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SHORT COMMUNICATION

The effects of regular physical activity on adult-onset asthma incidence in women

Marta Benet [a,b,c], Raphaëlle Varraso [d], Francine Kauffmann [d,e], Isabelle Romieu [f], Josep M. Antó [a,b,c,g], Françoise Clavel-Chapelon [d,e], Judith Garcia-Aymerich [a,b,c,g,*]

[a] *Centre for Research in Environmental Epidemiology (CREAL), Doctor Aiguader 88, 08003 Barcelona, Catalonia, Spain*
[b] *Municipal Institute of Medical Research (IMIM-Hospital del Mar), Doctor Aiguader 88, 08003 Barcelona, Spain*
[c] *CIBER Epidemiologia y Salud Pública (CIBERESP), Doctor Aiguader 88, 08003 Barcelona, Spain*
[d] *National Institute of Health and Medical Research (Inserm), CESP Centre for Research in Epidemiology and Population Health, U1018, Respiratory and Environmental Epidemiology Team, 16, avenue Paul Vaillant Couturier, F-94807 Villejuif, France*
[e] *Paris-South University 11, UMRS 1018, F-94807 Villejuif, France*
[f] *Instituto Nacional de Salud Pública, Col Santa Maria Ahuacatitlan, 62508 Cuernavaca, Morelos, México*
[g] *Department of Experimental and Health Sciences, Universitat Pompeu Fabra, Doctor Aiguader 88, 08003 Barcelona, Spain*

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Summary
Background: Potential benefit of physical activity in asthma incidence is scarce and controversial. We aimed to assess the association between regular physical activity and adult-onset asthma.
Methods: We included 51,080 women from a French cohort study, and followed them from 1993 to 2003. Physical activity at baseline was defined as time spent in household and leisure time physical activity, converted to metabolic equivalents (METs), and categorised in tertiles. Adult-onset asthma during follow-up was defined according to the American Thoracic Society criteria.
Results: Mean age at baseline was 53 years, 13% of women were current smokers, 19% were overweight or obese, and 56% were postmenopausal; 512 (1%) developed asthma. No association was found between physical activity and asthma incidence in the crude or in the adjusted

* Corresponding author. Centre for Research in Environmental Epidemiology (CREAL), Doctor Aiguader 88, 08003 Barcelona, Catalonia, Spain. Tel.: +34 93 214 73 50; fax: +34 93 214 73 02.
E-mail address: jgarcia@creal.cat (J. Garcia-Aymerich).

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Cox regression model (adjusted HR 1.03 and 1.01 for the 2nd and 3rd tertiles compared to the 1st tertile, p for trend = 0.979).
Conclusion: Physical activity is not related to adult-onset asthma in this cohort of French middle-aged women.
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Introduction

Adult-onset asthma is an important health problem in terms of prevalence and morbidity, although more research is needed into how its potential risk factors, such as smoking, atopy, or hay fever, are linked to asthma.[1,2] The consistent reported association between increasing body mass index (BMI) and asthma incidence,[1] and the finding that regular physical activity reduces the risk of asthma exacerbations in adults,[3] suggest that physical activity may play a role in the development of adult-onset asthma. A Finnish cohort study of 10,597 adult twins followed for 9 years found that physical activity was associated, among men, with a reduction in asthma risk, while, among women, it was associated with an increased asthma risk, none of these associations being statistically significant.[4] An 8-year Danish twin cohort study found physical activity related to a reduction in asthma risk among monozygotic twin pairs ($n = 126$), and to an increase of asthma risk among dizygotic twin pairs ($n = 273$).[5] Overall, previous studies have reported controversial results which may be due to the inclusion of highly selected samples, small sample size, and/or shortness of follow-up.

The present study aimed to assess the association between regular physical activity and adult-onset asthma incidence in a large cohort of middle-aged women from the study Étude Epidémiologique auprès de Femmes de l'Education Nationale (E3N).[6]

Methods

The E3N study started in 1990 when a self-administered questionnaire was sent to all women aged 40–65 years from the Mutuelle Générale de l'Education Nationale, a national health insurance scheme primarily covering teachers, and 98,995 answered. Follow-up questionnaires were sent thereafter approximately every two years. Physical activity was assessed in 1993. Asthma information was obtained by a simple question in 1993, and with a detailed questionnaire in 2003. Thus the present study included women who participated in 1993 (third E3N questionnaire, from now on called "baseline questionnaire") and 2003 (seventh E3N questionnaire) covering a median of 9 years of follow-up. All women signed an informed consent, and Ethics approval was obtained.

Physical activity was obtained from a reduced version of the short European Prospective Investigation of Cancer (EPIC)[7] physical activity questionnaire with self-reported frequency and duration of recreational physical activity habits (walking, cycling, gardening, home do-it-yourself activities, sports, and climbing stairs) and physical habits at work. A total summary measure in metabolic equivalents (MET) was obtained[8] and categorised in tertiles. At baseline, asthma status was self-reported as "having ever had asthma attacks". At the end of follow-up, asthma was defined as "asthma attacks ever" together with "a doctor diagnosis", using the American Thoracic Society (ATS) questionnaire,[9] and age of onset (year of first attack) was obtained. Women were considered to have adult-onset asthma between 1993 and 2003 if they had not reported asthma attacks ever at baseline and met the ATS criteria for asthma definition at follow-up.

Relative risk for asthma onset was estimated using Cox proportional hazards models, with age as the timescale. All women were followed until the first of i) age of asthma onset, or ii) end of follow-up. Potential confounding baseline variables included BMI, smoking status, menopausal status, education level, working status, and relevant co-morbidities (allergic rhinitis, diabetes, cancer, angina pectoris, myocardial infarction, and stroke). Sensitivity analysis included stratification of final models by (i) smoking status, (ii) BMI (less or equal to 25 kg/m^2 and over 25 kg/m^2), or (iii) menopausal status (at baseline, at the end of follow-up, or non menopause), and restriction to women with frequent asthma attacks (at least one per week in the last 12 months). Analyses were performed with SAS version 9 (Cary, NC, USA).

Results

From a total of 78,083 women who answered our baseline questionnaire, 21,928 were excluded because of missing data on physical activity and/or asthma or did not participate in the follow-up. They were older (53.7 *vs.* 52.7 years, $p < 0.001$), had higher proportion of active smokers (15.0 *vs.* 13.3%, $p < 0.001$) and had higher BMI (23.3 *vs.* 22.8 kg/m^2, $p < 0.001$) than included women. Women that were excluded because of missing physical activity data at baseline had a higher asthma incidence than included women (1.6% *vs.* 1.0%, $p = 0.002$). We also excluded women who reported having had asthma attacks or doctor diagnosis at baseline ($n = 5075$).

A total of 51,080 women were included, with a mean follow-up of 8.7 years. Out of them, 512 (1%) developed asthma during follow-up, and mean age at first asthma attack was 57 years. Baseline subjects' characteristics according to asthma incidence are displayed in Table 1. Higher BMI was associated with higher risk of asthma. The Cox regression model adjusted for age, BMI, allergic rhinitis and angina pectoris provided no association between physical activity and asthma incidence (Table 2). Sensitivity analysis, including stratification for BMI, yielded very similar estimates.

Discussion

Results of the present study do not support the hypothesis that engaging in regular physical activity may reduce adult-onset asthma. Results, as seen in previous studies, show

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Table 1 Baseline sociodemographic, lifestyle, and clinical characteristics of 51,080 French women followed for a median of 9 years, according to asthma incidence during follow-up.

	All Subjects	Asthma during follow-up		*p*-value
	n = 51,080	No	Yes	
		n = 50,568	*n* = 512	
Age (years), *m* (SD)	53 (6.5)	53 (6.5)	52 (6.3)	0.016
Working status: current worker, *n* (%)	38,600 (78.3)	38,200 (78.3)	400 (81.5)	0.088
Tobacco smoking				
Active smoker, *n* (%)	6736 (13.3)	6634 (13.2)	102 (20.0)	<0.001
Former smoker, *n* (%)	15,378 (30.4)	15,213 (30.3)	165 (32.3)	
Never smoker, *n* (%)	28,547 (56.3)	28,303 (56.5)	244 (47.7)	
Body mass index (BMI)				
<20 kg/m^2, *n* (%)	7937 (15.5)	7886 (15.6)	51 (10.0)	<0.001
20–24.9 kg/m^2, *n* (%)	33,123 (64.9)	32,815 (64.9)	308 (60.2)	
25–29.9 kg/m^2, *n* (%)	8332 (16.3)	8210 (16.2)	122 (23.8)	
≥30 kg/m^2, *n* (%)	1683 (3.3)	1652 (3.3)	31 (6.0)	
Menopause, *n* (%)	28,457 (56.4)	28,178 (56.4)	279 (55.1)	0.572
Angina Pectoris, *n*(%)	197 (0.4)	191 (0.4)	6 (1.2)	0.004
Allergic Rhinitis, *n* (%)	5121 (10.0)	5021 (9.9)	100 (19.5)	<0.001
Physical Activity (MET·h/week), *m* (SD)	40.17 (27.68)	40.2 (27.7)	39.4 (26.8)	0.521
Physical Activity group[a]				
1st tertile (≤24 MET·h/week), *n* (%)	16,863 (33.0)	16,689 (33.0)	174 (34.0)	0.835
2nd tertile (>24 to ≤45 MET·h/week), *n* (%)	16,861 (33.0)	16,691 (33.0)	170 (33.2)	
3rd tertile (>45 MET·h/week), *n* (%)	17,356 (34.0)	17,188 (34.0)	168 (32.8)	

SD: standard deviation; BMI: body mass index; MET: Metabolic Equivalents.
[a] The value of 24 MET·h/week is equivalent to walking or doing household work 1 h per day during seven days a week; 45 MET·h/week is equivalent to walking or doing household work 2 h per day during seven days a week, or cycling or practising sports 1 h per day during seven days a week.

Table 2 Adjusted association between regular physical activity (in tertiles) and asthma incidence during a mean of 8.7 years follow-up of 51,080 middle-aged women.

	HR (95% CI)	*p*-value
Age	0.98 (0.97–0.99)	0.005
Body Mass Index		
<20 kg/m^2	0.67 (0.50–0.91)	0.010
≥ 20 and ≤24.9 kg/m^2	1	
≥ 25 and ≤29.9 kg/m^2	1.63 (1.32–2.02)	<0.001
≥30 kg/m^2	2.04 (1.41–2.95)	<0.001
Angina Pectoris (yes)	3.14 (1.40–7.06)	0.006
Allergic Rhinitis (yes)	2.15 (1.73–2.68)	<0.001
Physical Activity group[a]		
1st tertile (≤24 MET·h/week)	1	
2nd tertile (>24 to ≤45 MET·h/week)	1.03 (0.83–1.27)	0.819
3rd tertile (>45 MET·h/week)	1.00 (0.81–1.24)	0.981
P for trend		0.979

[a] The value of 24 MET·h/week is equivalent to walking or doing household work 1 h per day during seven days a week; 45 MET·h/week is equivalent to walking or doing household work 2 h per day during seven days a week, or cycling or practising sports 1 h per day during seven days a week.

a relation between obesity and increased adult asthma risk; however this association would not be explained by physical activity levels. Alternative mechanisms such as reductions in airway calibre as a result of chest wall restriction have been proposed.[10] It could be argued that physical activity relates to the evolution[3] but not to the development of the disease, as has been reported for other risk factors of asthma.[1]

A limitation of our study is the potential selection bias due to differences in age, smoking or BMI between participants and non-participants. These differences, although statistically significant, are very small and likely not clinically relevant. The difference in asthma incidence between women with and without physical activity data at baseline could have led to an underestimation of the effects of physical activity on asthma risk. Another limitation — in common with the previous studies — is the possible misclassification both in the measure of physical activity and in asthma diagnosis due to self-reporting, which is difficult to avoid when large sample sizes and long follow-up periods are needed. However, we favoured a more specific definition of asthma incidence, as it has been suggested that this reduces bias in etiological research.[11] Finally, current analysis did not include repeated measures of physical activity over time, which has previously been related to underestimation of the effects of physical activity.[12] Obviously, present results should only be extrapolated to middle-aged women, which limits their external validity.

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We conclude that physical activity is not related to adult-onset asthma in this cohort of French women. Further studies considering changes in physical activity during follow-up, and better measures of both physical activity and asthma, are needed to avoid possible misclassifications and consequent biases. While our study does not support the role of physical activity in asthma incidence, the importance of recommending regular physical activity in adult populations should be stressed for prevention of cardiovascular diseases, cancer and other chronic diseases or conditions.[13]

Conflicts of interest

None of the authors have any conflicts of interests declared.

Authorship

All authors have contributed to (i) the conception and design, acquisition of data or analysis and interpretation of data; (ii) the drafting of the article or revising it critically for important intellectual content; and (iii) final approval of the version to be submitted.

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