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The effect of physical activity on asthma incidence over 10 years: population-based study

Melissa Anne Russell\textsuperscript{1,2}, Shyamali Dharmage\textsuperscript{1,2}, Elaine Fuertes\textsuperscript{3}, Alessandro Marcon\textsuperscript{4}, Anne-Elie Carsin\textsuperscript{5,6,7,8}, Silvia Pascual Erquicia\textsuperscript{9}, Joachim Heinrich\textsuperscript{1,10}, Ane Johannessen\textsuperscript{11}, Michael J Abramson\textsuperscript{12}, Andre F.S. Amaral\textsuperscript{3}, Isa Cerveri\textsuperscript{13}, Pascal Demoly\textsuperscript{14,15}, Vanessa Garcia-Larsen\textsuperscript{16}, Deborah Jarvis\textsuperscript{3,17}, Jesus Martinez-Moratalla\textsuperscript{18,19}, Dennis Nowak\textsuperscript{10}, Leopoldo Palacios-Gomez\textsuperscript{20}, Giulia Squillacioti\textsuperscript{21}; Wasif Raza\textsuperscript{22}, Margareta Emtner\textsuperscript{23}, Judith Garcia-Aymerich\textsuperscript{5,7,8}.

Affiliations

1. Allergy and Lung Health Unit, Melbourne School of Population and Global Health, The University of Melbourne, Melbourne, Australia
2. Gastro & Food Allergy Group, Murdoch Children’s Research Institute, Melbourne, Australia
3. National Heart and Lung Institute, Imperial College London, London, UK
4. Unit of Epidemiology and Medical Statistics, Department of Diagnostics and Public Health, University of Verona, Verona, Italy
5. Barcelona Institute of Global Health (ISGlobal), Barcelona, Spain
6. IMIM-Hospital del Mar, Barcelona, Spain
7. CIBER Epidemiologia y Salud Publica, Barcelona, Spain
8. Universitat Pompeu Fabra (UPF), Barcelona, Spain
9. Respiratory Department, Galdakao Hospital, OSI Barrualde-Galdakao, Biscay, Spain
10. Institute and Clinic for Occupational, Social and Environmental Medicine, University Hospital, LMU Munich, Comprehensive Pneumology Center (CPC) Munich, Member DZL, German Center for Lung Research, Munich, Germany
11. Centre for International Health, Department of Global Public Health and Primary Care, University of Bergen (NO), Bergen, Norway
12. School of Public Health & Preventive Medicine, Monash University, Melbourne, Australia
13. Division of Respiratory Diseases, IRCCS Policlinico San Matteo, University of Pavia, Pavia, Italy
14. Département de Pneumologie et addictologie, Hôpital Arnaud de Villeneuve, University Hospital of Montpellier, Montpellier, France
15. INSERM UMR-S 1136, IPLESP, Sorbonne Université, Paris, France
16. Department of International Health, The Johns Hopkins Bloomberg School of Public Health, Baltimore, United States
17. MRC-PHE Centre for Environment and Health, Imperial College London, London, UK
18. Servicio de Neumología del Complejo Hospitalario Universitario de Albacete. Albacete, Spain
20. El Torrejón Health Centre. Huelva, Andalusian Health Service, Spain
21. Department of Public Health and Pediatrics, University of Turin, Turin, Italy
22. Department of Public Health and Clinical Medicine, Section of Sustainable Health, Umeå University, Umeå, Sweden.
23. Department of Medical Sciences: Respiratory, Allergy and Sleep Research, Uppsala University, Uppsala, Sweden

Corresponding author
Dr Melissa Russell,
The University of Melbourne, Melbourne, Australia
melissar@unimelb.edu.au

Take home message
Although there are many health benefits from being active, there was no benefit observed in this study from vigorous physically activity in reducing the risk of asthma onset in middle aged adults
Asthma remains a common disease around the world, with global estimates indicating that 4.3% of adults have doctor diagnosed asthma [1]. Physical activity has been found to improve asthma outcomes in adult with asthma [2, 3]. While it has been hypothesised that physical activity could also reduce asthma incidence through a variety of mechanisms, studies to date have provided mixed results. Some studies find that physical activity reduces the incidence of asthma [4, 5], yet others find no evidence for a reduction in risk [6, 7]. These inconsistent findings could be partly attributed to variation in the definition of incident asthma, which is mostly restricted to self-reported asthma outcomes. In this analysis, we investigated the association between (frequency and duration of) vigorous physical activity and asthma incidence over 10 years, using the European Community Respiratory Health Survey (ECRHS), considering multiple asthma related outcomes in an initially asthma-free population.

ECRHS is a multi-centre cohort involving 46 centres in 25 countries from Europe and Australia [8]. From a random sample in ECRHSI, participants (originally 20-44 years of age) completed questionnaires and a battery of tests twice more at 10-year intervals. The present analysis uses data from ECRHSII (42 to 57 years of age) and ECHRSIII (54 to 68 years of age) as physical activity data were not collected in ECRHSI. There were 10,217 participants in ECRHSII. Of these, we excluded participants who reported: (1) ‘ever asthma’ in ECRHSI or II (n=1895), (2) wheeze in the previous 12-months at ECRHS I or II (n=2328), or (3) an asthma attack prior to ECRHSI or ECHRSII (n=70). Additionally, 2421 participants were lost to follow-up, leaving 3503 participants for analysis. Ethics approval was gained by each center.

The ECRHSII and ECRHSIII questionnaires included items regarding vigorous physical activity during leisure time, in addition to questions regarding the diagnosis of respiratory diseases, respiratory symptoms, medications taken, occupation, smoking and other socio-demographic factors. The responses from the questions “How often do you usually exercise so much that you get out of breath or sweat?” and “How many hours a week do you usually exercise so much that you get out of breath or sweat?” were categorised by frequency (≤ once/month, one to three times/week, four or more times/week) and duration (zero to 30 mins, one hour to three hours, four or more hours per week) respectively. Participants reporting at least one hour of vigorous activity across 2-3 incidences per week were classified as ‘vigorously active’ and participants reporting less in either question were classified as ‘not vigorously active’ [9]. This classification was applied across ECRHSII and ECRHSIII data and used to create the categories of ‘consistently vigorously active’, ‘becoming vigorously
inactive’, ‘becoming vigorously active’, and ‘consistently not vigorously active’ as a ‘change in vigorous activity status’ variable.

Asthma incidence was assessed using several outcomes at ECRHSIII. Firstly, current asthma was deemed present if participants responded positively to the question ‘Have you had wheezing or whistling in your chest at any time in the last 12-months’ and/or ‘Are you currently taking any medicines including inhalers, aerosols or tablets for asthma’ [10]. Secondly, asthma-like symptoms were deemed present with more than three positive responses to questions regarding 12-month symptoms of: (1) wheeze, (2) wheeze with breathlessness, (3) wheeze without a cold, (4) nocturnal chest tightness, (5) nocturnal shortness of breath, (6) nocturnal attack of coughing (7) asthma attack, and (8) current asthma medications [11]. Bronchodilator reversibility was deemed present when there was an increase or decrease in FEV\textsubscript{1} of 12% and >200ml from baseline [12]. This change is accepted as being consistent with asthma in those with respiratory symptoms [12].

We also utilised ECRHSI data on sex, age, age at completion of education (<17, 17-20, ≥21 years), ECRHS II data on occupation (categorised according to the International Standard Classification of Occupations-88 code [13]) and objectively measured weight and height, from which we derived body mass index (BMI). ECRHS II smoking data were collected across multiple questions and categorised as never, ex-smoker, current-smoker.

Associations between the physical activity measurements (ECRHSII vigorous activity status, frequency and duration, change in vigorous activity status during follow-up) were examined for each asthma outcome (current asthma, asthma-like symptoms, bronchodilator reversibility) using modified Poisson regression [14]. Age, sex, age at the completion of education, BMI, smoking and occupation at ECRHSII were included as covariates, as they were identified as potential confounders a priori. Centre clustering was taken into account using robust standard errors and interactions between physical activity and age, sex, BMI and smoking were considered.

We conducted three sensitivity analyses: (1) to account for potential residual confounding we repeated analyses with adjustment for heart disease at ECRHS III, available in a subsample (n=2195); (2) to investigate the potential attenuating effects of asthma medications, we repeated the analyses with bronchodilator reversibility as the outcome excluding those taking asthma medications at ECRHSIII; (3) to investigate heterogeneity across regions, we conducted a random-effects meta-analysis. Stata ver16 (StataCorp, College Station, TX) was used.
The participants included in this analysis were similar to those eligible, in regard to age, sex, physical activity and BMI. However, those included were less likely to be current smokers (21% versus 27%) and more likely to have completed their education ≥21 years of age (48% versus 41%) at ECRHSII than those lost to follow-up (40% of the ECRHS II cohort).

The average age of the 3503 participants at ECRHSII was 43 years (standard deviation [SD] 7.0), 52% were female and average BMI 25.1 (SD 3.9) kg/m^2. The majority were never smokers (48%) with 31% ex-smokers and 21% current smokers. Over half (52%) completed their education by 21 years of age and 37% were working in management/professional fields. The majority of participants were classified as not vigorously active (63%) at ECRHSII.

Almost half of participants (43%) were not-vigorously active at both time points. At ECRHSIII, 9% of participants had current asthma, 2% reported more than three asthma-like symptoms and 2% had a positive bronchodilator response.

There was little association between the vigorous physical activity measures and asthma outcomes (Table 1). No differences were observed in the sensitivity analyses, and no interactions were found with the potential effect modifiers investigated (results not shown).

In this population of initially asthma-free middle-aged adults, we found little association between vigorous physical activity and the onset of asthma measures over a 10-year period. These results are consistent with some previous research investigating the effect of physical activity on asthma incidence [6, 7]. Of the two studies that found a beneficial effect of physical activity on asthma incidence, one appeared to not adjust for relevant confounders, such as age and smoking [4], and the other study used lighter physical activity as the exposure [5]. The lack of observable beneficial associations from physical activity in our study may be because of insufficient statistical power, that only less vigorous physical activity protects against asthma incidence, or that there is no benefit from physical activity in regard to asthma incidence.

The strengths of this study were the long-term follow-up, reduction in asthma misclassification by combining self-report with objective measurements, and inclusion of several sensitivity analyses to minimise other potential biases. Study weaknesses include loss to follow-up and the utilization of self-reported (instead of objective) physical activity measures; self-report of physical activity can impact validity due to individual’s propensity to overestimate physical activity levels. Additionally, bronchodilator reversibility, although a measure of asthma, can also be present with other respiratory diseases [15]. In conclusion, although multiple health benefits from physical activity are known, we did not find evidence...
that participating in vigorous physical activity during leisure time reduced the risk of asthma developing in adults.
Table 1. Association between ECRHSII vigorous activity status, frequency and duration, change in vigorous activity status and ECRHSIII current asthma, asthma-like symptoms and bronchodilator reversibility in middle aged adults.

<table>
<thead>
<tr>
<th>Activity status</th>
<th>Current asthma at ECRHS III (%) (n≥3129)</th>
<th>Risk of current asthma, adjusted analyses (95% CI)# (n≥2757)</th>
<th>More than three asthma-like symptoms at ECRHS III (%) (n≥3057)</th>
<th>Risk of asthma-like symptoms, adjusted (95% CI)# (n≥2695)</th>
<th>Bronchodilator reversibility present at ECRHS III (%) (n≥2451)</th>
<th>Risk of bronchodilator reversibility, adjusted analyses (95% CI)# (n≥2148)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not vigorously active</td>
<td>182 (8.9)</td>
<td>1.00</td>
<td>54 (2.8)</td>
<td>1.00</td>
<td>38 (2.5)</td>
<td>1.00</td>
</tr>
<tr>
<td>Vigorously active</td>
<td>102 (8.4)</td>
<td>0.96 (0.75, 1.23)</td>
<td>22 (1.9)</td>
<td>0.71 (0.42, 1.18)</td>
<td>21 (2.2)</td>
<td>0.82 (0.46, 1.47)</td>
</tr>
<tr>
<td><strong>Frequency of vigorous activity</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤ 1 times/month</td>
<td>120 (9.1)</td>
<td>1.00</td>
<td>36 (2.8)</td>
<td>1.00</td>
<td>25 (2.6)</td>
<td>1.00</td>
</tr>
<tr>
<td>1-3 times/week</td>
<td>120 (7.7)</td>
<td>0.94 (0.73, 1.22)</td>
<td>31 (2.1)</td>
<td>0.78 (0.48, 1.28)</td>
<td>29 (2.4)</td>
<td>0.86 (0.49, 1.50)</td>
</tr>
<tr>
<td>4+ times/week</td>
<td>45 (10.7)</td>
<td>1.14 (0.82, 1.63)</td>
<td>10 (2.5)</td>
<td>0.93 (0.45, 1.93)</td>
<td>6 (1.9)</td>
<td>0.67 (0.25, 1.76)</td>
</tr>
<tr>
<td><strong>Amount of vigorous activity</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 – 30 mins/week</td>
<td>132 (9.8)</td>
<td>1.00</td>
<td>39 (3.0)</td>
<td>1.00</td>
<td>28 (2.8)</td>
<td>1.00</td>
</tr>
<tr>
<td>1 – 3 hours/week</td>
<td>105 (7.4)</td>
<td>0.82 (0.63, 1.07)</td>
<td>30 (2.2)</td>
<td>0.79 (0.48, 1.30)</td>
<td>24 (2.2)</td>
<td>0.74 (0.42, 1.31)</td>
</tr>
</tbody>
</table>

*CI = confidence interval, # Adjusted for age, sex and smoking status.*
<table>
<thead>
<tr>
<th>Change in vigorous activity from ECRHSII to ECRHSIII</th>
<th>4+ hours/week</th>
<th>47 (9.5)</th>
<th>1.00 (0.71, 1.42)</th>
<th>7 (1.5)</th>
<th>0.49 (0.21, 1.17)</th>
<th>7 (1.8)</th>
<th>0.66 (0.27, 1.61)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consistently not vigorously active</td>
<td>123 (9.1)</td>
<td>1.00</td>
<td>43 (3.2)</td>
<td>1.00</td>
<td>29 (2.8)</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>Becoming vigorously inactive</td>
<td>54 (8.7)</td>
<td>1.00 (0.70, 1.43)</td>
<td>11 (1.9)</td>
<td>0.83 (0.34, 1.35)</td>
<td>9 (1.9)</td>
<td>0.96 (0.44, 2.08)</td>
<td></td>
</tr>
<tr>
<td>Becoming vigorously active</td>
<td>41 (9.1)</td>
<td>1.11 (0.80, 1.54)</td>
<td>11 (2.4)</td>
<td>0.68 (0.42, 1.61)</td>
<td>10 (2.8)</td>
<td>0.83 (0.39, 1.78)</td>
<td></td>
</tr>
<tr>
<td>Consistently not vigorously active</td>
<td>60 (8.5)</td>
<td>1.01 (0.73, 1.41)</td>
<td>11 (1.6)</td>
<td>0.50 (0.24, 1.03)</td>
<td>11 (1.9)</td>
<td>0.64 (0.29, 1.42)</td>
<td></td>
</tr>
</tbody>
</table>

CI: Confidence Interval, FEV\textsubscript{1}: Forced Expiratory Volume in one second

# Adjusted for sex, ECRHSII age, smoking status, occupation, education and BMI
References


