Abstract

Background: This study aimed to investigate the epidemiological characteristics of pulmonary tuberculosis (TB) in Heilongjiang province from 2008 to 2015 and provide scientific basis for the development of TB control. Methods: The TB patients were confirmed by chest radiography and sputum examination, and the TB incidence data were from the Chinese Tuberculosis Management Information System, population data were from the National Basic Information System. Results: By the SPSS statistics analysis, there was a total of 280,767 cases of TB registered in Heilongjiang province from 2008 to 2015; the average annual incidence rate was 91.60/100,000, the male incidence rate was 122.81/100,000; the female incidence rate was 59.39/100,000, and TB incidence increased as the growth of age. Farmers’ incidence was higher than other occupations; Shuangyashan city incidence of 122.09/100,000 was highest during 13 cities in Heilongjiang province, all above factors existed significant difference. Conclusions: As a result, TB incidence was higher among the elderly, males and farmers, so it is important to promote the scientific knowledge about the prevention and treatment of TB. In particular, it is necessary to strengthen the health education of the elder aged people and improve the self-care awareness and ability to prevent TB.

Keywords: Epidemiology, prevention, pulmonary tuberculosis

Introduction

Tuberculosis (TB) is a major global health problem. It causes ill-health among millions of people each year as a leading cause of death worldwide. In 2014, there were estimated 9.6 million new TB cases in the world, which 5.4 million among men, 3.2 million among women, and 1.0 million among children. There are six countries accounted for 60% of new TB incidence, which are India, Indonesia, China, Nigeria, Pakistan, and South Africa. To make TB prevention and treatment progress in the world, these six countries must make significant progress.[1-3] According to the World Health Organization statistics, there were estimated 0.82 million new TB cases in China, accounting for 8.5% of the global incidence, ranking second in the world, only after India.[4,5] There were approximately 30,000 active pulmonary TB patients each year in Heilongjiang province, the national average TB incidence rate was 63.42/100,000 in 2015, and the average TB incidence was 91.60/100,000 in Heilongjiang province during 2008–2015, which was much higher than the national average. Hence, it is necessary to analysis the TB epidemic characteristics in Heilongjiang province, which is important to reduce the national average TB incident. In 2015, the United Nations adopted the goal to end the TB epidemic in 2030. In 2014, the World Health Assembly approved the TB Strategy, which called for a 90% reduction in TB deaths and 80% reduction in incidence by 2030 compared with 2015.[6] This study summarized TB incidence and its epidemic characteristics in Heilongjiang from 2008 to 2015, which laid the foundation for the next step to achieve the goal of reducing the global incidence of TB by 80%.

Methods

Chest radiography

The diagnosed patients took chest radiography for routine examination, and the new suspected patients were reported...
to the Heilongjiang Province Center for Tuberculosis Control and Prevention for further sputum examination.

**Sputum examination**  
The suspected patients after chest radiography were ordered to take sputum examination; the procedures were: first gargled with clean water, and then deeply breathed for three times, finally took the sputum samples, make sure not the slobber.

**Data source**  
The data of TB patients came from the Chinese Tuberculosis Management Information System, and the population data came from the Basic Information System of 2008–2015. The data included a total of 13 cities in Heilongjiang province, which were Harbin city, Qiqihar city, Jixi city, Hegang city, Shuangyashan city, Daqing city, Yichun city, Jiamusi city, Qitahei city, Mudanjiang city, Heihe city, Suihua city, Daxinganling area.

**Statistical analysis**  
The data were collected by Excel 2007, and statistical analysis by SPSS version 19.0. The Chi-squared test was used to assess the difference in proportion.

**RESULTS**

**The basic condition of tuberculosis patients**  
There were 280,767 TB cases during 2008–2015 in Heilongjiang province, the average annual incidence rate was 91.60/100,000, including new smear-positive TB (SPTB) cases, were 93,383, average annual incidence rate was 35.07/100,000; the smear negative TB (SNTB) cases were 167,860, average incidence rate was 54.77/100,000; the TB cases without sputum examination were 1416, TB pleurisy cases were 2879, other extrapulmonary TB cases were 1132. An average of 36.32% cases was SPTB, the recurrence SPTB was 4.86% after treatment, and 99.50% suspected cases after chest radiography were under sputum examination [Table 1].

By the analysis of TB patients during 2008–2015 [Figure 1], the TB incidence was declined year by year from 2008 to 2011 and tended to be gentle from 2012 to 2015. The TB incidence dropped from 109.11/100,000 in 2008 to 86.64/100,000 in 2015 ($\chi^2 = 5.44$, $P > 0.05$); which SPTB incidence was declined year by year from 2008 to 2015, the average annual incidence was dropped from 50.87/100,000 in 2008 to 18.75/100,000 in 2015 ($\chi^2 = 28.81$, $P < 0.01$); the SNTP average annual incidence decreased slightly from 2008 to 2010, and then, increased year by year from 2011 to 2015, the SNTP incidence was 54.83/100,000 in 2008, 46.35/100,000 in 2010, 47.54/100,000 in 2011, 66.64/100,000 in 2015, there was significant difference ($\chi^2 = 6.47$, $P > 0.05$).

**Gender and age distribution of tuberculosis patients**  
The male TB cases were 191,191, and the incidence was 122.81/100,000, the female TB cases were 89 576, and the incidence was 59.39/100,000 in Heilongjiang province from 2008 to 2015. The male patients were 2.13 times more than female patients [Figure 2]. The proportion of men and women in global TB reporting cases is 1.7, in the 30 countries with high TB burden, Pakistan has the lowest proportion, 1.0, China has the similar proportion as global.

The TB patients were divided into three groups by age [Table 2] from 2008 to 2015. The annual average incidence was declined year by year from 2008 to 2012 and trended to stable from

![Figure 1: The average tuberculosis incidence in Heilongjiang province during 2008–2015.](image)

**Table 1: Tuberculosis patients in Heilongjiang province during 2008-2015**

| Year | Total | NSPTB | Recurrence SPTB | SNTB | Without sputum examination | Tuberculous pleurisy | Other extrapulmonary TB |
|------|-------|-------|----------------|------|---------------------------|---------------------|------------------------|
|      |       |       | Relapse | Failure |                         |                     |                        |
| 2008 | 41,802| 16,453| 1672    | 61     | 21,007                    | 456                 | 584                    | 265                   |
| 2009 | 37,785| 15,686| 1596    | 74     | 18,602                    | 231                 | 443                    | 172                   |
| 2010 | 35,947| 15,279| 1379    | 53     | 17,757                    | 147                 | 410                    | 159                   |
| 2011 | 33,239| 12,518| 1276    | 53     | 18,212                    | 133                 | 412                    | 121                   |
| 2012 | 32,797| 9925  | 912     | 42     | 20,932                    | 95                  | 316                    | 92                    |
| 2013 | 33,017| 9094  | 904     | 57     | 22,375                    | 90                  | 267                    | 108                   |
| 2014 | 32,985| 8129  | 660     | 46     | 23,445                    | 88                  | 227                    | 129                   |
| 2015 | 33,195| 6299  | 603     | 46     | 25,530                    | 176                 | 220                    | 86                    |
| Total| 280,767| 93,383| 8600    | 432    | 167,860                   | 1416                | 2879                   | 1132                  |

TB: Tuberculosis, SNTB: Smear-negative tuberculosis, SPTB: Smear-positive tuberculosis, NSPTB: New Smear-positive tuberculosis
2013 to 2015. The TB incidence increased as age growth, there was significant difference correlated with different age groups \( \chi^2 = 151.00, P < 0.01 \).

**Occupational distribution of tuberculosis patients**
The TB patients were analyzed by different occupations, of which farmers suffering from TB up to 123,832 cases, accounting for 44.10% of all total patients, and followed by 84,456 cases of housekeepers and unemployed accounting for 30.08% [Table 3].

**Area distribution of tuberculosis patients**
The average incidence of Heilongjiang province was 91.60/100,000 from 2008 to 2015, which the TB incidence of seven cities Qiqihar, Jixi, Hegang, Shuangyashan, Yichun, Qitaie, and Mudanjiang were higher than whole province average. The highest TB incidence cities were Shuangyashan city with 122.09/100,000, Qitaie city with 114.61/100,000, Jixi city with 107.64/100,000 [Figure 3].

**DISCUSSION**
TB epidemic was serious in China according to the National TB epidemiology survey results in 2000.[7] The World Health Organization 2010 global TB control report showed that the global incidence of TB from 2004 showed a slowly decline year by year, but the total number of TB cases was increased with the population increase year by year.[8] through the whole province’s TB prevention workers efforts, the TB incidence was decreased from 41,802 cases in 2008 to 33,195 cases in 2015, the average TB prevalence was decreased from 109.11/100,000 down to 86.64/100,000. There were 7 cities among 13 cities exceeding the average in Heilongjiang. The results showed that the male’s TB incidence was significantly higher than female’s, which was similar to other findings.[9,10] The main reason may be related to men’s smoking ratio was much higher than women; smoking was a risk factor for TB. There were more than 400 kinds of chemical substances in cigarette. Smoking

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**Table 2: Tuberculosis incidence of different age groups during 2008-2015**

| Year | 0-14 TB incidence/100,000 | 15-64 TB incidence/100,000 | Above 65 TB incidence/100,000 |
|------|--------------------------|----------------------------|-------------------------------|
| 2008 | 4.09                     | 119.34                     | 167.68                        |
| 2009 | 9.07                     | 107.41                     | 147.42                        |
| 2010 | 7.85                     | 101.19                     | 150.45                        |
| 2011 | 6.08                     | 92.78                      | 145.97                        |
| 2012 | 6.06                     | 91.18                      | 144.76                        |
| 2013 | 6.04                     | 92.16                      | 139.02                        |
| 2014 | 5.52                     | 91.76                      | 139.06                        |
| 2015 | 5.15                     | 91.81                      | 139.28                        |

TB: Tuberculosis

**Table 3: Occupational distribution of tuberculosis patients in Heilongjiang province during 2008-2015**

| Career                                              | Total cases/n | Constituent ratio/% |
|-----------------------------------------------------|---------------|---------------------|
| Farmers                                             | 123,832       | 44.10               |
| Housekeepers and unemployed                         | 84,456        | 30.08               |
| Others                                              | 22,227        | 7.92                |
| Workers                                             | 15,046        | 5.36                |
| Retired staff                                       | 11,757        | 4.19                |
| Students                                            | 9432          | 3.36                |
| Unknown                                             | 4837          | 1.72                |
| Cadre staffs                                        | 3809          | 1.36                |
| Business servicers                                  | 1932          | 0.69                |
| Migrant workers                                     | 1087          | 0.39                |
| Teachers                                            | 938           | 0.33                |
| Medical staffs                                      | 565           | 0.20                |
| Food and beverage industry workers                  | 217           | 0.08                |
| Seafarers and long distance drivers                 | 236           | 0.08                |
| Herders                                             | 143           | 0.05                |
| Scattered children                                  | 107           | 0.04                |
| Public place attendants                             | 97            | 0.03                |
| Kindergarten children                               | 17            | 0.01                |
| Fishing (boat) people                               | 28            | 0.01                |
| Nurses and babysitters                              | 4             | 0.00                |
| Total                                               | 280,767       | 100.00              |

**Figure 2:** The ratio of male and female patients in Heilongjiang province during 2008–2015. The blue color stands for the incidence of men, the orange color stands for the incidence of women.

**Figure 3:** The area distribution of tuberculosis incidence in Heilongjiang province during 2008–2015. The column stands for the incidence of 13 cities and total incidence in Heilongjiang province.
can damage the bronchial mucosa and alveolar wall, lead to respiratory epithelial cilia damage, immune cells function decline, Mycobacterium TB scavenging ability decline, and finally lead to TB infection. The research\cite{5,11,12} showed that the probability of smoking people suffering from pulmonary TB was 2.0–5.1 times higher than the people without smoking. The age distribution showed that the TB incidence increased with age growth, the highest incidence was the age group of over 65, the TB incidence moved to the elderly, which was the world’s TB epidemic trend.\cite{6} The main reason may be the cellular immune function, metabolism, and phagocytic activity of alveolar macrophages of elderly was declined, or other diseases caused complications.\cite{13} The highest incidence occupations were farmers, housekeepers, and unemployed. The incidence of farmers was significantly higher than other occupations, which basically matched the national TB epidemic situation.\cite{14}

The highest TB incidence was in Shuangyashan city, Qitaibei city, and Jixi city, these areas were the main coal mining area of Heilongjiang province, the workers were suffered from coal dust, with the low immunity of lung itself and the level of education was not high, the TB knowledge background was not enough, which led to the high TB incidence of migrant workers in mining area. The TB prevention and control policy carried out in most of the cities of China since 1950s while the policy was carried out in rural and mining areas only in recent year, all these delayed treatment of farmers and miners in severe cases. Second, Heilongjiang province was a major agricultural province, the rural population with large base and low income, low education level, and the health education status, nutrition, environment and life habit were poor, which may further lead the peasants with high incidence of TB phenomenon.\cite{15} Unlike India, most of China’s funds come from domestic central financial transfers. There are no special prevention methods currently for the province’s TB epidemic situation. According to the result of this study, the government should focus on rural areas, males and the people over the age of 65. It is necessary to increase funding and work of farmers, also enhance the health education and variety forms to promote the prevention of TB. In particular, it is important to strengthen the health education of the elderly and improve themselves’ health and disease prevention.

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Conflicts of interest

There are no conflicts of interest.

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