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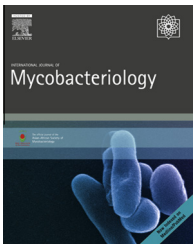

Impact of industrial structure and soil exposure on the regional variations in pulmonary nontuberculous mycobacterial disease prevalence

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ABSTRACT

Objective/background: The prevalence of pulmonary nontuberculous mycobacterial (pNTM) disease, including *Mycobacterium avium* complex (MAC), varies widely according to geographic region. However, the factors that influence regional variations in pNTM disease prevalence remain unknown. This study was undertaken to examine whether environmental or occupational factors or host traits could influence regional variations in pNTM disease prevalence.

Methods: We collected laboratory data on pulmonary tuberculosis (pTB) and pNTM from two hospitals in the West Harima area of Japan and five hospitals in Kyoto City, Japan from 2012 to 2013. We estimated microbiological pNTM disease prevalence by multiplying all pTB cases in each area with the ratio of pNTM cases and pTB cases at the survey hospitals in each area. We administered a standardized questionnaire to 52 patients and 120 patients with pulmonary MAC (pMAC) disease at Ako City Hospital and Kyoto University Hospital, respectively.

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Results: The estimated prevalence of microbiological pNTM disease in the West Harima area (85.4/100,000 population-years) was significantly higher than that observed in Kyoto City (23.6/100,000 population-years; $p < .001$). According to multiple logistic regression analysis, in Ako City Hospital, primary (activities directly related to natural resources) and secondary industries (construction, mining, and manufacturing primary industry produce; odds ratio [OR] = 4.79; 95% confidence interval [CI] = 1.49 – 14.0; $p = .007$) and soil exposure (OR = 13.6; 95% CI = 4.94 – 45.26; $p < .001$) were associated with pMAC disease.
Conclusion: Environmental factors, both industrial structures associated with occupational dust and environmental soil exposure, could influence the regional variations in pNTM disease prevalence.

Introduction

Pulmonary nontuberculous mycobacterial (pNTM) disease is recognized because of its increasing prevalence, particularly in developed countries [1]. Recently, in Japan, Morimoto et al. [2] estimated pNTM disease prevalence to be 33–65/100,000 population-years.

NTM species, including *Mycobacterium avium* complex (MAC), are broadly observed in the environment, particularly in aerosols generated from colonized soil and water [3]. Therefore, the risk of acquiring pNTM disease is associated with environmental factors, including climate and soil characteristics and the engagement in aerosol-generating occupations (e.g., agriculture and construction works) and other activities [4–12]. Furthermore, the risk of acquiring pNTM disease is also associated with host factors (e.g., racial differences, female gender, advanced age, skeletal abnormalities, underlying diseases, and the use of inhaled corticosteroid and immunomodulatory drugs) [13–16].

pNTM disease prevalence varies widely according to the geographic region. Some reports showed that the regional variations in pNTM disease prevalence were correlated with host factors, both race and income, while others revealed that they were associated with environmental factors, both climate and soil characteristics. Therefore, whether environmental or host factors can influence the regional variations in pNTM disease prevalence remains unknown [17–21]. Furthermore, the effects of other host (e.g., underlying diseases and medications) and environmental factors (e.g., occupations and frequency of exposure to soil and water) on regional variations in pNTM disease prevalence have not been investigated.

In this study, we first examined pNTM disease prevalence in the West Harima area (rural area with a small population) and Kyoto City (urban area with a large population) in Japan. Here, we estimated pNTM disease prevalence in each area by the correction with numbers of pulmonary tuberculosis (pTB) patients according to previous reports [22,23]. Next, using clinical data and a questionnaire, we examined whether environmental and host factors could influence the regional variations in pNTM disease prevalence.

Materials and methods

Study area

The population of West Harima area, including Ako city, Aioi City, and Ako County, was 96,489 in 2012 and 95,527 in 2013. The population in Kyoto City was 1,473,069 in 2012 and 1,470,730 in 2013. The West Harima area has a Seto Inland Sea climate, which is observed around the region of the Seto Inland Sea, and a mild and sunny climate characterized by low rainfall in August. The annual precipitation, mean humidity, and mean maximal and minimal temperatures in the West Harima area are approximately 1200 mm, 71%, 20.2 °C, and 10.8 °C, respectively. Kyoto City has both a Seto Inland Sea climate and inland climate, as typified by a hot summer and cold winter. The annual precipitation, mean humidity, and mean maximal and minimal temperatures of Kyoto City are approximately 1500 mm, 71%, 20.8 °C, and 11.7 °C, respectively.

Industrial structure

We divided the industrial structure into three categories based on the national census as follows: primary industry (activities directly related to natural resources, e.g., agriculture, forestry, and fishery); secondary industry (construction, mining, and manufacturing industry product); and tertiary industry (services) [24]. The results of a national census taken in 2010 revealed that in the West Harima area, 2.1%, 34.6%, and 63.3% of the population was engaged in primary, secondary, and tertiary industries as compared to 0.9%, 21.7%, and 77.5%, respectively, in Kyoto City [24].

Data collection

We collected microbiological data for all culture-positive acid-fast bacilli to examine the numbers of patients with pNTM disease who met the American Thoracic Society microbiological criteria (microbiological pNTM disease) [25] from two local hospitals [Ako City Hospital (396 beds) and Ako Central Hospital (265 beds)] in the West Harima area and five medical