Incidence of tuberculosis in the association of South-East Asia Nation (ASEAN) countries and its relation with health expenditure: a secondary data analysis.

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Abstract

Introduction: Tuberculosis (TB) is an infectious disease that mainly affects the lungs. ASEAN is responsible for the high incidence of tuberculosis recorded worldwide. Therefore, this study analyses the trend of tuberculosis and its association with per capita health expenditure in ASEAN. **Methods:** The incidence of tuberculosis and the per capita health expenditure are collected from Global Health Observatory resources and World Bank Organization. The data were interpreted using SPSS Software Version 23 and the results were presented in graphs and tables. **Results:** Six ASEAN countries showed a declining trend, three countries had a fluctuating trend, and one country had an increasing trend in the incidence of tuberculosis. There was a relationship between mean TB cases (per 1,00,000 population) and mean per capita (US$) health expenditure. On an average, Singapore spends the highest amount per capita, whereas Myanmar spends the least amount per capita on health. **Conclusion:** Generally, ASEAN is showing a decreasing trend in the incidence of tuberculosis. Delay in diagnosis, ageing populations, and immigrants are identified as the barriers to curb the incidence of tuberculosis in ASEAN. Moreover, ASEAN countries should consider increased health expenditure when planning strategies to reduce the incidence of tuberculosis.

Keywords: ASEAN, health expenditure per capita, secondary data analysis, tuberculosis

Introduction

Association of South-East Asia Nation (ASEAN) consists of 10 independent countries. They are Brunei, Cambodia, Indonesia, Lao, Malaysia, Myanmar, Singapore, Philippines, and Vietnam (ASEAN, 2015). This association aims for all the member states well-being in terms of economic growth, cultural development, social progress, and maintaining peace and stability among all the countries (ASEAN, 2015). ASEAN region consists of diverse populations and rapidly evolving epidemiology and demography. Hence, the health system and health status are highly distinctive in each country. These factors have also raised concern on the public health of the nation, notably on the control of emerging infectious diseases and the epidemic of non-communicable disease within the ageing population (Chongsuvivatwong et al., 2011). The infectious diseases in ASEAN are classified into emerging infectious diseases, re-emerging diseases, and drug resistance diseases (Coker, Hunter, Rudge, Liverani, & Hanvoravongchai, 2011). Tuberculosis (TB) was the first infectious disease that was declared a global emergency by the World Health Organization (WHO) (Zaman, 2010).

Tuberculosis is one of the deadliest infectious disease in the world. It is caused by *Mycobacterium tuberculosis bacilli* which belong to the *Mycobacterium tuberculosis*

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complex (Niemann, Richter, & Rüsch-Gerdes, 2000). The pathogen gets expelled into the air when the infected person coughs or sneezes Close contact people are at high risk of getting the disease (Tierney & Nardell, 2018). Tuberculosis commonly affects the lungs (Zaman, 2010). In some instances, other sites (Extrapulmonary TB) such as the brain, intestines, kidneys, or the spine are also affected (Zaman, 2010). TB infection can be classified into three stages - primary infection, latent infection, and active infection. Primary infection occurs when the bacilli deposits in the lung. Most individuals recoup from primary TB infection. However, the bacilli stay dormant in the body. This is known as latent infection. During this period, the bacillary replication remains silent. Thus, the bacteria do not spread. The chances of reactivation of infection depend on the host's resistance and microbial virulence factors (Tierney & Nardell, 2018). There is a 5 to 10% risk of developing the disease in an infected individual.

The symptoms of TB include chronic cough, chest pain, and coughing up blood or sputum (Zaman, 2010). Older adults, infants, and people with weakened immune systems are at high risk of developing active TB or reactivation of TB (MedlinePlus, 2015). Malnutrition, drinking alcohol, and tobacco use are also listed as the risk factors of tuberculosis (Wu & Dalal, 2012). The diagnostic tests used to confirm tuberculosis are rapid molecular tests, sputum smear microscopy, and culture-based methods. According to the World Health Organization (WHO), most people use rapid molecular tests (Xpert® MTB/RIF assay) for diagnosis. A six-month regime consisting of Rifampicin, Isoniazid, Pyrazinamide, and Ethambutol is prescribed to the patients for six months. Some patients might present with rifampicin-resistant TB and multidrug-resistance TB (MDR-TB) who need expensive drugs and a long time of treatment. Globally, the success rate in treating MDR-TB is 57% (World Health Organization, 2018).

The ASEAN region constitutes 45% of the total TB cases reported in 2016 which is the highest compared to other regions. In 2020, the 30 high TB burden countries accounted for 86% of new TB cases. Eight countries account for two-thirds of the total, with India leading the count, followed by China, Indonesia, the Philippines, Pakistan, Nigeria, Bangladesh, and South Africa (World Health Organization, 2020). A study says that ASEAN countries can reach the Universal Health Coverage target with a strong health financing system (Van Minh et al., 2014). Thus, ASEAN countries can overcome socioeconomic deprivation (Duarte et al., 2018) and reduce the transmission of TB.

Objectives: The objectives of the study were to:

- Check the incidence of tuberculosis per 1,00,000 population in each ASEAN country from the year 2002 to 2017.

- Identify the relationship between current health expenditure (CHE) per capita and the mean number of TB cases per 1,00,000 population during the same period.

Materials and Methods

We used secondary data to interpret the incidence of tuberculosis and its association with health expenditure. The data on the incidence of tuberculosis was collected from Global Health Observatory (GHO) (WHO, 2021), a WHO database. The TB incidence was compiled based on the annual case notifications, assessments of the quality and coverage of TB notification data, national surveys of the prevalence of TB disease, and information from death (vital) registration systems. Meanwhile, we used the World Bank Organization to collect the data on the per capita health expenditure. (World Bank, 2019). Health expenditure is defined as money spent on health goods and services by the public and private sectors (OECD, 2017).

We focused on the estimated incidence of tuberculosis (per 1,00,000 population) and per capita total expenditure on health (US$) in 10 ASEAN countries from 2002 to 2017. The data were excluded if it did not fit in the year range and the country is not a member state of ASEAN.

The data was saved in Microsoft Excel and entered into the Statistical Package for the Social Sciences (IBM SPSS Statistics, version 23) for analysis. The countries were listed based on alphabetical order. We computed the variable to find the mean value of TB cases and each country's mean per capita. Then, the

10 countries were divided into two groups. Group 1 consists of countries that spend less than US$100 on health expenditure per capita, while Group 2 consists of countries that spend more than US$100. Per capita of US$ 100 was set as the benchmark to divide the countries as half of the country in the ASEAN spends less than US$100 and another half spends more than US$100 on health. We divided the countries into two groups based on a cut-off value of US$100. We observed that the countries which spend less than US$ 100 are lower-middle-income countries except for Indonesia and the countries that spend more than US$100 are upper-middle and high-income countries. We compared the incidence of tuberculosis and per capita expenditure of both groups by applying an independent t-test. Moreover, all descriptive values were expressed in mean ± SD. We used a line graph to visualize the trend of TB cases while a bar graph to interpret the relationship between the mean per capita expenditure against the mean incidence of TB.

Ethical permission

This study used databases that were made available to the public (WHO and World Bank). Data that were not made available by the countries were not used. Ethical approval was obtained from the Universities internal review board.

Results

Incidence of Tuberculosis

The incidence of Tuberculosis in ASEAN is declining from the year 2002 (3,062 cases per 1,00,000 population) to 2017 (2,274 cases per 1,00,000 population). As demonstrated in Figure 1, six out of 10 ASEAN countries show a continuous decrease in the number of TB cases. They are Cambodia, Myanmar, Indonesia, Vietnam, Lao, and Thailand. The Philippines is the only country that highlights an increase in the trend of TB incidence following the reduction in the number of cases until 2007. Fluctuations in the trend of TB cases are seen in Malaysia, Singapore, and Brunei. Malaysia shows a rising trend from 2009. However, the number of cases in these three countries remains below 100 per 1,00,000 population.
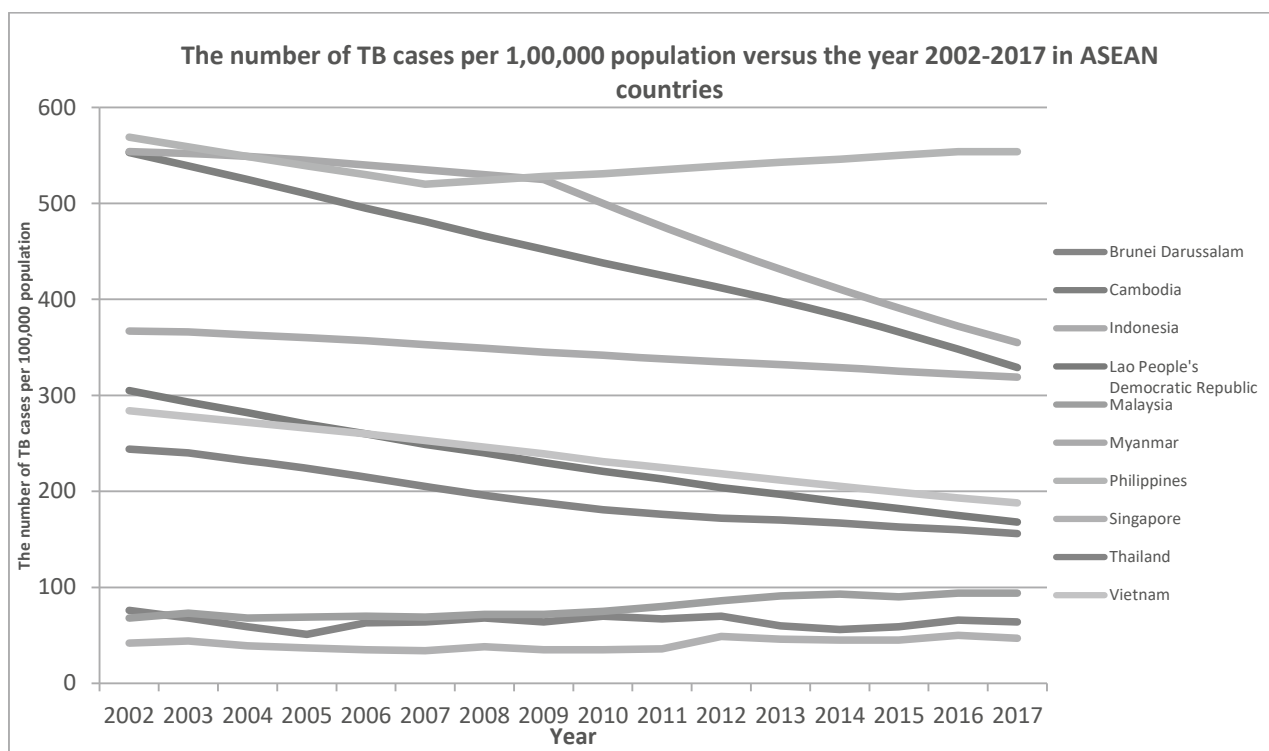

Figure 1. Illustrates the number of TB cases per 1,00,000 population from the year 2002-2017 in ASEAN countries.

Association between the mean TB cases per 1,00,000 population and the mean per capita expenditure (US$)

The ASEAN countries were divided into two groups. Group 1 countries are Cambodia, Indonesia, Lao, Myanmar, Philippines, and Vietnam, whereas, group 2 countries are: Brunei, Singapore, Malaysia, and Thailand. The study shows that the mean TB cases (per 1,00,000 population) in group 1 is higher compared to group 2. Meanwhile, the mean per capita expenditure (US$) is significantly higher in group 2 compared to group 1. Therefore, it is identified that the group that invests more in per capita expenditure has a low incidence of tuberculosis and vice versa.

Table 1

Comparison between Mean TB Cases Per 1,00,000 Population and the Mean Per Capita (US$) of Each Group on Applying the Independent t-Test

	Group 1 (*Mean ± SD*)	Group 2 (*Mean ± SD*)
TB cases (per 1,00,000 population)	*380 ± 131	94 ± 68
Per capita (US$)	57.78 ± 24	677 ± 629**

*$p < .01$- mean TB cases (per 1,00,000 population) is significantly higher in group 1 than group 2 on applying independent t-test.

**$p < .05$- mean per capita (US$) is significantly higher in group 2 than group 1 on applying independent t-test.

Specifically, in Group 2, Singapore spends the highest amount, which is US$ 1550.42, followed by Brunei, which is US$ 716.15. Brunei and Singapore had the least mean number of TB cases (per 1,00,000 population) which are 64 and 41, respectively (Figure 2). Myanmar spends the minimum amount per capita compared to other countries. At the same time, Myanmar had the second-highest mean number of TB cases per 1,00,000 population (Figure 3). A huge gap was found between the health expenditure and the number of TB cases in all the countries. On applying Pearson correlation, we found a significant negative correlation between the mean TB cases and CHE per capita (Figure 4).
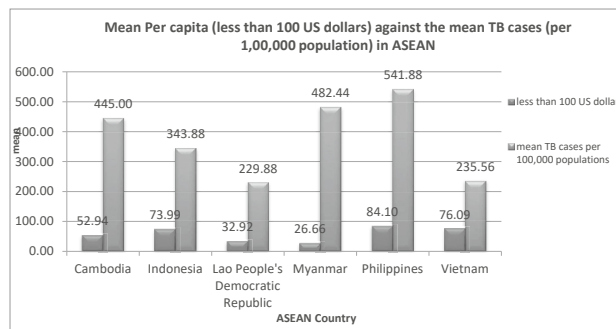

Figure 2. Illustrates the mean per capita (less than 100 US$) against the mean TB Cases (per 1,00,000 population) in ASEAN.
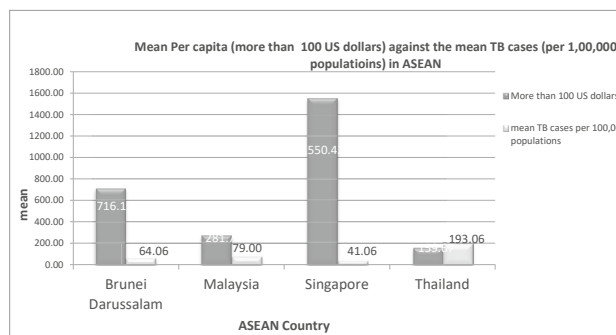

Figure 3. Illustrates the mean per capita (More than 100 US$) against the mean TB cases (per 1,00,000 population) in ASEAN.
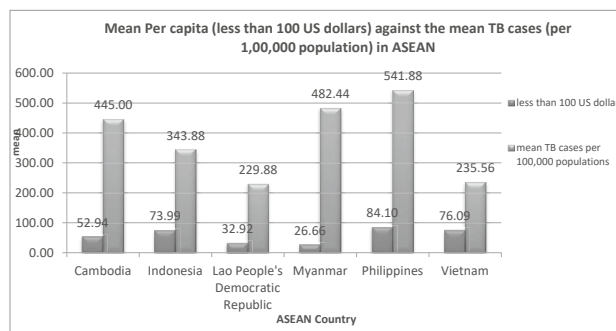

Figure 4: Illustrates the relationship between the mean TB cases and CHE per capita ($r = 0.654$ and $p < .05$)

Discussion

This study analyses the trend of incidence of tuberculosis in ASEAN countries from 2002-2017 and its association with health expenditure per capita (US$). The number of TB cases per 1,00,000 population in ASEAN countries is decreasing. However, the trend differs according to the country. Based on this study, the mean health expenditure per capita (US$) is inversely proportional to the mean number of TB cases per 1,00,000 population in the same period.

The National Tuberculosis Program (NTP) proved to reduce the incidence, mortality, and prevalence of tuberculosis in high TB burden countries (Akachi, Zumla, & Atun, 2012). However, in the Philippines, the incidence of TB rose from 524 cases to 554 cases per 1,00,000 population (2008-2017). A study identified that delay in diagnosis is the barrier to controlling TB disease in the Philippines (Auer, Sarol, Tanner, & Weiss, 2000). The same article describes that multiple healthcare-seeking behaviours and the costs of treatment are the reasons for the delay in diagnosis.

Likewise, other studies also show that delay in diagnosis and treatment is the major concern in supervising the TB disease in Asia (Cai et al., 2015). A meta-analysis conducted in 17 Asian countries describes the factors that cause a delay in diagnosis. They are socio-demographic characteristics, poor access to the first healthcare provider, TB symptoms, and gender. However, Cambodia managed to curb the rising TB cases with the help of NTP approaches. The seed-and-recruit method is a mobilizing community network found to be efficient in early diagnosis and treatment initiation (Teo et al., 2020; Tuot et al., 2019). In this approach, the peers or people in the community will refer the presumptive TB cases to healthcare providers, especially the high-risk populations. All of this could have contributed to the sharp decline in the trend of TB cases in Cambodia, as shown in our study.

Singapore, Malaysia, and Brunei are experiencing a fluctuating trend in the incidence of TB. A study states that most of Malaysia's cases were reported from Sabah and are seen at the late stage due to poor access to healthcare (Goroh et al., 2020). Additionally, the influx of immigrants is also an obstacle in Malaysia and Singapore to curb the incidence of TB as these two countries are located near high TB burden countries (Goroh et al., 2020; Tam & Lai, 2019).

In addition, the ageing population are rising in ASEAN countries, particularly in Singapore (Henning, 2019). Therefore, the burden on reducing TB incidence rise as the ageing population can increase the risk of emerging latent TB disease in Singapore (Tam & Lai, 2019). Nevertheless, the number of cases remains below 100 per 1,00,000 population in Malaysia, Singapore, and Brunei.

From our study, it is seen that there is a relationship between health expenditure (per capita US$) and the mean number of TB cases per 1,00,000 population. A similar association was also found in another study (Wu & Dalal, 2012). We divided the countries into two groups based on a cut-off value of US$100. We observed that the countries which spend less than US$ 100 are lower-middle-income countries except for (World Bank, 2021), and the countries that spend more than US$100 are upper-middle and high-income countries (World Bank, 2021). This shows that spending on health varies based on the income of the respective countries.

Among them, Myanmar spends the least amount on health expenditure per capita which is US$ 26.66 and had the second-highest mean number of TB cases. This is because the implementation of a military rule affects the economy of the country. Therefore, the health sector was not focused during that period (Ergo, Htoo, Badiani-Magnusson, & Royono, 2019). Myanmar also presented with the highest out-of-pocket expenses in the ASEAN region in 2015 (Myint, Pavlova, & Groot, 2019). Despite all, now Myanmar is working on its National Health Plan (2017-2021) in line with Universal Health Coverage to strengthen the health system. This is well reflected in WHO's report where it highlights that Myanmar is progressing on track to reach the End TB Strategy's 2020 milestone to reduce the incidence by 20% (Organisation Mondiale De La Santé, 2020).

Singapore had the least mean number of TB cases per 1,00,000 population and spends per capita of US$ 1550.42 on healthcare. We did not find articles regarding the health expenditure of Singapore on TB. Nonetheless, we identified that high utilization of health services, high manpower costs, and the increasing elderly populations are the factors that contribute to the growing healthcare expenditure (Salma Khalik, 2019, Abu Bakar, 2020).

Limitations

We had limitations in our study. The health expenditure value used in this study is not specific to tuberculosis. Therefore, the association between TB incidence and the amount spent on the prevention

of tuberculosis is unidentified. The other factor is the presence of comorbidities. while the association between HIV and tuberculosis is well established and data is readily available, other comorbidities like malnutrition, diabetes, smoking also play a significant role in tuberculosis infection. The data regarding these comorbidities are not readily available. Hence, this also becomes a limitation. A study on the exact amount spent on tuberculosis prevention would help the public health officers and the Ministry of Health to initiate relevant measures to curb tuberculosis's burden.

Conclusion

Overall, the ASEAN countries were showing a declining trend in TB cases except for the Philippines. The factors causing high and low incidence in countries were discussed. The ageing population, delay in diagnosis, and immigrants were the barriers in controlling the TB cases in ASEAN. Meanwhile, Cambodia managed to produce significant changes in TB cases with the help of the NTP approach, which is a seed-and-recruit method. We would recommend other countries use a similar manner to overcome the delay in diagnosis.

However, research is needed to prove the effectiveness of the method before implementing it in the country. Furthermore, there was a relationship between the mean number of TB cases per 1,00,000 population and the per capita (US$). This shows that increasing the healthcare expenditure produces a positive health outcome in TB.

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