Allergology International. 2009;58:383-388
DOI: 10.2332/allergolint.08-OA-0050

ORIGINAL ARTICLE

Two Thirds of Forest Walkers with Japanese Cedar Pollinosis Visit Forests even During the Pollen Season

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ABSTRACT

Background: The most common type of pollinosis in Japan is Japanese cedar pollinosis (JCP). While forest walking is a common form of recreation for Japanese people, it has been unclear whether forest walkers with JCP still choose to visit forested areas during the pollen season or whether they avoid those areas, and as such, the aim of this study was to investigate this question.

Methods: The study participants were all healthy men and women volunteers aged 20 years or over who visited the Tokyo University Forest in Chiba during 4 different days. The survey was conducted using self-administered questionnaires.

Results: The number of available responses was 498. Of these, 112 participants who experienced JCP were included in the analysis. Seventy-three participants (65.2%) responded that they visit forests even during the pollen season. The association between forest walking choices during the pollen season and self-rated levels of pollinosis symptoms was not statistically significant (Cramer's V = 0.13, $p = 0.47$). As many as 60% of the participants who reported serious symptom levels responded that they visit forested areas even during the pollen season.

Conclusions: These results revealed that two thirds of forest walkers who had experienced JCP visited forests even during the pollen season. This indicates the further need for public service announcements informing people with JCP that the risk of pollen exposure and subsequent JCP reaction is increased by visiting forested areas during the pollen season.

KEY WORDS

forest walking, Japanese cedar pollinosis, pollen season, recreation activity, shinrin-yoku

INTRODUCTION

A natural environment is recognized as bolstering good health in humans. For example, there is a long tradition of health resort programs in European countries and Japan, with a natural environment recognized as relevant to such facilities.[1] However, when people visit a natural environment during the pollen season, it is quite likely that they will encounter allergens such as pollen.

In Japan, forest walking ("shinrin-yoku") is a popular recreational activity. According to a public opinion poll conducted by the Cabinet Office of the Government of Japan in 2007, 36.2% of respondents had participated in forest walking ("shinrin-yoku") for recreation and both mental and physical benefits within the preceding year.[2] Recent studies have revealed the preferable physiological and psychological effects of

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Received 1 October 2008. Accepted for publication 24 February 2009.
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forest walking.[3-5] However, approximately 10–20% of Japanese adults suffer from Japanese cedar pollinosis (JCP), the most common type of pollinosis in Japan.[6-8] Forests cover 68.2% of the land in Japan, and forests of mainly Japanese cedar occupy 12% of the country.[9,10] As such, it is quite likely for people to encounter Japanese cedar trees when visiting forested areas. It is recommended that patients with JCP avoid exposure to pollen during the pollen season.[11]

Contradictorily, people are recommended to avoid exposure to pollen during the pollen season, but forest walking is still an encouraged activity, and so far this has not been clearly reversed.[11] Before now, it has been unclear whether forest walkers who are susceptible to JCP still choose to visit forested areas during the pollen season or whether they avoid those areas, and as such, the aim of this study was to investigate this question.

METHODS

The study participants were healthy male and female volunteers aged 20 years and over who visited the Tokyo University Forest in Chiba while it was opened to the public over 4 different days in November and December, 2004, and who agreed to participate in the study. The forest is located deep in a mountainous area in the middle of Honshu, the main island of Japan. The forest covers a total area of 2200 hectares and consists of natural conifers, natural broadleaf trees, a planted Japanese cedar forest of 500 hectares, and a planted Japanese cypress forest of 250 hectares.[12]

The survey was conducted using self-administered questionnaires. The participants were required to answer questions regarding whether they suffer from JCP ("yes" or "no"), their usual frequency of visits to forested areas, and the presence of one or more companions ("none" or "yes"). If the respondents indicated that they experienced JCP, they were also required to indicate their self-rated level of symptoms ("serious," "moderate," or "slight"), and their choice whether to visit forests during the pollen season ("visit forested areas even during the pollen season," "avoid visiting forested areas during the pollen season," or "rarely visit forested areas"). First, the age, gender, and usual frequency of visits to forested areas were compared between the participants without JCP and the participants with JCP, using a Student's t-test and a Chi-squared test. Only the participants who responded that they had experienced JCP were included in the subsequent analysis. The Chi-squared test was used to evaluate any relevance between self-rated levels of symptoms and gender, and to evaluate relevance between self-rated levels of symptoms and age group. Cramer's V coefficient was used to evaluate the relevance between the participants' forest walking choices during the pollen season and their usual frequency of visits to forested areas, and to evaluate the relevance between their forest walking choices during the pollen season and participants' self-rated levels of symptoms. A Chi-squared test was used to evaluate the relevance between forest walking choices during the pollen season and gender, to evaluate the relevance between forest walking choices during the pollen season and age groups (20–39 years, 40–59 years, and 60+ years), and to evaluate the relevance between forest walking choices during the pollen season and the presence of one or more walking companions on the survey day. SPSS 14.0J for Windows was used for statistical analyses. Significance level was set at 5%.

The Ethics Committee of Kyoto University approved the study protocol.

RESULTS

A total of 541 people agreed to participate in the survey. The number of available responses was 498. Of these, 112 participants had experienced JCP (22.5% of the available responses; 55 men and 57 women; mean age ± SD: 54.6 ± 9.9 years). Nine participants did not provide information related to their experience of JCP. The remaining 377 participants had not experienced JCP (187 men and 190 women; mean age ± SD: 56.7 ± 10.8 years). The characteristics of the participants are presented in Table 1. There were no statistical differences in the age and ratio of gender between the participants with JCP and the participants without JCP. There was also no statistical difference in the usual frequency of visits to forested areas between the participants without JCP and the participants with JCP. The 112 participants with JCP were included in the subsequent analysis. Among the 112 included participants, 35 (31.3%) indicated "serious" as their self-rated level of symptoms, 49 (43.8%) responded "moderate" and 28 participants (25.0%) responded "slight." Associations between self-rated levels of symptoms and gender, and between self-rated levels of symptoms and age group are presented in Table 2. Neither were significant.

Seventy-three participants (65.2%) responded that they visit forested areas even during the pollen season, while 32 participants (28.6%) stated that they avoid visiting forested areas during the pollen season. Seven participants (6.2%) responded that they rarely visited forests. As shown in Table 3, the association between people's forest walking choices during the pollen season and their frequency of visits to forested areas was statistically significant at a middle level (Cramer's V = 0.35, $p < 0.001$). The higher the usual frequency of visits to forested areas, the higher the rate of visiting forested areas even during the pollen season. To further explore factors that may affect the decision of visiting forested areas by regular forest-walkers with JCP, we examined, using a Chi-squared test, several properties of participants who visit forested areas once a month or more ($n = 47$) in associa-

Table 1 Characteristics of participants with and without Japanese cedar pollinosis (JCP)

	With JCP	Without JCP	Statistical test	
Mean age (years)	54.6±9.9	56.7±10.8	t (486) = 1.8, p = 0.07	b
Total (n)	112 (100.0%)	377 (100.0%)	χ^2 = 0.008, df = 1, p = 0.9	a
Male	55 (49.1%)	187 (49.6%)		
Female	57 (50.9%)	190 (50.4%)		
Frequency of visits to forested areas (n)				
More than once a month	27 (24.1%)	85 (22.5%)	χ^2 = 2.8, df = 3, p = 0.4	a
Once a month	20 (17.9%)	80 (21.2%)		
Several per year	43 (38.4%)	151 (40.1%)		
Once a year or less	22 (19.6%)	58 (15.4%)		

a: Chi-squared test; b: Student's t-test.

Table 2 Association between self-rated level of symptoms and sex, and between self-rated level of symptoms and age

		Serious		Moderate		Slight		Total		Chi-squared test
		n	%	n	%	n	%	n	%	
Sex	Male	18	32.7	24	43.6	13	23.6	55	100	P = 0.9
	Female	17	29.8	25	43.9	15	26.3	57	100	χ^2 = 0.2, df = 2
Age (years)	20−39	3	27.3	6	54.5	2	18.2	11	100	P = 0.7
	40−59	21	35.6	25	42.4	13	22.0	59	100	χ^2 = 2.1, df = 4
	60 +	11	26.2	18	42.9	13	31.0	42	100	

tion with their forest walking choices during the pollen season. However, we could not find a statistically significant association for the factors including gender, age, job, self-rated level of symptoms, health practices (smoking, drinking alcohol, breakfast habits, and exercise), self-rated overall health condition, and perceived mental stress (data not shown).

Next, the association between people's forest walking choices during the pollen season and their self-rated level of symptoms is presented in Table 3; the association was weak and statistically non-significant (Cramer's V = 0.13, p = 0.47). Even in the subgroup who reported a serious level of symptoms, as many as 60% of the participants responded that they visit forested areas even during the pollen season. The association between forest walking choices during the pollen season and their gender was not statistically significant (χ^2 = 1.6, df = 2, p = 0.5), although 70.9% (n = 39) of men and 59.6% (n = 34) of women responded that they visit forested areas even during the pollen season. The association between people's age and their forest walking choices during the pollen season is shown in Table 3. Fifty-four point five percent (n = 6) of the participants aged 20 to 39 years, 62.7% (n = 37) of those aged 40 to 59 years, and 71.4% (n = 30) of those aged 60+ years responded that they visit forested areas even during the pollen season. The higher their age, the higher was their rate of visiting forested areas even during the pollen season. However, there was no statistical difference between people's forest walking choices during the pollen season and their age (3 groups) (χ^2 = 3.4, df = 4, p = 0.6). A total of 84.6% (n = 11) of the participants who came to the forest alone on the survey day responded that they visit forested areas even during the pollen season, while 62.6% (n = 62) of the participants who came to the forest with one or more walking companions on the survey day responded that they visit forested areas even during the pollen season. However there was no statistical difference between people's forest walking choices during the pollen season and the presence of one or more walking companions (χ^2 = 2.7, df = 2, p = 0.3).

DISCUSSION

The forested area where the survey took place in this study occupies 31% of Chiba Prefecture. The Japanese cedar area occupies approximately 30% of this forested area.[13] Japanese cypress pollen is also released in the spring, following the dispersion of Japanese cedar pollen, which is mainly from February to April. The peak season for Japanese cedar pollen in the Chiba area is March. An example of the prevalence of cedar pollen in Japan is that the Japan Ministry of the Environment noted that in March 2005, in Chiba Prefecture, the average total concentration of Japanese cedar pollen and Japanese cypress pollen at three residential area survey points during one hour was 64.8–137.2 grains/m^3 monitored with real-time pollen monitors.[14,15] However, the same monitoring at two mountain area survey points were 234.3 grains/m^3 and 534.1 grains/m^3, respectively.[16] These figures indicate that Japanese cedar pollen tends to be scattered more in mountain areas than in towns.

Table 3 Association between forest walking choices during the pollen season and frequency of visits to forested areas, self-rated levels of pollinosis symptoms, and age, respectively

			Forest walking choices during the pollen season				
			Visit forests	Avoid visiting forests	Rarely ever visit forests	Total	Statistical Test
Frequency of visits to forested areas	More than once a month	*n*	23	4	0	27	Cramer's
		%	85.2	14.8	0.0	100.0	V = 0.35
	Once a month	*n*	14	6	0	20	$P < 0.001$
		%	70.0	30.0	0.0	100.0	
	Several per year	*n*	29	13	1	43	
		%	67.4	30.2	2.3	100.0	
	Once a year or less	*n*	7	9	6	22	
		%	31.8	40.9	27.3	100.0	
	Total	*n*	73	32	7	112	
		%	65.2	28.6	6.3	100.0	
Self-rated symptoms	Serious	*n*	21	13	1	35	Cramer's
		%	60.0	37.1	2.9	100.0	V = 0.13
	Moderate	*n*	31	14	4	49	$P = 0.47$
		%	63.3	28.6	8.2	100.0	
	Slight	*n*	21	5	2	28	
		%	75.0	17.9	7.1	100.0	
	Total	*n*	73	32	7	112	
		%	65.2	28.6	6.3	100.0	
Age (years)	20–39	*n*	6	4	1	11	$\chi^2 = 3.4$
		%	54.5	36.4	9.1	100.0	df = 4
	40–59	*n*	37	17	5	59	$P = 0.6$
		%	62.7	28.8	8.5	100.0	
	60 +	*n*	30	11	1	42	
		%	71.4	26.2	2.4	100.0	
	Total	*n*	73	32	7	112	
		%	65.2	28.6	6.3	100.0	

Nevertheless, this present survey shows that as many as two thirds of forest walkers who are susceptible to JCP choose to visit forested areas even during the pollen season. The most significant factor was the usual frequency of visits to forested areas. More than 85% of heavy forest walkers, those who go to forested areas more than once a month (n = 23), responded that they visit forested areas during the pollen season. Since it may be a lifestyle choice for heavy forest walkers to visit forested areas as they feel particular enjoyment when doing so, it might be difficult to effectively discourage them from visiting forested areas during the pollen season. They might choose the pleasant feelings from visiting forested areas over the discomfort of JCP. However, forest walkers who frequently visit forested areas during the pollen season will occupy the highest risk groups for these pollinosis symptoms because of the greater chance of exposure to Japanese cedar pollen in forested areas.

The rate of visiting forested areas during the pollen season was higher (although not significant) among the participants aged 60+ years, male participants, participants who visited the forest alone, and participants who had only slight symptoms. The participants with slight symptoms may visit forested areas more often because their discomfort is not high. However, the association between people's forest walking choices during the pollen season and their self-rated level of symptoms is weak; in the serious-symptom subgroup, as many as 60% of the participants responded that they visit forested areas even during the pollen season.

Considering these results, since visiting forested areas increases the risk of exposure to Japanese cedar pollen, we recommend further clarification through public announcements of the risk of increasing one's exposure to the allergenic pollen by visiting forested areas during the pollen season. This information should be aimed at forest walkers with JCP, especially those who are heavy forest walkers. The content of the announcements should contain the following information: Forest walkers who experience JCP should not go into forested areas during the pollen season. Instead they should choose specific for-

ested areas that are far away from Japanese cedar pollen sources, or if they choose to visit forested areas that contain Japanese cedar pollen, they should use special protective equipment.

There are Japanese cedar trees in the University Forest, but the survey was conducted in late autumn, outside the pollen season. Therefore, at the time of the survey, participants were not afflicted with JCP. Because this survey was conducted at the Tokyo University Forest, which is not easily accessible by public transportation, we regarded the survey participants as particularly enthusiastic forest walkers. Therefore, the participants may not be representative of the general population. Furthermore, the participants, with a mean age in the fifth decade, were older than the general population. There is a possibility that the results in this study would be different from that in a younger or more general population with pollinosis.

This study has some limitations. First, the sample size was not very large, especially for exploring factors that may affect regular forest-walkers' decision of visiting forested areas despite of their JCP. We could not find a significant factor among demographic, lifestyle, job-related, and health-related factors, but this may be due to the insufficient sample size. This issue is important in making further concrete recommendations to regular forest-walkers, and needs to be addressed by future studies with a larger number of subjects. Second, the participants' level of pollinosis symptoms was self-rated and approximate, as opposed to a diagnosis by medical doctors or standardized estimations. As such, there may be a problem with the reliability and validity of the reported levels of pollinosis symptoms. Third, pollinosis can be considerably controlled using strong medications that have been recently developed, such as nose drops with corticosteroids. Some of the participants in this survey may have used such medications during the pollen season. With the result of being free from pollinosis symptoms, such people's forest walking choices during the pollen season may be affected. However, this survey did not collect any information regarding the treatment of pollinosis. Fourth, this study did not ask why patients with JCP choose to visit forested areas even during the pollen season. It is presumed that they might focus more on the pleasant feeling or well-being that comes from walking in forested areas over the uncomfortable symptoms of pollinosis. Or they might not recognize that there is a greater risk of exposure to high concentrations of antigens when visiting forested areas. In future studies with a sufficiently larger sample size, a high variability scale for the level of pollinosis symptoms should be used, and information regarding participants' treatment of pollinosis and their motives for visiting forested areas should be obtained, as these factors require further consideration. The merits or risks of choosing to visit forested areas during the pollen season, as considered by forest walkers with JCP, should also be investigated in future studies.

In conclusion, this study revealed that two thirds of forest walkers who had experienced JCP choose to visit forested areas even during the pollen season. This was despite the recommendation that those susceptible to JCP avoid exposure to pollen. This indicates the further need for public service announcements informing people with JCP, especially those who are heavy forest walkers, that the risk of pollen exposure and subsequent JCP reaction is increased by visiting forested areas during the pollen season.

ACKNOWLEDGEMENTS

The authors would like to thank the staff of the Tokyo University Forest, Chiba, as well as the Forest Instructor Association, Chiba, for their cooperation in collecting data for this study.

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