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Prevalence of Tuberculosis after the Great East Japan Earthquake: Late-Stage Follow-Up in the Coastal Region of Northern Miyagi

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Abstract

Compared to the early stage (2011-2012) after the Great East Japan Earthquake, no significant changes were seen in the total number of case of tuberculosis (TB), and pulmonary TB cases in the mid-term stage (2013-2014). However, the number of patients with latent tuberculosis infection (LTBI) decreased significantly in the coastal region of Northern Miyagi, which was ravaged by a post-quake tsunami. We analyzed the data of all TB patients in this region in the early (2011- 2012) and the late (2015- 2016) stages following the Great East Japan Earthquake and compared it with the pre-disaster data. The number of cases of total TB, extra pulmonary TB and LTBI significantly in comparison to the initial stage after the disaster decreased, but there was a significantly higher prevalence of TB and the LTBI compared to pre-disaster. These results suggest that continued health activities and an improved transportation system reduced the prevalence of total TB after the Great East Japan Earthquake. Thus, these health activities should be maintained.

Keywords: Miyagi coastal region; The Great East Japan earthquake; Tuberculosis

Introduction

Prior to the Great East Japan Earthquake, the prevalence of tuberculosis (TB) in the Miyagi prefecture, one of lowest epidemic areas of TB in Japan, was 11/100,000 people. Aggressive health activities were undertaken to aim for a TB incidence below10/100,000 people. In the coastal area of North Miyagi before the disaster, the local rate of TB decreased to 9/100,000 people, however, rate of TB, extra pulmonary TB, and LIBI significantly increased thereafter. During mid-term follow-up, refugees left the refuge, and the most of the transportation networks were restored [1]; however, the prevalence of TB except LTBI decreased less significantly [2]. The health activities that were implemented before the disaster were continued thereafter. Furthermore, the transportation system was expanded. We investigated rate of TB infection in the late-stage follow up (2015-2016) for TB infections in the tsunami-stricken areas of the Great East Japan Earthquake.

Methods

Data acquisition

As previously reported, TB patients in Japan include are all patients with TB who are registered in the Regional Public Health Centers and placed under state control [1]. The coastal region reports to the Health Centers of Kesennuma, Ishinomaki, and Shiogama [1]. Patients in the coastal region were divided into two groups; those who resided there in the early stage (2011-2012) and those who resided there in the late-stage (2015-2016), after the disaster.

In this study, annual data (measured from April 1 to March 31 of the following year) of all patients with TB between 2011 and 2015 were extracted from the database of the Public Health Centers of the Miyagi Prefectural Government. Data for the early (2011-2012) and the late (2015-2016) stages following the Great East Japan Earthquake were compared.

We used a divider smear test, an interferon gamma-releasing assay (IGRA), tubercle bacillus laboratory culture, a polymerase chain reaction, chest radiography, and computed tomography were included in the method to diagnose TB [1]. The tubercle bacillus was classified as pulmonary TB, extrapulmonary TB and LTBI, and the registered patients were classified by sex and age (in the groups of 10 years). Furthermore, the incidence of TB (based on expectoration smear examination or a positive culture) and the number of contacts who required screening [1]. TB was screened for with the tuberculin skin test (TST) or IGRA as well as chest radiography.

Statistical analysis

Categorical data were analysed with a Fischer exact or chi-square test. All analyses were two-sided, and a p-value of 0.05 was considered statistically.

Results

In the coastal area of Northern Miyagi, the population after the Great East Japan earthquake was 492,537 in 2011, 466,898 in 2012, 457,428 in 2015, and 453,189 in 2016. A total of 403 TB patients were registered during the study period (between April 1, 2009 and March 31, 2013 and between April 1, 2015 and March 31, 2017).

The numbers of annual registration after the earthquake disaster significantly decreased during the latter period of the early stage with 53 in 2015, 71 in 2016, 95 in 2011, and 89 in 2012 (19.2 *vs.* 13.6 per 100,000 people, respectively; p=0.003; Table 1).

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The numbers of sputum smear tests and patients with positive cultures requiring contact screening were 46 in the early stage and 33 in the late stage. The total number of TB patients who required contact screening was not significantly different between the early and late stages after the disaster (Table 1). Moreover, 1,479 and 1329 individuals during the early and late stages post-disaster, respectively, had contact with patients. This number was not significantly different between the early and late stages (Table 1).

		Early stage (2011+2012)	Late stage (2015+2016)	Early vs. Late
Population, n		9,59,435	9,10,618	
TB patients, n		184	124	p=0.003
Per 100,000 people		19.2	13.6	
Female, n (%)		90 (48.9)	60 (48.3)	ns
Tuberculosis patients who required screening				
Total number, n		46	33	ns
Contact persons				
Total number, n		1,479	1,329	ns
Visiting DOTS		178/209	211/214	ns
Pulmonary TB, n		77	72	ns
Per 100,000 people		8	8.2	
Age, n (%)	0-19 years	0 (0.0)	1 (1.4)	ns
	20-49 years	8 (10.4)	14(19.4)	ns
	50-69 years	19 (24.5)	16 (22.2)	ns
	≥ 70 years	50 (64.9)	41 (56.9)	ns
Extra pulmonary TB, n		28	12	p=0.018
Per 100,000 people		2.9	1.5	
Age, n (%)	0-19 years	1 (3.6)	0 (0)	ns
	20-49 years	3 (10.7)	1 (8.3)	ns
	50-69 years	3 (10.7)	3 (25.0)	ns
	≥ 70 years	21 (75.0)	8 (66.7)	ns
LTBI, n		79	40	p=0.001
Per 100,000 people		8.2	4.6	
Age, n (%)	0-19 years	2 (2.6)	4 (10.0)	ns
	20-49 years	30 (37.2)	7 (17.5)	ns
	50-69 years	28 (35.9)	10 (25.0)	ns
	≥ 70 years	19 (24.4)	19 (47.5)	ns

DOTS: Direct Observed Treatment Short-course; LTBI: Latent Tuberculosis Infection; ns: Non-Significant; TB: Tuberculosis.

Table 1: Characteristics of tuberculosis patients in the coastal region of northern Miyagi.

In the early stage after the disaster, the number of patients of pulmonary TB, extrapulmonary TB and LTBI were 77, 28 and 79; in the late stage, they were 72, 12 and 40. There was no significant difference in the number of patients with pulmonary TB between the early stage and late stage (8.0 *vs.* 8.2 per 100,000 people, respectively). However, we observed a significant difference in the number of patients with extra pulmonary TB (2.9 *vs.* 1.5 per 100,000 people, respectively; p=0.018) and LTBI (8.2 *vs.* 4.6 per 100,000 people, respectively; p=0.001) between the two stages (Table 1).

		Pre-disaster (2009+2010)	Late stage (2015+2016)	Pre vs. Late
Population, n		993209	910618	
TB patients, n		95	124	p<0.001
Per 100,000 people		9.6	13.6	
Female, n (%)		56 (58.9)	60 (48.3)	ns
Tuberculosis patients who required screening				
Total number, n		34	33	ns
Contact persons				
Total number, n		1468	1329	ns
Visiting DOTS		117/150	211/214	ns
Pulmonary TB, n		67	72	ns
Per 100,000 people		6.7	8.2	
Age, n (%)	0-19 years	0 (0.0)	1 (1.4)	ns
	20-49 years	12 (17.9)	14 (19/4)	ns
	50-69 years	17 (25.4)	16 (22.2)	ns
	≥ 70 years	38 (56.7)	41 (56.9)	ns
Extra pulmonary TB, n		10	12	ns
Per 100,000 people		1	1.5	
Age, n (%)	0-19 years	0 (0.0)	0 (0)	ns
	20-49 years	1 (10.0)	1 (8.3)	ns
	50-69 years	3 (30.0)	3 (25.0)	ns
	≥ 70 years	6 (60.0)	8 (56.9)	ns
LTBI, n		18	40	p=0.001
Per 100,000 people		1.8	4.6	
Age, n (%)	0-19 years	3 (16.7)	4 (10.0)	ns
	20-49 years	9 (50.0)	7 (17.5)	ns
	50-69 years	6 (33.4)	10 (25.0)	ns
	≥ 70 years	0 (0.0)	19 (47.5)	p=0.004

DOTS: Direct Observed Treatment Short-course; LTBI: Latent Tuberculosis Infection; ns: Non-Significant; TB: Tuberculosis.

Table 2: Characteristics of tuberculosis patients in the coastal region of Northern Miyagi.

The prevalence of total TB, pulmonary TB, extrapulmonary TB and LTBI was 9.6, 6.7, 1.0 and 1.8/100,000people before the disaster (2009-2010) [1]. The prevalence of total TB, pulmonary TB, extrapulmonary TB and LTBI was 9.6, 6.7, 1.0 and 1.8/100,000 people before the disaster (2009-2010). In our study, we found that the number of patients with pulmonary TB (pre-disaster *vs.* post disaster: 6.7 *vs.* 8.2 per 100,000 people) and extra pulmonary TB (1.0 *vs.* 1.5 per 100,000 people) returned to the pre-disaster stage (Table 2).

However, the total number of case of TB (9.6 *vs.* 13.6 per 100,000 people, p<0.001), and LTBI (1.8 *vs.* 4.6 per 100,000 people, p=0.001) did not returned to the pre-disaster stage (Table 2).

Discussion

Prior to the Great East Japan Earthquake, the prevalence rate of TB in the Miyagi Prefecture was 11.3 per 100,000 people, the fourth lowest in Japan. Immediately after the disaster, it dropped to 9.9 per 100,000 people, and was 8.3 per 100,000 people in the remote period. The prevalence of TB in the Northern coastal region, prior to the disaster was 9.6 per 100,000 people prior to the disaster, rising to 19.3 per 100,000 people immediately thereafter (13.6 per 100,000 peoples in the remote period). Based on these results, the increase in the number of TB cases after the East Japan Great Earthquake can be contributed to an inappropriate situation more likely affecting the refugees of the Northern coastal region [1].

A Cochrane systematic review reported that the clinic-based Direct Observed Treatment, Short-course (DOTS) was no more effective than self-administered treatment [3]. A recently published review focused on the microbiological failure included only five randomized controlled trials (RCTs) and five non-randomized studies [4]. Another systematic review of 75 observational studies reported that in patients with drug-resistant TB, fully implemented DOTS reduced the incidence of treatment default when compared to a partially implemented DOTS or self-administered treatment, while community-based visiting DOTS was associated with a lower rate of treatment default than the clinic-based DOTS [5]. Based on a direct comparison with RCTs, visiting DOTS was at least as effective as clinic-based DOTS in terms of clinical outcomes. This could be due to patients not liking the compulsory allocation to clinic-based DOTS [6]. In this study, the numbers of TB patients who underwent visiting DOTS in the pre-, early and late stage after the disaster were 117/150, 178/209, and, 211/214 respectively. No significant difference was noted between these stages.

Contact investigation systematically evaluates the contacts of a known TB patient and identifies active disease or LTBI, which can be used to increase the rate of case detection [7,8]. After having been exposed to an aerial suspension including *Mycobacterium tuberculosis*, TB develops in some individuals. The risk of the infection depends on the sensitivity or the infectious power of the TB patient, the sustained time of contact, the approach rate [9], and the contact [10]. The onset of TB after initial contact can be <6 weeks or several years later [11]. Investigating it is performed the prevention or contact to detect it in these cases. In this study, the numbers of the contacts per TB patient who required screening were 1,468/34, 1,479/46, and 33/1329 in the pre-stage, an early stage, and the late sage. No significant difference was found between the stages, indicating that the continuous healthy activities after the East Japan Great Earthquake resulted in a stable incidence of TB.

Defining the access to healthcare services (which includes several parameters such as care and service quality, geographical accessibility, adaptability of available services, as well as financial constraints of patients and medical systems) is difficult. Geographical accessibility is a critical barrier among individuals accessing healthcare facilities and is a key factor to consider as programs expand to TB services.

Two studies have suggested that both financial and non-financial barriers were associated with low adherence rates, including the relative poverty of LTBI patients [12] and work conflicts, which posed challenges for attending clinical appointments. Travel time to and from the clinic represented time absent from work, resulting in patients missing appointments and abandoning treatment [13]. A lack of the transportation means to the medical office was an important patient-based barrier l [13].

In 2015, the Sanriku expressway was expanded from two lanes (before the earthquake) to four lanes. As a result, the traffic volume increased by 20%, and access to the medical institution became easier [14]. Operation of the Senseki Tohoku Line which had not existed before the earthquake started in 2015, and the number of passengers at the Ishinomaki Station increased from 2,000 to 3,000 [15]. These improvements in transportation likely increased the opportunities for medical consultation and thereby, contributed to the decrease in the incidence of TB, following the disaster.

According to the 2016 report by the Japanese anti-TB Association, the prevalence of all Miyagi was below the national level [16]. In the coastal area of Miyagi, the prevalences of total TB and LTBI were significantly higher after than before the disaster. In conclusion, in-depth monitoring is necessary revert to the TB prevalence that was seen before the disaster in the coastal area of North Miyagi.

Disclosure

The authors declare that there are no conflicts of interest.

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