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Epidemiology of typhoid fever in the Philippines during the last six decades from 1960-2019: a profile and its trend

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ABSTRACT

Regardless of the numerous reviews and publications on typhoid fever in the Philippines, it continues to be an issue regarding public health. Using data obtained from the Philippine Health Statistics (PHS), this study examined trends in typhoid fever mortality across an interval of six decades in the Philippines. The results show a decrease in typhoid fever fatality rates in the Philippines over the previous year. In terms of sex-specific deaths, males outnumbered females. The individuals aged 70 and older have the highest death rates when it comes to age-specific mortality rates. In the Philippines, Region I also has the highest mortality rate from typhoid fever. For instance, the Autonomous Region of Muslim Mindanao (ARMM) has the lowest mortality rate from typhoid fever. The highest average morbidity rate is in the Cordillera administrative region (CAR), while the lowest is in Region IVB. To eliminate typhoid fever in the next few years and to completely combat typhoid fever throughout the years, educational campaign awareness or intimate knowledge must be conducted locally and globally.

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1. INTRODUCTION

Salmonella enterica is the bacteria that causes typhoid fever. *Salmonella typhi* subspecies *enterica serovar typhi (Salmonella typhi)*; a thorough overview that the infection spread chiefly by contaminated water or food [1]–[3]. The current worldwide burden of typhoid fever is estimated to be 16 million infections and 600,000 mortality per year [4]. Typhoid fever is the leading cause of disease and mortality across the world, involving more than seventeen million cases and an estimated 580,000 deaths. Despite the fact that the condition has been nearly eliminated in affluent nations, attack rates as high as 1,100 cases per population have been observed in some nations with limited resources [5]. Typhoid fever is an infection that spreads within the human body and is due to *Salmonella enterica serotype typhi (S. typhi)*.

In nations with limited resources, the disease remains a major threat to the public's health. In the year 2000, about 2.16 million incidents were reported. Typhoid fever caused the lives of 216,000 individuals globally, with Asia causing more than 90% of morbidity and mortality [6]. However, the most effective cure for this problem is improved water quality and sanitation; World Health Organization (WHO) suggests immunization in high-risk areas as a potential short-to-intermediate-term control approach [7]. The WHO revised its position statement on typhoid vaccinations in 2008, recommending the systematic use of the

current ViPS and Ty21a vaccines for endemic and epidemic disease control [7]. However, there is a scarcity of data on typhoid fever morbidity and death in nations with low incomes. The world paints an entirely different image, with mortality rates ranging from 2-33%. Several physicians were unfamiliar with its clinical presentation due to the range of signs and symptoms and the decreased prevalence of typhoid fever in affluent nations due to the use of clean water sources and improved sewage disposal [8], [9]. Furthermore, sanitation in many developing nations, including the Philippines, has not improved significantly. Moreover, there are less research on the morbidity and mortality profile and trends for typhoid fever, one of the most prevalent serious epidemics distributed by contaminated food and water. In addition, age, sex, and region-specific morbidity and mortality for typhoid fever were studied during a six-decade period.

The most frequent yet valid assessment used for managing and surveillance the spread of certain diseases is mortality and morbidity trend studies. To determine the precise extent of a specific disease's influence on a particular population, scientists must collect enough relevant data by performing studies about the trends in mortality and morbidity caused by diseases. However, studies on the mortality and morbidity trends for typhoid fever are currently lacking from 1960 to 2019, a morbidity and mortality studies for typhoid fever was done based on age, sex, and region-specific.

Philippine Health Statistics (PSH), an annual publication of the Department of Health (DOH) (*https://doh.gov.ph/publications*), gathers Philippine health data such as morbidity and mortality. For this study, data sets from 1960 to 2019 were acquired. Data on interest from multiple sources will be collated, analyzed, interpreted, and visualized. The data collected in this study was most likely compiled all over a period in various forms. Typhoid and para-typhoid fever were counted collectively in specific years and separately in others. The researcher next decided to look for uniformity in the typhoid health statistics. This study used data from this online source to characterize and trend typhoid fever mortality and morbidity in the Philippines from 1960 to 2019. The Microsoft Excel software tool became used for all data analysis. To better convey the study's result, the researchers used line graphs and cluster bar charts. Line graphs were used to depict sex-specific mortality trends and total morbidity death rates from 1960 to 2019, while bar graphs were used to highlight age-specific mortality trends.

2. METHOD

2.1. Data source and extraction

The PHS series, an annual publication of the DOH that collects data on major health events, was used to acquire typhoid mortality and morbidity figures for each age group, sex, and area. It covers the current morbidity and mortality data for the country. Collaboration and cooperation between the Philippine Statistics Authority (PSA), this department, and local health unit partners resulted in the PHS 10th version of the international classification of diseases (ICD-10). For more relevant and useful information, the data obtained from the source was compiled, evaluated, and presented as tables and graphs.

2.1.1. Missing data

Caraga region was established in 1995, and the inaugural value was used to replace missing data from 1990 to 1994. A significant number of missing values were found in regional data. There is insufficient mortality data from 2000 to 2019. Missing data were filled up the average values from preceding and succeeding years [10].

2.2. Computation of morbidity and mortality rates

The mortality rates of typhoid fever in the Philippines were calculated based on age groups (babies under the age of one, 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, 70 and over). Meanwhile, from 1960 to 2019, morbidity and mortality rates by 100,000 were calculated in various regions (National Capital Region, Cordillera administrative region (CAR), 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 Bangsamoro Autonomous Region in Muslim Mindanao (BARMM)).

2.3. Data analysis

In this study, the mortality and morbidity rates of typhoid fever were analyzed to discover trends of change for each year, age group, sex, and area. The Microsoft Excel software tool became used for all data analysis. To better convey the study's result, the researchers used line graphs and cluster bar charts. Line graphs were used to depict sex-specific mortality trends and total morbidity death rates from 1960 to 2019, while bar graphs were used to highlight age-specific mortality trends.

3. RESULTS AND DISCUSSION

3.1. Overall mortality rates for typhoid fever in the Philippines from 1960 to 2019

From 2000-2013 there is no available data for typhoid fever mortality, according to PHS. The graph in Figure 1 shows that there is volatility. Nevertheless, typhoid fever's mortality rate in the Philippines has steadily decreased over the decades, which is an advantageous thing.

The graph shows the mortality rate from 1960 to 2019. On the other hand, some data of mortality is not given. Sudden drop of trend indicates no data, or the data is missing. It reveals the efforts made by the DOH, such as their development of food and water-borne diseases and intensification of the program on food handlers and water quality surveillance to prevent outbreaks of water and sanitation-related diseases. Based on the findings of the previous studies, the most likely explanation for the sharp peak in increased mortality rates in 1970 simultaneously was when the challenging decade began, such as nature inflicted floods, typhoons, earthquakes, and volcanic eruptions since the Philippines is a disaster-prone country. This could lead to water supply disruptions, water contamination, food, improper sanitation, and congestion in evacuation centers. As a result, these conditions may show infectious disease transmission. Like typhoon Yolanda in 2013, it threatened the Philippines with disease outbreaks like typhoid, dengue, and malaria [11]. Other findings of these studies, 1970 was the most challenging year in the seventieth, and there were many events to remind Filipino people [12]. One of the deadliest typhoon landfalls in the Philippines sustained winds of 130 mph [13]. Thus, these calamities explained the sudden increasing mortality in the year 1970.

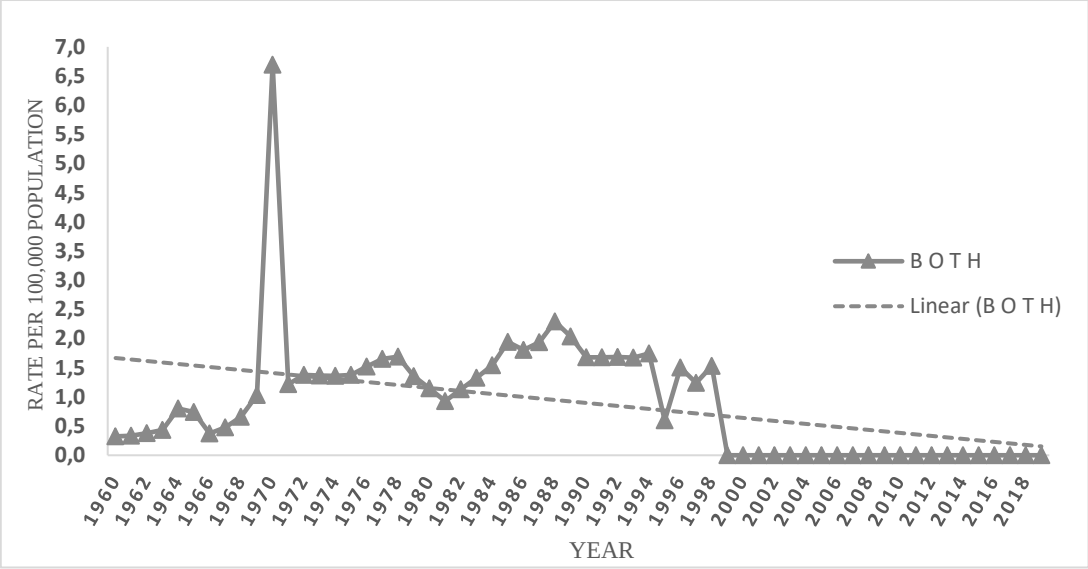

Figure 1. Typhoid fever mortality rate trend in the Philippines year 1960-2019

3.2. Sex-specific mortality rates

Figure 2, males lead to most typhoid fever cases in this study. The results show that men are more prone to typhoid fever than female are. Table 1 reveals that males and females have significantly different typhoid fever fatality rates. According to PHS, there is no available or missing data for the sex-specific death rate trend from 2000 to 2019. To determine if there is a significant difference in typhoid fever mortality rates between males and females in the Philippines, a two-independent sample t-test was performed. Table 1 demonstrates that the p-value is greater than 0.005. Thus, in the Philippines, there is a considerable disparity in typhoid mortality rates between male and female. Several variables, mostly poor income, may be impacted by this. The severe condition was more common in males, according to the studies, and all cases of intestinal perforation were in males. Previous study has found that disease incidence varies by geographic regions and is more prevalent in females [14], [15]. According to EB data from 2016, there were slightly more males than females having food and waterborne diseases (FWBDs) (cholera, typhoid, Hepa A, rotavirus, and paralytic shellfish poisoning) [16].

Based on other studies, this is made possible by the existence of numerous factors, like cultural differences, that may be attributed to biological differences between the sexes [17], [18]. Their conclusions would have been the same despite cultural differences in how males and females respond to their diseases. This is because cultural factors might influence clinical symptoms in every patient [19].

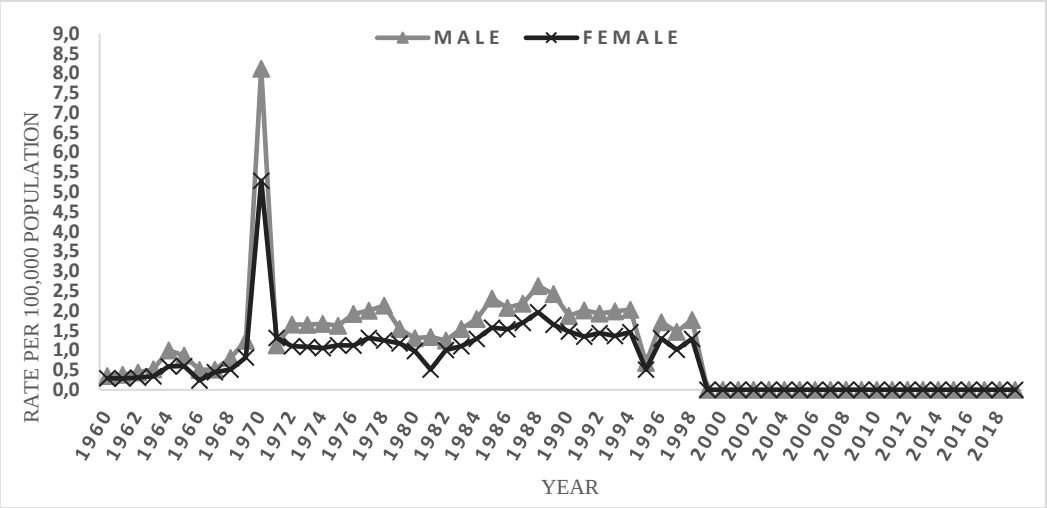

Figure 2. Typhoid fever sex-specific mortality rate trends year 1960-2019

T- Statistic (t- 1.613), degree of freedom (df- 118), significance probability values from a t-test (sig.<0.006).

3.3. Age-specific typhoid fever mortality rates

Figure 3 shows the average mortality rate per 100,000 population from typhoid fever for each age group based on the graph; according to the graph, older individuals aged 70 and older have the highest mortality rate, while children 1-4 have the lowest mortality rate, according to PHS. 70 and over, the elderly led the highest mortality rates from typhoid fever in six decades. Based on other studies, particularly prone were children [20]. In areas with malnutrition and co-infection with other infectious diseases [21]. Age, sex, and chronic infection have all been connected to severe or deadly typhoid fever [14], [22]–[25]. Furthermore, typhoid may present with nonspecific clinical symptoms such as syndromic sepsis, pneumonia, diarrhea, or a viral disease in very young children (under 5 years old). It is possible that it will be misdiagnosed as clinical typhoid fever [26].

In this study, the age group 70 and up was more affected (Figure 3) a bar graph is used to show the typhoid mortality rate according to age bracket from 1960 to 2019. In similar studies, all mortality cases were adults with encephalopathy and hemodynamic shock, previously recognized as indicators of especially severe disease [27], [28]. However, based on the raw data, children had a high number of documented deaths. According to the DOH, the most recorded cases of typhoid, cholera, and paralytic shellfish poisoning were among children aged 5 to 14 [29].

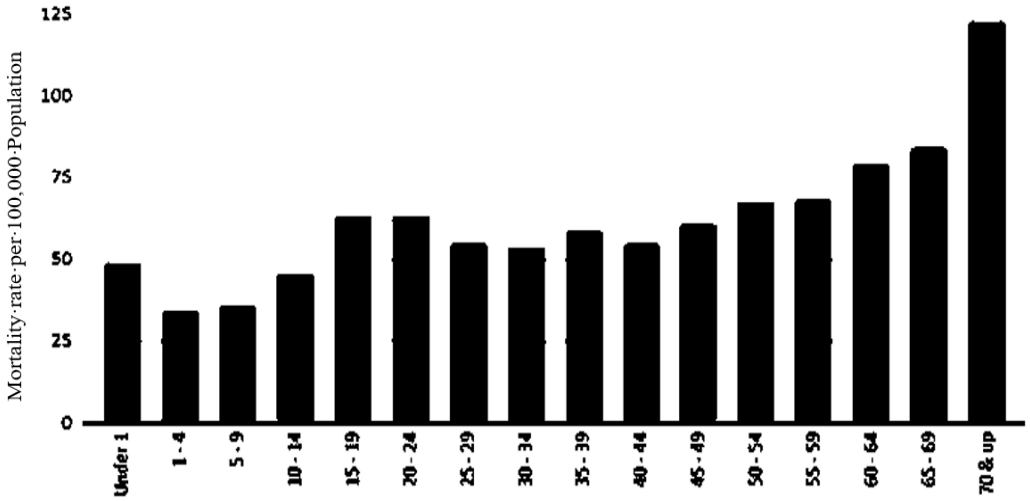

Figure 3. Typhoid fever average mortality rate per age group

3.4. Typhoid fever region-specific morbidity and mortality rates

Typhoid fever was formerly one of the most severe infectious diseases in the Philippines, causing significant mortality and morbidity. Because of the inadequate coverage of pure drinking water supply in rural regions, typhoid fever, as in other countries, can be a significant indication of the development of a society's socioeconomic status. Figure 4 shows that Region I has the highest typhoid fever mortality rate in this study, while the Autonomous Region of Muslim Mindanao (ARMM) has the lowest, even though no data is provided for Region IVB (MIMAROPA). The highest average morbidity rate is CAR, while the lowest is Region IVB (MIMAROPA). According to studies, typhoid fever is one of the most frequent epidemics in the CAR. This region contains the provinces of Abra, Apayao, Benguet, Ifugao, Kalinga, Mountain Province, as well as Baguio in North Central Luzon, the Philippines. The disease's frequency among CAR patients has risen over times [30]. It suggests that typhoid fever is endemic in Bohol, as it is in Metro Manila and other surrounding metropolitan or semiurban towns [31], [32].

A two-independent sample t-test was used to determine if there is a significant difference in the mortality rate of typhoid fever between males and females in the Philippines. Table 2 indicates that the p-value is less than alpha 0.05. As a result, there is ample of evidence indicating a significant variation in mortality and morbidity rates within the Philippines regions. One of the reasons for the high morbidity rate for typhoid fever in the CAR region might be environmental or biological variables, such as intensive mining operations, which could lead to a lack of water supply or water pollution.

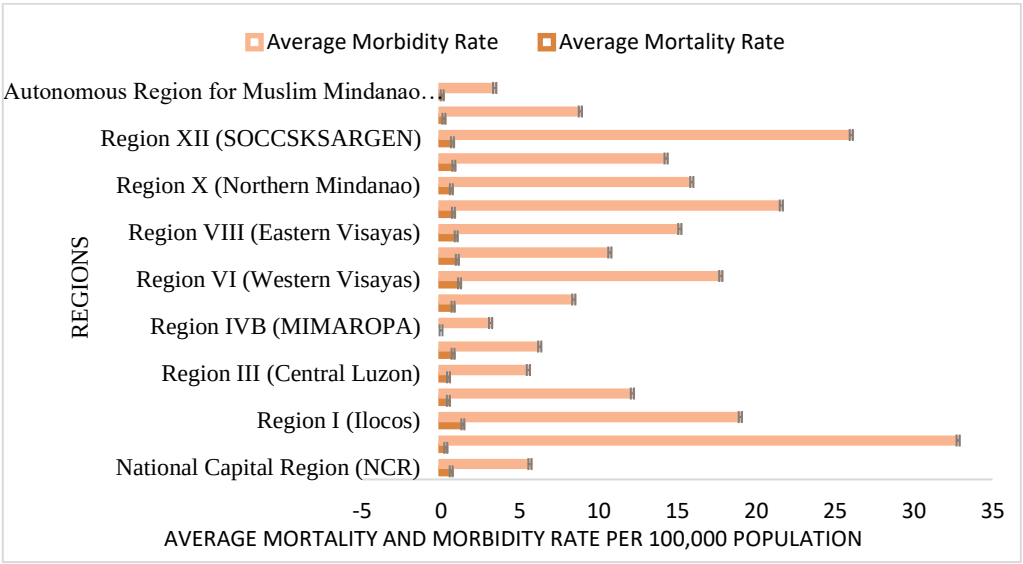

Figure 4. Typhoid fever average mortality rates per region

T- Statistic (**t**- 6.307), degree of freedom (df- 32), significance probability values from a t-test (sig.<0.000). The p-value is smaller than alpha 0.05, according to the results. As a result, there is adequate evidence indicating there is a considerable variance in morbidity and death rates among the Philippines' regions. Based on other studies, The most prevalent method of disease transmission is consuming contaminated food and water [33], [34]. Although 50% of typhoid fever outbreaks were associated with contaminated water [35]. Contaminated water with *S. Typhi* is a disease with lower organism concentrations than contaminated foods [36]. Based on other studies, significant risk factors for typhoid fever were floods, lack of a toilet in the home, and not using soap for handwashing. Typhoid was not substantially related to eating food from street vendors in terms of eating habits, but it was strongly connected with drinking cold drinks, using ice, and sharing food from the same plate [33].

Adequate water and sanitation are a safe, effective, and cost-efficient strategy to help decrease typhoid fever [35]. Despite the fact that multiple intervention strategies were discussed, the types of interventions that were implemented were broadly classified into five broad categories: i) improving WASH facilities (WASH is an abbreviation that stands for water, access, sanitation, and hygiene), which essentially eradicate water-borne disease, ii) further efforts to enhance drinking water quality, iii) increased health education, iv) policy and treatment guidelines revision, and v) typhoid vaccine [36]. These are reflected in

some of the policies of the government for human health (Table 3). However, according to the Philippines DOH, there have been numerous cases of typhoid fever, with the number of cases reaching over 15,000 in 2023, a significant increase from 2021. This occurred because of the typhi bacteria entering water used for drinking or washing food, particularly in slum areas where handwashing is less common, and water is contaminated with sewage. Even though the Philippines has laws in place that are related to human health, many people, especially those who live in slums, choose to ignore the government's efforts to enforce them. The government's attempts to promote discipline in the populace and strictly enforce the law are the only ways that the cases of typhoid fever will be resolved.

Table 3. Some of the policies in the Philippines for human health

MANDATE	
Title	Year issued
Sanitation code of the Philippines	1975 PD No. 856
Intensifying the program on food handlers and water quality surveillance to curb outbreaks of water and sanitation related diseases	1996 DOH DC No. 110
Creation of the food and water-borne disease prevention and control program	1997 DOH AO No. 29-A
Issuance of the Philippines National Standards for drinking water	2007 AO No. 0012
Food safety act to strengthen the food safety regulatory system in the country to protect consumer health and facilitate market access of local foods and food product	2012 RA 10611

*****Note: the same exact words of the law are provided
**Source: www.doh.gov.ph*

4. CONCLUSION

The data acquired demonstrate that the Philippines' typhoid fever death rates gradually declined between 1960 and 2019. Men tend to die more frequently than women do each year, according to the sex-specific mortality rate. The age-specific mortality rates demonstrate the direct age correlation of death rates across all age groups. The typical age group affected by this viral infection was those in their 70 s and older. Since 2021, however, there had been a significant increase in typhoid fever infections, particularly in communities with poor handwashing habits and sewage-tainted water. Human health laws are present in the Philippines, but despite efforts by the government to enforce them, many citizens, particularly those who living in slums, opt to disregard them. The incidence of typhoid fever can only be decreased if the government works to instill discipline in the public and strictly enforce the law.

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