ORIGINAL RESEARCH LETTER

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

To the Editor:

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 adults 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 multicentre cohort involving 46 centres in 25 countries in Europe and Australia [8]. From a random sample in ECRHS I, 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 ECRHS II (42 to 57 years of age) and ECHRS III (54 to 68 years of age), as physical activity data were not collected in ECRHS I. ECRHS II involved 10 217 participants. Of these, we excluded participants who reported: 1) "ever asthma" in ECRHS I 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 ECRHS I or ECHRS II (n=70). Additionally, 2421 participants were lost to follow-up, leaving 3503 participants for analysis. Ethics approval was gained by each centre.

The ECRHS II and ECRHS III 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 a month or less, 1–3 times per week, ⩾4 times per week) and duration (0 to 30 min, 1 to 3 h, ⩾4 h per week), respectively. Participants reporting at least 1 h of vigorous activity across two to three incidences per week were classified as "vigorously active", and participants reporting less for either question were classified as "not vigorously active" [9]. This classification was applied across ECRHS II and ECRHS III 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 ECRHS III. 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

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Although there are many health benefits from being active, there was no benefit observed in this study from vigorous physical activity in reducing the risk of asthma onset in middle-aged adults
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TABLE 1 Association between European Community Respiratory Health Survey (ECRHS) II vigorous activity status, frequency and duration, change in vigorous activity status and ECRHS III current asthma, asthma-like symptoms, and bronchodilator reversibility in middle-aged adults

	Current asthma at ECRHS III n (%)	Risk of current asthma, adjusted analyses# (95% CI)	More than three asthma-like symptoms at ECRHS III (%)	Risk of asthma-like symptoms, adjusted (95% CI)#	Bronchodilator reversibility present at ECRHS III n (%)	Risk of bronchodilator reversibility, adjusted analyses# (95% CI)
Subjects n	3129	2757	3057	2695	2451	2148
Activity status						
Not vigorously active	182 (8.9)	1.00	54 (2.8)	1.00	38 (2.5)	1.00
Vigorously active	102 (8.4)	0.96 (0.75–1.23)	22 (1.9)	0.71 (0.42–1.18)	21 (2.2)	0.82 (0.46–1.47)
Frequency of vigorous activity						
Once a month or less	120 (9.1)	1.00	36 (2.8)	1.00	25 (2.6)	1.00
1–3 times per week	120 (7.7)	0.94 (0.73–1.22)	31 (2.1)	0.78 (0.48–1.28)	29 (2.4)	0.86 (0.49–1.50)
⩾4 times per week	45 (10.7)	1.14 (0.82–1.63)	10 (2.5)	0.93 (0.45–1.93)	6 (1.9)	0.67 (0.25–1.76)
Amount of vigorous activity						
0–30 min per week	132 (9.8)	1.00	39 (3.0)	1.00	28 (2.8)	1.00
1–3 h per week	105 (7.4)	0.82 (0.63–1.07)	30 (2.2)	0.79 (0.48–1.30)	24 (2.2)	0.74 (0.42–1.31)
⩾4 h per week	47 (9.5)	1.00 (0.71–1.42)	7 (1.5)	0.49 (0.21–1.17)	7 (1.8)	0.66 (0.27–1.61)
Change in vigorous activity from ECRHS II to ECRHS III						
Consistently not vigorously active	123 (9.1)	1.00	43 (3.2)	1.00	29 (2.8)	1.00
Becoming vigorously inactive	54 (8.7)	1.00 (0.70–1.43)	11 (1.9)	0.83 (0.34–1.35)	9 (1.9)	0.96 (0.44–2.08)
Becoming vigorously active	41 (9.1)	1.11 (0.80–1.54)	11 (2.4)	0.68 (0.42–1.61)	10 (2.8)	0.83 (0.39–1.78)
Consistently not vigorously active	60 (8.5)	1.01 (0.73–1.41)	11 (1.6)	0.50 (0.24–1.03)	11 (1.9)	0.64 (0.29–1.42)

#: adjusted for sex, ECRHS II age, smoking status, occupation, education and body mass index.

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 forced expiratory volume in 1 s (FEV_1) of 12% and >200 mL from baseline [12]. This change is accepted as being consistent with asthma in those with respiratory symptoms [12].

We also utilised ECRHS I data on sex, age and age at completion of education (<17, 17–20, ⩾21 years) and 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-smoker, ex-smoker and current-smoker.

Associations between the physical activity measurements (ECRHS II 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 ECRHS II 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 ECRHS III; and 3) to investigate heterogeneity across regions, we conducted a random-effects meta-analysis. Stata ver16 (StataCorp, College Station, TX, USA) was used.

The participants included in this analysis were similar to those eligible with 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 after 21 years of age (48% *versus* 41%) at ECRHS II than those lost to follow-up (40% of the ECRHS II cohort).

The average age of the 3503 participants at ECRHS II was 43 years (SD 7.0), 52% were female and average BMI was 25.1 (SD 3.9) $kg \cdot m^{-2}$. The majority were never-smokers (48%) with 31% being 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 ECRHS II. Almost half of participants (43%) were not vigorously active at both time points. At ECRHS III, 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 not to 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 utilisation of self-reported (instead of objective) physical activity measures; self-report of physical activity can impact validity due to an 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.

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