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RESEARCH

Trends in Pulmonary and Respiratory Medicine

Survey on the Awareness of Nontuberculous Mycobacterial Pulmonary Disease in the Japanese General Public

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Abstract

Background: *In Japan, people are typically aware of tuberculosis (TB) as a respiratory infection, but awareness of nontuberculous mycobacteriosis is lacking. In 2014, the estimated incidence of nontuberculous mycobacterial pulmonary disease (NTM-PD) in Japan exceeded that of TB. Furthermore, the risk of infection is increasing because of the lack of public awareness regarding the high incidence of NTM-PD. The purpose of this study was to determine and raise the public awareness of NTM-PD, chronic obstructive pulmonary disease (COPD), and pulmonary rehabilitation (PR) in Japan.*

Methods: *A questionnaire survey was administered to 845 subjects who participated in and consented to a pulmonary age measurement event in Tokyo, Japan. The questions included items related to age, sex, smoking history, previous lung age measurement experience, and assessment of awareness of respiratory diseases such as NTM-PD and COPD, and PR awareness.*

Results: *Awareness of NTM-PD was significantly lower (5.9%) than that of other diseases and independently of age. Of the subjects questioned, 10.3% had experienced PR and 18.6% were aware about PR. Those individuals who were aware of lung age measurement, PR, and other respiratory diseases were more likely to be aware of NTM-PD than those who were unaware.*

Conclusions: *The general public is largely unaware of NTM-PD, regardless of age. In the future, more proactive educational activities targeting a wide range of age groups through different events such as lung age measurement are needed.*

keywords: *NTM-PD, pulmonary rehabilitation, awareness, lung age measurement event*

Abbreviations: *COPD: Chronic Obstructive Pulmonary Disease, TB: Tuberculosis, BA: Bronchial Asthma, IP: Interstitial Pneumonia, PR: Pulmonary Rehabilitation*

Introduction

Tuberculosis (TB) is a respiratory infection that is known to most Japanese people, but awareness of nontuberculous mycobacteriosis is lacking. The causative agents of nontuberculous mycobacteria (NTM) belong to the Mycobacterium genus, which includes Mycobacterium tuberculosis and M. leprae; more than 190 NTM species have been identified [1,2]. The incidence and mortality of NTM are increasing worldwide, and the treatment duration for NTM is lengthy. NTM typically occurs in the tropics where approximately 40% of the world's population lives. Furthermore, owing to expansion of the tropical landmass attributed to global warming, NTM-infected areas are expanding [3].

A study in Germany reported that NTM pulmonary disease (NTM-PD) is responsible for a high mortality rate and a huge medical burden [4]. An epidemiological study in Japan in 2014 showed that the incidence of new NTM-PD was approximately 14.7 per 100,000 people, being 2.6 times higher than the reported incidence in 2007 [5]. Furthermore, incidence of NTM-PD was higher than that of tuberculosis in 2014 [6]. Nevertheless, the increasing risk of infection can be attributed to the lack of public awareness related to NTM-PD.

NTM diseases are widely found in water systems and soil in the natural environment, in the bodies of animals used as livestock, and in water supply systems, such as water storage tanks. The disease is considered to be transmitted by breathing in airborne NTM, mainly in bathrooms and in soil handling operations [2].

Diseases caused by NTM manifest systemically, with pulmonary infection being the most common [3,7]. NTM-PD is a chronic, slowly progressive disease, presenting with cavitary lesions/nodules and bronchiectasis. NTM is increasingly antibiotic resistant and has recently dispersed internationally through human-to-human contact [8].

Understanding NTMs may help prevent infection. The 2020 clinical practice guidelines for the treatment of NTM-PD, developed jointly by the American Thoracic Society (ATS), the European Respiratory Society (ERS), the European Society for Clinical Microbiology and Infectious Diseases (ESCMID), and the Infectious Diseases Society of America (IDSA), recommend early initiation of treatment for patients who meet the diagnostic criteria [1]. For pulmonary rehabilitation (PR) from bronchiectasis, one of the main comorbidities of NTM-PD, the ERS guidelines state that adults with motor dysfunction should participate in a PR program

and have regular monitored exercise, depending on the patient's symptoms, physical ability, and disease characteristics [9]. However, there are few reports on the effects of PR on NTM-PD.

Smoking is the main cause of COPD, which occurs in 15%–20% of smokers. Inhalation of cigarette smoke causes the inflammation of the bronchi and the destruction of the alveoli. In Japan, approximately 8.5% of the population over 40 years of age suffer from COPD. However, a majority of COPD patients are undiagnosed and untreated. The Global Initiative for Chronic Obstructive Lung Disease (GOLD) Japan Committee has been conducting awareness campaigns since 2002 to promote the early detection and treatment of COPD [10]. The Ministry of Health, Labour, and Welfare (MHLW) set a goal of increasing COPD awareness to 80% by 2022 and is working to prevent COPD via the Health Japan 21 (a basic policy for the comprehensive promotion of health) [11]. Although Japanese COPD guidelines recommend regular use of long-acting bronchodilators and PR for moderate to severe COPD, few patients used to undergo PR [12].

The lung age measurement event is one of the COPD awareness projects, which employs the concept of lung age. This concept was created and widely disseminated by the Lung Age Promotion Secretariat under Pulmonary Physiology Specialist Committee of the Japanese Respiratory Society in 2006–2007 [13]. Notifying people of their lung age effectively motivates them to quit smoking [14]. Moreover, physical assessment of lung function raises awareness and motivates people to correct their smoking habits [15]. In the present study, we decided to investigate the awareness of NTM-PD, tuberculosis (TB), bronchial asthma (BA), interstitial pneumonia (IP), and PR by adding survey items to the COPD-related questionnaires administered by the lung age measurement event.

The aim of this study was to determine the awareness of COPD, PR, and NTM-PD. Increasing public awareness and understanding of these diseases may prevent NTM-PD and COPD and increase the adoption of PR.

Subjects and methods

Study approval

The present study was approved by the Fukujuji Hospital Institutional Review Board on October 21, 2020 (approval number: 20039).

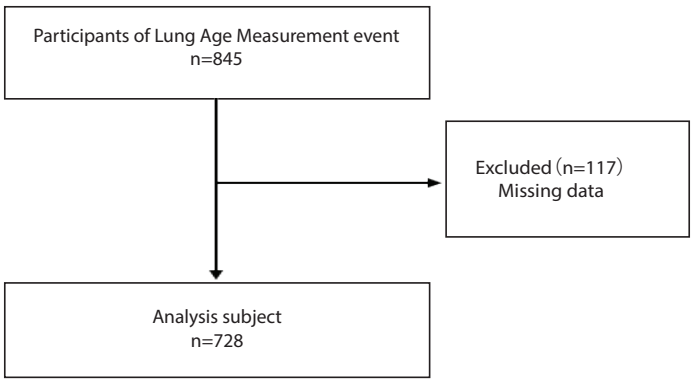

Figure 1. *Flow chart for subject selection*

Gender	Male
	Female
Smoking history	Current smoking
	Ex smoking
	No
Smoking years	<1year
	<5years
	<10years
	10years
Do you know COPD?	Known
	Have heard before
	Don't know
Symptom	Chronic cough excluding colds
	Sputum often comes out
	Short of breath
Experience with lung age measurement	Yes
	No
Awareness of pulmonary rehabilitation	Known
	Have heard before
	Don't know
Mark any illnesses you know	Tuberculosis
	Bronchial asthma
	Interstitial pneumonia
	Nontuberculous mycobacteria pulmonary disease

COPD= Chronic Occlusive Pulmonary Disease

Figure 2. *Questionnaire contents*

Study design

Booths for lung age measurements were set up at events held in Tokyo, Japan, in 2019. Individuals were excluded from the study if lung function could not be measured or the individual was unable to complete the questionnaire. Of the 845 people surveyed, 728 participants were included in the study and gave their consent (Figure 1). The subjects were informed orally about the study in accordance with the Declaration of Helsinki and their responses to the questionnaire were considered consent to participate in the study.

Clinical course

The content of the questionnaire is shown in figure 2. Five diseases were selected for the awareness survey. In addition to COPD and NTM-PD, three diseases were selected for comparison (TB, BA, and IP). Participants who responded "known" or "have heard before" to the questions about COPD and PR awareness were categorized as the aware group. Former and current smokers were included in the same group. NTM-PD awareness was compared between the three age groups: 49 years and younger, 50–69 years, and 70 years and older.

Statistical analyses

Statistical analyses were conducted using IBM SPSS Statistics for Windows, Version 25.0 (IBM Corp., Armonk, NY, USA). Comparisons between the two groups were made with Chi-square tests. Stepwise binomial logistic regression analysis was used for the association between NTM-PD awareness and other items, with the level of significance set at less than 5%. Adjusted residuals in the Chi-square test were considered significant if they were greater than or equal to 1.96.

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Results

A comparison of the participants according to sex is shown in table 1. The majority of participants were women (496 participants, 68.1%) and the average age of the participants was 62.8 years. The women had a lung age below their actual age, while the men had a lung age 6.6 years older than their actual age. A significantly higher percentage of men were current smokers (14.7%) compared with women (6.9%). Including past smokers produced similar results; a higher percentage of men were smokers (53.4%) compared with women (17.9%). Disease awareness was highest for BA at 84%, followed by TB at 78.8%, COPD at 51%, IP at 29.9%, and NTM-PD at 5.9%. Women were significantly more aware of COPD, TB, and BA than men. Awareness of PR was low (18.5%) overall, with no intersex differences. An equal percentage of men and women (10.3%) had undergone a lung age measurement experience.

NTM-PD awareness according to the age group is shown in table 2. Awareness of NTM-PD was low at less than 7% for both men and women in all age groups, with an overall rate of 5.9%. No significant differences in awareness among the age groups were observed.

Table 1. *Comparison by gender*

	Male	Female	Total
Participants (n,%)	232(31.9)	496(68.1)	728(100)
Age(years, SD)	61.3(16.1)	63.5(15.0)	62.8(15.4)
Lung age(years, SD)	67.9(21.4)	62.3(20.5)	64.1(20.9)
Smoking history: current smoker (n,%)	34(14.7)*	34(6.9)	68(9.3)
Smoking history: current and ex-smoker (n,%)	124(53.4%)*	89(17.9%)	213(29.2)
Experience of lung age measurement (n,%)	24(10.3)	51(10.3)	75(10.3)
Awareness:			
COPD (n,%)	108(46.6%)	263(53.0%)*	371(51.0)
pulmonary rehabilitation (n,%)	50(21.6)	85(17.1)	135(18.5)
Tuberculosis (n,%)	170(73.3)	404(81.5)*	574(78.8)
Bronchial asthma (n,%)	185(79.7)	427(86.1)*	612(84.1)
Interstitial pneumonia (n,%)	49(21.1)	169(34.1)	218(29.9)
NTM-PD (n,%)	12(5.2%)	31(6.3%)	43(5.9%)

NTM-PD: Nontuberculous mycobacteria pulmonary disease; COPD: Chronic Occlusive Pulmonary Disease; Data are reported as mean, standard deviation or n (%)

* Results were calculated by Chi square test, p<0.05

Table 2. *Age and NTM-PD awareness*

Gender		Female			Male			Total		
		NTM-PD awareness								
Age		Yes	No	p-value	Yes	No	p-value	Yes	No	p-value
49 ≥	n(%)	6(6.7%)	83(93.3%)		2(3.2%)	60(96.8%)		8(5.3%)	143(94.7%)	
	adjusted residuals	0.2	-0.2		-0.8	0.8		-0.4	0.4	
50-69	n(%)	12(6.5%)	174(93.5%)	0.951	4(5.1%)	75(94.9%)	0.652	16(6.0%)	249(94.0%)	0.938
	adjusted residuals	0.1	-0.1		-0.1	0.1		0.1	-0.1	
70 ≤	n(%)	13(5.9%)	208(94.1%)		6(6.6%)	85(93.4%)		19(6.1%)	293(93.9%)	
	adjusted residuals	-0.3	0.3		0.8	-0.8		0.2	-0.2	
	n(%)	31(6.3%)	465(93.8%)		12(5.2%)	220(94.8%)		43(5.9%)	685(94.1%)	

NTM-PD: Nontuberculous mycobacteria pulmonary disease

* Results were calculated by Chi square test, p<0.05

Table 3. *Relationship between experience with lung age measurement, respiratory rehabilitation and NTM-PD*

			NTM-PD awareness		
			Yes	**No**	**p-values**
Experience with lung age measurement	Yes	n(%)	9(12.0%)	66(88.0%)	0.018
		adjusted residuals	2.4	-2.4	
	No	n(%)	34(5.2%)	619(94.8%)	
		adjusted residuals	-2.4	2.4	
Total		n(%)	43(5.9%)	685(94.1%)	
Awareness of pulmonary rehabilitation	Yes	n(%)	16(11.9%)	119(88.1%)	0.001
		adjusted residuals	3.2	-3.2	
	No	n(%)	27(4.6%)	566(95.4%)	
		adjusted residuals	-3.2	3.2	
Total		n(%)	43(5.9%)	685(94.1%)	

NTM-PD: Nontuberculous Mycobacteria Pulmonary Disease
* Results were calculated by Chi square test, p<0.05

Table 4. *Relationship between awareness of other diseases and NTM-PD awareness*

			NTM-PD awareness		
			Yes	No	p-value
COPD awareness	Yes	n (%)	34 (9.2%)	337 (90.8%)	<0.01
		adjusted residuals	3.8	−3.8	
	No	n (%)	9 (2.5%)	348 (97.5%)	
		adjusted residuals	−3.8	3.8	
	Total	n (%)	43 (5.9%)	685 (94.1%)	
TB awareness	Yes	n (%)	42 (7.3%)	532 (92.7%)	0.002
		adjusted residuals	3.1	−3.1	
	No	n (%)	1 (0.6%)	153 (99.4%)	
		adjusted residuals	−3.1	3.1	
	Total	n (%)	43 (5.9%)	685 (94.1%)	
BA awareness	Yes	n (%)	43 (7.0%)	569 (93.0%)	0.003
		adjusted residuals	2.9	−2.9	
	No	n (%)	0 (0%)	116 (100%)	
		adjusted residuals	−2.9	2.9	
	Total	n (%)	43 (5.9%)	685 (94.1%)	
IP awareness	Yes	n (%)	29 (13.3%)	189 (86.7%)	<0.01
		adjusted residuals	5.5	−5.5	
	No	n (%)	14 (2.7%)	496 (97.3%)	
		adjusted residuals	−5.5	5.5	
	Total	n (%)	43 (5.9%)	685 (94.1%)	

NTM-PD: Nontuberculous mycobacteria pulmonary disease; COPD: Chronic Occlusive Pulmonary Disease; TB: Tuberculosis; BA: Bronchial asthma; IP=Interstitial pneumonia; * Results were calculated by Chi-square test, p<0.05

Table 5. *Logistic regression analysis of the relationship between NTM-PD and other items*

Variables	Odds ratio	95%CI		p-value
COPD awareness	2.695	1.231	5.902	0.013
IP awareness	3.28	1.396	5.873	0.001

NTM-PD: Nontuberculous mycobacteria pulmonary disease; COPD: Chronic Occlusive Pulmonary Disease; IP: Interstitial pneumonia; 95% CI: 95% Confidence Interval; *Results were calculated by stepwise binomial logistic regression analysis, p<0.05; Hosmer & Lemeshow test p=1.000

Lung age measurement experience was significantly associated with the awareness of NTM-PD (p=0.018), and sex-related association was not observed. NTM-PD awareness was significantly higher in people who were aware of PR (p=0.001) (Table 3). The association between NTM-PD awareness and COPD, TB, BA, and IP was investigated. NTM-PD awareness was also significantly associated with awareness of COPD, TB, BA, or IP (Table 4). A stepwise binomial logistic regression analysis was performed for NTM-PD awareness, PR awareness, lung age measurement experience, and four other diseases (Table 5). In addition, COPD, BA, and IP were associated with NTM-PD awareness, with IP showing the strongest association (odds ratio, 3.28, p<0.01).

Discussion

A questionnaire survey was conducted at a lung age measurement event held in Tokyo, Japan, to determine the general public's awareness of NTM-PD and other diseases, as well as PR. The results of the survey showed that approximately 95% of the public were unaware of NTM-PD. Although the awareness of COPD did not reach the Japanese target of ≥80% [11], 51% of the respondents had heard of it or were aware of COPD. People may be more aware of COPD than NTM-PD because COPD awareness campaigns began in 2002. Since then, there have been many opportunities for people in all age groups to see and hear about COPD through the dissemination of information on websites and video streaming services [16]. PR awareness among the general public was low (18.5%), which may contribute to delayed rehabilitative interventions, not only for NTM-PD but also for respiratory diseases in general.

NTM-PD takes a long time to diagnose and treat and incurs a significant treatment burden and economic loss [7]. Although antibiotic treatment is the mainstay intervention, drug selection and other treatment strategies are still inconsistent [1]. The importance of PR was emphasized in a 2013 ATS/ERS statement [17]. In addition, recent publications indicate that PR is effective against NTM-PD [18]. Raising awareness of PR and NTM-PD may facilitate early PR interventions to improve disease control and reduce the burden of treatment for patients.

The average of smokers is more in male than in female. The percentage of male smokers (14.6%) was lower than the male smoking rate of 26.9% in 2018 reported by MHLW [19]. Thus, concerns related to male's health are improving. However, the number of female participants was more than twice as high as male participants, and a higher number of women were aware of COPD, TB, and BA, suggesting that men still have lower health awareness than women.

The association found between NTM-PD and awareness of other diseases may be due to exposure to information about respiratory diseases through the general media and participation at health events. Ten percent of all participants had previous lung age measurement experience and the association between previous lung age measurement experience and NTM-PD was confirmed. Participants with previous lung age measurement experience may have been more health conscious and had more opportunities to obtain information about NTM-PD. Considering that awareness of NTM-PD was low in all age groups, we believe that providing the general public with information on NTM-PD, not only at lung age measurement events but also at events targeting all age groups, is important for raising awareness of NTM-PD.

The awareness of COPD in this study was higher than the 2019 internet awareness survey (27.8%) conducted by the GOLD Japan Committee. This result may be limited by the subjects being all participants in a lung age measurement event and had a high level of health awareness. Those respondents could choose two options for the other four diseases, compared with three options for COPD awareness, may have influenced the results. If the other four diseases had a choice of "have heard before," the results for NTM-PD and IP, for which awareness was low in the survey, might have been different. This survey was limited to investigating the awareness of NTM-PD and PR, and no detailed explanations were given in the actual field. Thus, the survey did not increase awareness. We believe it is necessary to go beyond awareness surveys to provide detailed explanations of NTM-PD and increase the opportunities to raise awareness in the general public.

Conclusions

The survey revealed that awareness of NTM-PD is very low compared with other respiratory diseases, such as COPD and TB. Because the prevalence of NTM-PD is increasing year by year and the medical burden of NTM-PD is high, more active awareness-raising activities should be conducted in the future. Targeting a wide range of age groups through the media and events, such as the lung age measurement events, is needed.

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