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Fatemeh Torshizi,[1] Mohammad Honarvar,[2] Elahe Rahimarbabi,[3] Mahnaz Sheikhy,[3] Mohammadhossein Hajiebrahimi[4] and Nasser Behnampour[5]

[1]Faculty of Health, Golestan University of Medical Sciences, Gorgan, Islamic Republic of Iran. [2] Health Management and Social Development Research Center, Department of Nutrition, Golestan University of Medical Sciences, Gorgan, Islamic Republic of Iran.
[3] Office of the Deputy of Health, Golestan University of Medical Sciences, Gorgan, Islamic Republic of Iran.
[4] Health Management and Social Development Research Center, Golestan University of Medical Sciences, Gorgan, Islamic Republic of Iran.
[5] Health Management and Social Development Research Centre, Department of Biostatistics and Epidemiology, Golestan University of Medical Sciences, Gorgan, Islamic Republic of Iran. (Correspondence to Nasser Behnampour: behnampour@goums.ac.ir).

Abstract

Background: Pulmonary tuberculosis is the most common type of tuberculosis and few studies have investigated the incidence and treatment outcome of smear-positive pulmonary tuberculosis in Golestan Province, Islamic Republic of Iran.

Aims: To estimate the cumulative incidence and trends in incidence of smear-positive pulmonary tuberculosis in Golestan Province between 2014 and 2019, and to determine the treatment outcomes.

Methods: All smear-positive pulmonary tuberculosis cases between 2014 and 2019 recorded in the tuberculosis registry in Golestan Province, Islamic Republic of Iran, were included in this study. The yearly incidence and cumulative incidence were calculated, and differences by sex

and residence were examined. Treatment outcomes classified as success and failure were determined. The Mann–Kendall test was used to assess the significance of the trend in incidence.

Results: A total of 2047 smear-positive pulmonary tuberculosis cases were evaluated. The cumulative incidence was 18.52 [95% confidence intervals (CI): 17.72–19.33] per 100 000 population during 2014–2019. The incidence of smear-positive pulmonary tuberculosis declined from 23.84 (95% CI: 21.57–26.11) per 100 000 population in 2014 to 15.02 (95% CI: 13.29–16.75) in 2019. Incidence rate was higher among men and among rural residents. Most patients (85.34%) were cured, 2.05% completed their treatment, 1.17% were lost to follow-up, 4.40% had treatment failure, and 6.45% died.

Conclusion: The incidence of pulmonary tuberculosis in Golestan Province, Islamic Republic of Iran, declined during the period of study. However, the proportion of patients who were cured decreased and the proportion who died increased. Interventions are needed to improve the treatment success rate for pulmonary tuberculosis in the province.

Keywords: tuberculosis, pulmonary, incidence, treatment outcome, Iran.

Citation: Torshizi F, Honarvar M, Rahimarbabi E, Sheikh M, Hajiebrahimi M, Behnampour N. Incidence and treatment outcomes of pulmonary tuberculosis in Islamic Republic of Iran. East Mediterr Health J. 2023;29(6):417–424. https://doi.org/10.26719/emhj.23.047 Received: 15/04/21; accepted: 21/11/22

Introduction

Tuberculosis, caused by Mycobacterium tuberculosis, is one of the oldest infectious diseases of humankind (1). It is estimated that tuberculosis infected 10 million individuals (132 per 100 000

population) and was responsible for about 1.4 million deaths worldwide in 2019 (2). However, the incidence of tuberculosis decreased 2% annually between 2015 and 2019, 9% overall (3). Tuberculosis has a specific regional pattern: in 2019, the World Health Organization's South-east Asian region had the highest percentage of the new tuberculosis cases (44%), followed by the African region (25%) and the Western Pacific region (18%) (4). In Eastern Mediterranean region, in 2020, Pakistan accounted for 70% of tuberculosis cases, Afghanistan for 9%, Iraq for 1.3% and the Islamic Republic of Iran for 1.3% (5).The incidence of the disease in the Islamic Republic of Iran was reported at 16 cases per 100 000 population in 2015, which decreased to 13 cases per 100 000 in 2019 (3,6). Golestan Province in the north had the second highest incidence of smear positive tuberculosis in the country after Sistan and Baluchestan Province in the south-east (7), despite the long distance between the two provinces. Migration from Sistan and Baluchestan Province to Golestan Province after natural disasters in recent years and the easily available transportation between the two provinces may explain their similar rankings.

M. tuberculosis attacks different organs (8), mostly the lungs. Pulmonary tuberculosis is bacteriologically confirmed in 84% of patients (smear-positive tuberculosis) in high-income countries, with lower rates in low-income countries. The remaining 16% pulmonary tuberculosis cases are confirmed clinically (2,9). In the Islamic Republic of Iran, the incidence of smear-positive pulmonary tuberculosis was 6.25 per 100 000 population in 2015 which decreased to 5.46 per 100 000 population in 2018 (7). Therefore, smear-positive pulmonary tuberculosis could be used as an epidemiological indicator of tuberculosis distribution, and it is useful to evaluate its incidence and the outcome of its treatment.

Tuberculosis is a complicated disease to treat and different indicators, such as proportion of cured patients, completed treatment, lost to follow-up and death, are used to show treatment outcomes (10). For example, the World Health Organization in its End TB strategy until 2020 set a target of a 35% reduction in deaths and 20% reduction in the incidence of tuberculosis for 2020 compared with 2015 (11).

In this study we aimed to estimate the cumulative incidence of and trends in smear-positive tuberculosis cases in Golestan Province between 2014 and 2019. We compared the incidence of smear-positive pulmonary tuberculosis by sex and residence, and determined the distribution of smear-positive pulmonary tuberculosis treatment outcomes.

Methods

This was a cross-sectional study of notification data from Golestan Province between 2014 and 2019. Golestan Province is one of the 31 provinces of the Islamic Republic of Iran. It is located

in the north-east of the country and had a population of 1.8 million in 2016. All smear-positive pulmonary tuberculosis patients (bacteriologically confirmed) whose data were recorded in the tuberculosis registration system at Golestan University of Medical Sciences and Health Services between 21 March 2014 and 20 March 2019 were included in the study. The tuberculosis registry collects detailed data on all tuberculosis patients, including on demographic and disease characteristics and treatment outcomes at the Golestan Province level. Data on age, sex, residence and smear-test results were extracted from register. More information on the tuberculosis register software are reported elsewhere (12). Data on total population of the province for each year of the study were obtained from the Golestan electronic health record system which has collected these data for the past 10 years. The records of eligible patients were reviewed from diagnosis to the treatment outcomes of interest or end of study. The treatment outcomes of interest were based on WHO definitions (10): cured and treatment completed were categorized as a successful treatment; treatment failure, lost to follow-up and died were categorized as unsuccessful treatment.

Smear-positive pulmonary tuberculosis diagnosis was based on WHO guideline (13) in the Islamic Republic of Iran. A smear-positive pulmonary tuberculosis patient was: someone who had had at least 2 positive acid-fast bacilli sputum smears; or someone who had only 1 positive acid-fast bacilli smear plus signs of pulmonary tuberculosis in X-ray; or someone with 1 positive acid-fast bacilli sputum smear and 1 positive acid-fast bacilli sputum culture (14).

Statistical analysis

Demographic and clinical characteristics and treatment outcomes were reported using descriptive statistics. The cumulative incidence by sex and the residence (urban/rural) of the smear-positive pulmonary tuberculosis patients was calculated by the formula: number of cases/total population × 100 000. The relative risk to compare the incidence by sex and residence was calculated using formula: cumulative incidence in males/cumulative incidence in females, and cumulative incidence in rural patients/cumulative incidence in urban patients. The Mann–Kendall test was used to determine the incidence trend. R software version 4.0.2 was used for data analysis.

Ethical considerations

All anonymized data were extracted from the tuberculosis register and Golestan electronic health record system with permission of the Ethical Committee of Golestan University of Medical Sciences (ethics code: IR.GOUMS.REC.1399.168).

Results

A total of 2047 smear positive pulmonary tuberculosis cases were evaluated. The mean

(standard deviation) age of the patients was 50.94 (20.19) years, 55.00% were male, 60.00% lived in rural areas and 36.20% had been diagnosed with three or more smear tests. The average cumulative incidence of smear-positive pulmonary tuberculosis was 18.52 [95% confidence interval (CI): 17.72–19.33] per 100 000 population for years 2014 to 2019. The trend in smear-positive pulmonary tuberculosis incidence decreased during the study period (Table 1, Figure 1).

The highest cumulative incidence of smear-positive pulmonary tuberculosis was among men living in the rural areas; the lowest incidence was among women living in the urban areas (Table 2). Our findings indicated that rural residence with cumulative incidence rate 1.78 (95% CI: 1.63–1.95) and male sex with cumulative incidence rate 1.22 (95% CI: 1.12–1.33) could be considered as risk factors for smear positive pulmonary tuberculosis incidence.

The trend in the incidence of smear-positive pulmonary tuberculosis was significantly higher in males than females and in rural areas than urban areas; Mann–Kendall P