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Association between exercise habits including exercise partner and allergic rhinitis in a Japanese population

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Abstract

Background: Evidence on the association between physical activity (PA) and allergic rhinitis (AR) remains inconsistent. While the prevalence of AR was high in Japan, no epidemiological study regarding this issue has been conducted.

Objective: This study examined the association between exercise habits including exercise partner and self-reported AR among Japanese young adults.

Methods: This cross-sectional study included 12,497 university students who underwent annual health checkups. Exercise habits were evaluated using a self-administered questionnaire on frequency (none, 1–2/month, 1–3/week, ≥ 4/week), intensity (none, light, moderate, intense), and exercise partner (no exercise, group, friends, alone). AR was defined as responding "Yes" to the question about self-reported AR. Multivariable logistic regression estimated adjusted odds ratios (ORs) and 95% confidence intervals (CIs), controlling for age, sex, body mass index, smoking, and alcohol use.

Results: Of 12,497 participants (mean age 20.1 ± 3.1 years; 60.4% men), the prevalence of AR was 20.0% (n = 2,500). Compared with non-exercisers, high-frequency exercise (≥ 4/week) was independently and inversely associated with AR (adjusted OR = 0.83, 95%CI 0.72–0.96; *p* for trend = 0.008). Inverse associations between intense exercise (adjusted OR = 0.84, 95%CI 0.75–0.95), exercising with groups (adjusted OR = 0.83, 95%CI 0.72–0.94), and AR were also observed.

Conclusions: Among Japanese young adults, frequent and intense exercise, particularly in organized settings, was independently and inversely associated with self-reported AR. These findings provide the first large-scale evidence from Japan suggesting an inverse association between habitual exercise and AR.

Key words: exercise, allergic rhinitis, Japanese population, physical activity, cross-sectional study

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Introduction

Allergic rhinitis (AR) is one of the most common allergic conditions worldwide, affecting approximately 10% to 40% of the general population.[1] Previous reviews have reported that its prevalence ranges from about 9% to 42% globally,[2-4] and more recent studies suggest that it may now vary between 5% and 52%,[5,6] indicating an upward trend over the past decades.

Although several epidemiological studies across different populations have examined the relationship between physical activity (PA) and AR, the evidence regarding this issue remains inconclusive. Most studies conducted in Western countries have generally indicated an inverse association between PA and AR.[7-17] In contrast, studies from Asian countries yielded more heterogeneous findings.[18-25] However, while the prevalence of AR is high in the Japanese population, no epidemiological studies have specifically examined the association between PA and AR in this population. Given the high prevalence of AR and the large number of affected individuals, clarifying the impact of habitual PA on AR is clinically and socially important. By potentially reducing healthcare costs and preventing disease progression, the findings of this study may have substantial public health implications.

Additionally, accumulating evidence suggests that the presence of an exercise partner has an independent and beneficial impact on health status and chronic diseases, including gastrointestinal disorders, and mental health conditions.[26-31] However, the relationship between the presence of exercise partners and allergic diseases remains unclear.

Accordingly, the present study aimed to examine the association between exercise habits, including exercise partners, and AR among Japanese young adults.

Methods

Study population

This cross-sectional study was conducted using data from 12,497 university students who underwent annual health checkups at Ehime University.

Ethics approval and consent to participate

All subjects were provided with the opportunity to opt out, and the study protocol was developed in accordance with the ethical guidelines of the Declaration of Helsinki. This study was approved by the ethics committee of the Ehime University Graduate School of Medicine (approval no. 1610012).

Questionnaire Measurements

Information on age, drinking, and smoking was collected using a self-administered questionnaire. Current smoking was defined as positive if a participant reported smoking at least one cigarette per day. Current drinking was defined as positive if a participant reported a habit of consuming alcoholic beverages. Weight was measured with participants wearing light clothing, and body mass index (BMI) was calculated as weight in kilograms divided by height in meters squared.

Assessment of exercise habits, including presence/absence of exercise partners

A self-administered questionnaire was used to assess exercise habits, including frequency of exercise, main exercise intensity, and exercise partner, as described in detail in the preceding article[29-31] and **Supplementary File 1**: 1) frequency of exercise: none, 1–2 times a month, 1–3 times a week, 4 or more times a week; 2) intensity of main exercise: no exercise, light exercise, moderate exercise, intense exercise; 3) exercise partners: no exercise, group, friends, alone. Exercise habits were assessed based on subjective perception, without using any objective indicators.

Assessment of Allergic Rhinitis

A self-administered questionnaire was used to collect data on AR diagnosed by medical institutions. Participants answered "YES" or "NO" to the question of whether they had been diagnosed with AR.

Statistical Analysis

Participants' exercise habits were categorized across three dimensions. Exercise frequency was grouped into four levels: no exercise (reference group), low (1–2 times per month), moderate (1–3 times per week), and high frequency (4 or more times per week). Exercise intensity was similarly divided into four categories: no exercise (reference), light, moderate, and intense. The context of exercise participation was also classified into four groups: no exercise (reference), with groups, with friends, or alone.

To assess associations between exercise habits and prevalence of AR, logistic regression models were applied. Crude odds ratios (ORs) and corresponding 95% confidence intervals (CIs) were calculated. Multivariable logistic regression analyses were also conducted to adjust for potential confounders identified a priori: age, sex, BMI, current drinking, and current smoking. The trend of the association was assessed using a logistic regression model in which consecutive integers were assigned to the categories of exercise habit variables (frequency and intensity). All statistical analyses were performed using SAS software version 9.4 (SAS Institute Inc., Cary, NC, USA). Statistical significance was determined using two-sided tests, with p-values less than 0.05 considered statistically significant.

Results

Participant characteristics

Table 1 shows the characteristics of the 12,497 study participants. The mean age and BMI were 20.1 ± 3.1 years and 21.37 ± 3.08 kg/m^2, respectively. The proportion of men was 60.4%. The frequencies of smoking and drinking were 5.4% and 10.0%, respectively. The prevalence of AR was 20.0%. The distribution of exercise habits was as follows. Frequency of exercise was none in 31.5%, 1–2 times per month in 29.6%, 1–3 times per week in 24.6%, and 4 or more times per week in 14.2%. Intensity of main exercise was none in 31.5%, light in 17.0%, moderate in 26.0%, and intense in 25.4%. Regarding exercise companionship, 31.5% did not exercise with others, 17.9% exercised in groups, 16.3% with friends, and 34.2% exercised alone.

Association between exercise habits and allergic rhinitis

Table 2 presents the crude and adjusted ORs with 95%CIs for AR according to frequency of exercise, intensity of main exercise, and exercise partners. High exercise frequency was associated with the prevalence of AR (crude OR of 0.86 [95%CI: 0.75–0.995]). After adjustment for confounding factors, inverse association between exercise frequency and AD was still significant (adjusted OR of 0.83 [95%CI: 0.72–0.96], *p* for trend = 0.008). Intense exercise was significantly associated with the prevalence of AR (crude OR: 0.90; 95%CI: 0.80–1.01; adjusted OR: 0.84; 95%CI: 0.75–0.95, *p* for trend = 0.010). Compared with non-exercisers, individuals exercising in organized groups was inversely associated with the prevalence of AR (crude OR: 0.87; 95%CI: 0.76–0.99; adjusted OR: 0.83; 95%CI: 0.72–0.94). Exercising alone or with friends showed no significant associations.

Table 1. Clinical characteristics of 12,497 study participants.

	Total (N = 12,497)
Age, years, mean ± SD	20.1 ± 3.1
Sex (Male/Female)	7546/4951
Body mass index	21.37 ± 3.08
Smoking, %	669 (5.4)
Drinking, %	1253 (10.0)
Allergic rhinitis	2500 (20.0)
Exercise habit, %	
Frequency of exercise habit	
None, %	3940 (31.5)
1–2 times/month, %	3704 (29.6)
1–3 times/week, %	3077 (24.6)
4 or more times/week, %	1776 (14.2)
Intensity of main exercise	
None, %	3940 (31.5)
Light exercise, %	2130 (17.0)
Moderate exercise, %	3248 (26.0)
Intense exercise, %	3179 (25.4)
Exercise with	
None, %	3940 (31.5)
Groups, %	2242 (17.9)
Friends, %	2040 (16.3)
Alone, %	4275 (34.2)

Table 2. Association between exercise habits and allergic rhinitis.

Variable	Prevalence (%)	Crude OR (95%CI)	Adjusted OR (95%CI)
Allergic rhinitis			
Frequency of exercise habit			
High (4 or more times/week), %	323/1,776 (18.2)	0.86 (0.75–0.995)	0.83 (0.72–0.96)
Moderate (1-3 times/week), %	600/3,077 (19.5)	0.94 (0.84–1.06)	0.91 (0.81–1.02)
Low (1-2 times/month), %	770/3,704 (20.8)	1.02 (0.91–1.14)	0.99 (0.89–1.11)
None, %	807/3,940 (20.5)	1.00	1.00
p for trend			0.008
Intensity of main exercise			
Intense exercise, %	598/3,179 (18.8)	0.90 (0.80–1.01)	0.84 (0.75–0.95)
Moderate exercise, %	659/3,248 (20.3)	0.99 (0.88–1.11)	0.96 (0.86–1.08)
Light exercise, %	436/2,130 (20.5)	0.999 (0.88–1.14)	0.99 (0.87–1.13)
None, %	807/3,940 (20.5)	1.00	1.00
p for trend			0.010
Exercise with			
Alone, %	887/4,275 (20.8)	1.02 (0.91–1.13)	0.994 (0.89–1.11)
Groups, %	410/2,242 (18.3)	0.87 (0.76–0.99)	0.83 (0.72–0.94)
Friends, %	396/2,040 (19.4)	0.94 (0.82–1.07)	0.90 (0.79–1.03)
None, %	807/3,940 (20.5)	1.00	1.00

Adjusted for age, sex, body mass index, drinking and smoking. OR, odds ratio; CI, confidence interval.

Discussion

In this study, exercise frequency, intensity, and exercising in a group were independently and inversely associated with AR. To the best of our knowledge, this is the first study worldwide to demonstrate an association between exercise partners and AR. Moreover, this is the first report from Japan to describe the association between exercise and AR.

In previous observation and cohort studies, the association between exercise and AR has been inconsistent. In a U.S. study of 133,107 children aged 6–17 years, vigorous PA and participation in sports were inversely associated with AR.[7] Similarly, in a Spanish nationwide study including 20,016 children aged 6–7 years, regular exercise was inversely associated with rhinitis symptoms.[8] Consistent findings were reported in a Polish study of 2,913 elementary and junior high school students and in a Brazilian cross-sectional study of 1,058 urban adolescents aged 13–14 years, where lower PA was associated with a higher prevalence of AR.[9,10] Moreover, an Austrian interventional study of adults (n = 40; aged 18–55 years) demonstrated that regular outdoor winter exercise improved nasal symptoms.[11]

In contrast, a large cross-sectional study in Bangkok reported that PA levels were positively associated with the prevalence of AR.[21] Studies from North Macedonia and Ecuador even suggested that higher levels of PA might worsen nasal symptoms.[16,17] A Korean study of 1,932 subjects aged ≥ 19 years reported that exercise intensity was related to severity of AR.[23] A Taiwanese cross-sectional study of 259 adolescents indicated that low levels of moderate-to-vigorous PA were associated with a higher prevalence of AR.[24] Similarly, a nationwide study in Saudi Arabia (children aged 6–7 years: n = 3,614; adolescents aged 13–14 years: n = 4,068) found that vigorous PA was a risk factor for AR.[25] Studies from Finland, Poland, and Spain found no significant associations between PA and AR.[12–15]

On the other hand, in interventional studies, exercise has shown a protective effect against AR. In a randomized controlled trial in Thailand, combining aerobic exercise with Vitamin C demonstrated improvements in nasal symptom scores in the exercise group, regardless of Vitamin C supplementation.[18] In another intervention study conducted in Thailand, exercise was found to alleviate rhinitis symptoms; notably, moderate-intensity exercise was more effective than vigorous-intensity exercise in reducing these symptoms.[19] Similarly, in a Chinese interventional study, improvements in both nasal and ocular symptoms in the exercise group were observed.[20]

It is also possible that the improvements observed in interventional studies were partly influenced by the group-based nature of the exercise programs. Exercising with others may have a stronger beneficial effect on health.[26-31] In a large epidemiological Korean study of 10,306 adults aged 40–60 years, high occupational PA was positively associated with AR, while leisure-time PA was not significantly related.[22]

The underlying mechanisms linking PA and AR remain unclear. However, based on existing evidence, several potential mechanisms have been proposed through which PA may exert beneficial effects on AR. First, exercise modulates immune responses via neuroendocrine and cytokine mechanisms, and may shift the Th1/Th2 balance, potentially suppressing excessive inflammatory cytokine production.[18,32] In particular, moderate-intensity exercise has been shown to reduce Th2-related inflammatory markers such as IL-4, IL-5, and IgE, which may help attenuate chronic airway inflammation.[19,33] Second, exercise is believed to improve autonomic nervous system function and suppress excessive secretion of stress hormones such as cortisol, thereby contributing to the improvement of nasal mucosal hypersensitivity and vascular reactivity.[34,35] The findings of this study are consistent with prior evidence highlighting the link between group- or partner-based exercise and a range of health outcomes.[26-31] Taken together, these findings suggest that exercise may exert an overall protective effect against AR through multiple physiological pathways. On the other hand, moderate exercise was more effective at enhancing immune function for AR compared to high-intensity exercise.[19] Thus, the symptoms of AR might reduce the frequency and intensity of exercise, as well as opportunities to exercise with a partner.

The present study has several limitations that should be noted. First, the cross-sectional study design does not permit the assessment of causality. Second, the assessment of exercise habits, exercise partners, and AR in this study was based on a self-administered questionnaire that had not been validated, which may have introduced misclassification bias. In addition, the use of a single self-reported scale to assess exercise habits represents another methodological limitation. The prevalence of AR in this study was 20.0%, consistent with prevalence rates reported in previous international studies.[36] However, a study of Japanese university students reported an AR prevalence of approximately 49% using a different questionnaire.[37] Therefore, misclassification may have occurred in this study. Accordingly, the prevalence of AR may have been underestimated due to differences in the questionnaire and potential misclassification. However, non-differential misclassification of the association between exercise and AR would likely bias the OR toward the null hypothesis. Since exercise habits and AR symptoms were self-reported without objective validation, a differential misclassification bias cannot be ruled out. Participants with higher health consciousness might have over-reported their exercise levels and under-reported their AR symptoms, potentially leading to an overestimation of the inverse association between exercise and AR. Third, this study did not collect information on medication use or family history of allergic diseases, including AR and atopy. Therefore, the potential confounding effects of pharmacological treatment and its influence on symptom improvement could not be adequately considered. Finally, the study population may not be representative of the entire young Japanese population. Because the present cohort consisted exclusively of university students, their relatively high educational level may have influenced their health-related behaviors.

Conclusions

Among young Japanese adults, exercise frequency, intensity, and exercising with a partner were independently and inversely associated with AR. Further research is warranted to clarify the underlying mechanisms and longitudinal association between PA and AR.

Ethics approval and consent to participate

This study was conducted in accordance with the Declaration of Helsinki and was approved by the ethics committee of the Ehime University Graduate School of Medicine (approval no. 1610012). All subjects were provided with the opportunity to opt out.

Consent for publication

Not applicable.

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

- J.W. and H.N. contributed to writing the main manuscript.
- A.K., K.K., and S.F. played a key role in data collection.
- S.F., T.M., H.N, M.M, A.K, (Kanamoto), Y.K., O.Y., and M.Y. provided important revision suggestions and made the corresponding modifications to the manuscript.
- S.F., and Y.H. oversaw the entire research project and offered critical supervision and direction at each stage.
- All authors contributed to this article and approved the submitted version

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Supplementary File 1.

Assessment of exercise habits including presence/absence of exercise partners

Please select the option that best describes you for the following questions about your exercise habits over the preceding six months.

(1) Frequency of exercise

"How frequently do you exercise?"

- None
- One-to-two times per month
- One-to-three times per week
- Four or more times per week

(2) Intensity of exercise

"What is your main type of exercise?"

- No exercise
- Light exercise (normal walking, housework, vehicles, ball playing, stretching, etc.)
- Moderate exercise (fast walking, stairlifts, bicycle, softball, hiking, golf, radio calisthenics, etc.)
- Intense exercise (jogging, climbing stairs, badminton, tennis, mountain climbing, swimming, muscle training, judo, etc.)

(3) Exercise partner

"Who do you mostly exercise with?"

- No exercise
- Group
- Friends
- Alone