increased with age, showing the direct proportionality of age to the rate of deaths. Lastly, for the region-specific morbidity and mortality rates, it was observed that Region V (Bicol Region) has the highest of morbidity rate, while Region VI (Western Visayas) has the highest mortality rate.

With these results, it can be concluded that the spread of tuberculosis in the Philippines is still of significant concern. It affects people of all sexes, ages, and regions in the Philippines, with males, the elderly, and those in regions V and VI, having the highest burden. With this, the concerned government agencies, most especially the Department of Health, can now have a directed approach to controlling the spread of tuberculosis in the Philippines, in terms of what ages, sex, and regions should be given particular attention.

ACKNOWLEDGEMENTS

The authors would like to express their gratitude to the Department of Science and Mathematics Technology (DOST) of the Philippines through its director, Dr. Josette Biyo, for the financial support that it has provided for the accomplishment of this study, as well as to the Climate Change Laboratory of the Premier Research Institute of Science and Mathematics of MSU-IIT, and the Philippine Health Statistics of Department of Health.

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