# Comparative assessment of the condition of tuberculosis in countries of Iran, Turkey, Germany, Egypt, and Malaysia, 2018

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**Abstract**
*Introduction:* Tuberculosis (TB) is a global emergency. This study was conducted to determine the status of TB in selected countries.
*Methods:* This comparative study was conducted in 5 countries. The values for the indicators of each country were extracted from the World Health Organization (WHO) Profile and 2015 World Population Data Sheet.
*Results:* Among the selected countries, the highest and lowest incidence rates of TB were related to Malaysia and Germany, respectively. Regarding the improved index of patients undergoing treatment, Iran and Germany had the highest and lowest improvement rates, respectively.
*Conclusion:* To achieve the End of Tuberculosis Epidemic (END-TB 2035), it is necessary to increase the number of activities aimed at increasing the detection, diagnosis, and effective treatment of disease by implementing strategies (Dots) in order to improve the success rate of treatment, as well as reduce the incidence of cases of resistance to treatment. Moreover, it is necessary to make interventions to improve living conditions and social welfare, support poor people in the community, and improve the status of prisons in the country.

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## Introduction

Tuberculosis (TB) is the biggest cause of death among single-agent infectious diseases, caused by mycobacterium TB. According to the World Health Organization (WHO), nearly 2 billion people in the world are either infected or at risk for mycobacterium TB. Often, one tenth of infections develop and eventually become infected. If TB is not treated, more than 50% of the infected patients will die.[1,2] Annually, about 8-12 million individuals become active in TB and more than 20% of them (about 2 million) become ill. More than 95% of cases of TB and death from TB occur in countries where 75% of the cases are in the biggest age group of 15-64 years old.

Apart from economic losses, TB also has other indirect negative effects on the quality of life (QOL) of patients or their families, as on average, 3-4 months of working time of an adult with TB can be influenced by this disease. Therefore, 20-30% of the annual income of his/her family is lost. In addition, due to the death of this individual, on average, the income of 15 years of the family will be lost. This disease is ranked as the seventh in the global burden of diseases in this regard. Clearly, apart from economic losses, there are other indirect negative effects on the QOL of patients or their families like the rejection of the affected women by their families due to the wrong attitudes or abandonment of the

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children of the patients for various reasons.[2,3] Poverty and severe class divisions in different societies are of the main reasons for the increasing global burden of TB.

In 2015, around 10.4 million people have become infected with TB, accounting for 5.9 million (56%), 3.5 million (34%), and about 1 million (10%) men, women, and children, respectively. The incidence rate of TB in the world was 142/100000, of which about 1.2 million people (11%) were infected with human immunodeficiency virus (HIV) (11%). More than 95% of deaths from TB have been reported in low-and middle-income countries. TB was one of the five main causes of the death of women aged 15-44.[4] Epidemiological studies are of great importance for the design of a comprehensive disease control program, and this study has been performed on this basis. Therefore, this study was conducted with the aim of evaluating and comparing the status of selected countries with the achievement of the Millennium Development Goals in 2015, and the distance and the steps taken to achieve the goals of sustainable development in 2030.[3,4]

TB and poverty are interlinked, as the higher the poverty and the poorer living conditions, the higher the incidence of TB. Moreover, TB and high treatment costs contribute to the increased poverty. The risk of TB infection and the activation of the disease in societies with lower socioeconomic status are higher due to living in more populated areas with more offspring and adverse environmental conditions. As urbanization increases, TB increases due to the high population density and high exposure of individuals. In addition, there is a higher rate of TB among the immigrant groups.[1,3,5]

Several factors predispose individuals to TB, with the most important risk factor in the world being HIV; 13% of all cases of TB are infected with HIV.[6] TB is highly associated with overcrowding and inappropriate nutrition. This connection causes TB to be one of the major diseases associated with poverty.[7,8] The following categories of people are at high risk of TB infection: individuals who take injectable opioid substances, residents, workers and employees of the places where vulnerable individuals gather (including prisons and special shelters for homeless individuals), poor individuals who are deprived of suitable medical care, high-risk ethnic minorities, children in close contact with high-risk individuals, and healthcare providers who serve these individuals.[9-12]

## Methods

This study was conducted using library methods and the main sources used in the study included the reports by the WHO, the United Nations Development Program (UNDP), the World Bank Group (WBG), and the information available on the database and studies regarding the selected countries. The countries of Iran, Turkey, and Egypt were chosen because of their religious, geographical, and demographic composition, and Malaysia was chosen because of its Asian and Islamic culture and many advances in the fields of science, technology, and health. Germany was also selected due to the size of the population similar to that of Iran and progress in the field of health and control of infectious diseases, including the reduction of the incidence of TB.

## Results

Table 1 shows the demographic information of selected countries including life expectancy, population below 15 and over 65 years of age, per capita gross national income (GNI), per capita health expenditure, health expenditure percent of gross domestic production (GDP), urban population, and population density reported per km[2].

Investigation of the indicators presented in table 1 showed that among the selected countries: the highest and lowest life expectancy in both sexes was related to Germany and Turkey, respectively. Regarding the per capita GNI and total per capita expenditure, Germany and Egypt were the largest and lowest, respectively.

In terms of percentage of health expenditure from gross domestic product, Germany and Malaysia were the highest and

**Table 1.** Demographic data and baseline data in selected countries in 2015

| Country | Life expectancy at birth (years) Both sexes in 2015 | Percentage of population in 2015 | | GNI per capita ($) in 2014 | Total expenditure on health per capita ($) in 2013 | Total expenditure on health as % of GDP ($) in 2013 | Percentage of urban population | Population per km² |
|---|---|---|---|---|---|---|---|---|
| | | Age < 15 | Age + 65 | | | | | |
| Egypt | 77 | 31 | 4 | 11020 | 539 | 5.1 | 43 | 3196 |
| Germany | 80 | 13 | 21 | 46840 | 4812 | 11.3 | 73 | 685 |
| Iran | 74 | 24 | 5 | 16080 | 1414 | 6.7 | 71 | 442 |
| Malaysia | 75 | 26 | 6 | 23850 | 938 | 4.0 | 74 | 3231 |
| Turkey | 71 | 24 | 8 | 19040 | 1053 | 5.6 | 77 | 381 |

GNI: Gross national income; GDP: Gross domestic production

lowest, respectively. The highest population density was for Malaysia and Egypt respectively, and the lowest population density was related to Turkey and Iran. Egypt had the highest population of below 15 years of age and the lowest population over 65, with Germany having the lowest population of below 15 years and the highest population of over 65 years. Table 2 shows the reported rate of disease per 100000 individuals and its rate based on sex as well as the incidence of pulmonary TB and the incidence of the disease from 1990 to 2015.

Table 2 indicates that in all selected countries after the age of 45, the risk of suffering from a disease increased and the incidence of illness was higher. In addition, the incidence of the disease was higher among women compared to men. The highest and lowest rate of TB cases was in Malaysia and Egypt, respectively. Among the selected countries, regarding the process of struggle

and control of TB, Turkey had the most success, and the weakest performance was for Malaysia, which increased by more than 10%.

Table 3 shows that the highest and lowest rates of success in treatment was related to Iran and Germany, respectively. The most unevaluated treatments were related to Germany and Malaysia, respectively, and the lowest untreated cases were for Iran. Moreover, the highest rates of absence from treatment were in Malaysia and Egypt, and the lowest was in Iran. Table 4 illustrates the incidence of disease reported by gender and age group.

In Egypt, the highest incidence of TB among women and men was in the age group of 15- 24 and 45-64 years old, respectively. In both genders in Germany, the highest incidence was in the age group of 25-34 years old. In the countries of Iran, Malaysia, and Turkey, the highest incidence of TB in both genders was in the age group over 65 years.

**Table 2.** Incidence rate of tuberculosis (TB)

| Country | 2016 | | | | | Incidence rate per 100000 | | |
|---|---|---|---|---|---|---|---|---|
| | Population | Number of TB infections in thousands | | Incidence rate per 100000 | Pulmonary (%) | 1990 | 2000 | 2015 |
| | | Women | Men | | | | | |
| Iran | 80 | 5.4 | 6.1 | 12 | 72 | 32 | 22 | 16 |
| Turkey | 80 | 6.0 | 8.0 | 18 | 66 | 53 | 33 | 18 |
| Malaysia | 31 | 11.0 | 18.0 | 92 | 86 | 77 | 74 | 89 |
| Egypt | 96 | 5.5 | 7.7 | 14 | 57 | 35 | 26 | 15 |
| Germany | 82 | 2.2 | 4.4 | 8.1 | 75 | 21 | 13 | 8 |

TB: Tuberculosis

**Table 3.** Treatment outcomes among tuberculosis (TB) cases in 2013

| Country | Success (%) | Failed (%) | Died (%) | Lost to follow up (%) | Not evaluated (%) |
|---|---|---|---|---|---|
| Egypt | 86 | 1 | 3 | 4 | 5 |
| Germany | 67 | 0 | 11 | 3 | 19 |
| Iran | 87 | 2 | 8 | 2 | 1 |
| Malaysia | 76 | 0 | 9 | 5 | 11 |
| Turkey | 86 | 0 | 5 | 3 | 6 |

**Table 4.** Notified new and relapsed tuberculosis (TB) cases by age and sex in 2014

| Country | Sex | Notified cases by age group (rate per 100000 population) | | | | | | | |
|---------|-----|------|------|-------|-------|-------|-------|-------|------|
| | | Age group (year) | | | | | | | |
| | | 0-4 | 5-14 | 15-24 | 25-34 | 35-44 | 45-54 | 55-64 | ≥ 65 |
| Egypt | Women | 0.6 | 13.0 | 108.0 | 4.4 | 8.7 | 14.0 | 11.0 | 5.7 |
| | Men | 0.9 | 14.0 | 2.0 | 6.7 | 10.0 | 20.0 | 20.0 | 12.0 |
| Germany | Women | 1.8 | 1.1 | 4.6 | 5.9 | 4.5 | 3.0 | 3.0 | 4.7 |
| | Men | 1.9 | 1.3 | 12.0 | 9.3 | 7.7 | 5.6 | 5.9 | 7.7 |
| Iran | Women | 1.8 | 2.6 | 10.0 | 8.1 | 11.0 | 13.0 | 27.0 | 82.0 |
| | Men | 2.2 | 1.2 | 7.2 | 13.0 | 15.0 | 15.0 | 24.0 | 69.0 |
| Malaysia | Women | 7.9 | 10.0 | 62.0 | 70.0 | 69.0 | 72.0 | 99.0 | 119.0 |
| | Men | 12.0 | 7.7 | 71.0 | 97.0 | 139.0 | 172.0 | 227.0 | 266.0 |
| turkey | Women | 2.2 | 3.0 | 16.0 | 16.0 | 13.0 | 16.0 | 20.0 | 33.0 |
| | Men | 2.3 | 3.0 | 16.0 | 20.0 | 22.0 | 32.0 | 41.0 | 49.0 |

## Discussion

TB was proclaimed by the WHO in 1993 as an emergency and is still a global emergency. In the sixth goal of the United Nations Millennium Development Goal, targeting 50% of the global prevalence and death rate in 2015 was set for the countries of the world by 1990. During this period, the prevalence of TB decreased by 40% and the death rate from TB was reduced by 45%.[13] One of these goals is the end of the year 2030, the end of the TB epidemic, with the goal of reducing the incidence of tuberculosis by 90% and the death rate attributable to the TB of 95%.; One of the goals of the end of the global epidemics of TB (END-TB) set for 2035 is to reduce 90% of the incidence of TB and 95% of the rate of death from TB. The endpoint of the WHO epidemic endpoint strategy is to decrease the incidence of TB by 80%, the deaths attributable to TB by 90%, and the cost of TB to zero. The ultimate goal is to achieve the elimination of TB (incidence less than one case in millions) by 2050.[14] Among the selected countries, Malaysia had the highest rate of increase in TB incidence rate by more than 10% and had the weakest effect, since TB is a multifactorial disease due to high population density, high levels of humidity (96%), and tobacco use. Then, with a 10% reduction in incidence, Iran has been less successful in controlling TB than other countries. Considering the thirteenth goal of Iran's health promotion plan in the fight against contagious diseases, it requires internal and external cooperation and attention to the health sector and the fight against contagious diseases, consideration and improvement of the prison conditions of the country.

As, according to the studies, it has been determined that the incidence of TB in prisons is 100 times higher in the ordinary society, as the prison conditions facilitate the extreme rate of transmission and diffusion of TB among prisoners.[15] Furthermore, high levels of TB in prisons have a great impact on the spread of this disease in the community due to massive transfer among the prison population. The high rate of TB in the prison has a huge impact on the spread of this disease in the community. Admitted people are about 5 times more prison capacity. Most of the prison population is between the ages of 20-40, which is usually marginalized, drug users, homeless people and the poor.

TB is even more worrisome than acquired immune deficiency syndrome (HIV/AIDS), as it is transmitted through respiration. Neighborhood of Iran with Afghanistan, Pakistan, and independent countries from the Soviet Union, which are among the most polluted countries in the world, call for greater attention to this disease.

The success of countries in reducing the incidence and death rates of TB are influenced by various factors, including the extent of identification of the patients scattered in the community, as they are detected sooner and treated appropriately [short-term treatment under direct day-to-day supervision of Directly Observed Treatment Short-Course Strategy (DOTS)].

The cycle of transmission of the disease in the society is cut short faster, and these two indicators are expressed by the WHO as the rate of identification of new cases of disease and the success rate of treatment. In 2015, the index for identifying the expected new cases was 59%, with selected countries of Egypt and Iran with rates of 59% and 80%, respectively, and Germany, Malaysia, and Turkey each as 87%. There are about 3.6 million individuals with TB worldwide that are not identified and require the participation and support of the government and various organizations. There are about $ 1.3 billion in funding for the fight against TB.[3,4]

The global index of the expected recovery rate was 83%, which was 87% among selected countries in general as 84% for Egypt, 63% for Germany, and 78% for Malaysia, Iran, and Turkey. Among the selected countries, Germany and Malaysia had the lowest success rate of treatment, which could be due to the poor follow-up of health workers and the lack of evaluation of patient care (11% and 19%, respectively). Each patient with TB spreads around 3000 TB bacteria annually, hence causing an infection of 10-15 individuals each year. It is recommended for countries of Germany and Malaysia to pursue active follow-up and continuous follow-up of patients in order to increase the success of the treatment of the disease.

## Conclusion

To achieve the goals of the WHO and the end of the TB epidemic, activities must be performed including increased detection and diagnosis early in the onset of clinical symptoms (because the patient spreads about 3000 bacilli in each cough and causes an additional 10-15 cases per year), diagnosis in the primary stage of the disease (+1), and a reduction in the rate of advanced cases of (+2 and +3) effective treatment of patients, including TB screening tests for high-risk groups (around sick people, prisoners, HIV+, dialysis and transplantation patients, and addiction quitting camps and clinics) and new diagnostic and therapeutic approaches to control TB.

## Authors' Contribution

All of the authors contributed equally.

## Conflict of Interest

Authors have no conflict of interest.

## Ethical Approval

Not indicated.

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