



Leisure time activity and new onset of wheezing during adolescence

C. Vogelberg*, T. Hirsch[#], K. Radon[†], H. Dressel[†], D. Windstetter⁺, G. Weinmayr[§], S.K. Weiland^{§,†}, E. von Mutius⁺, D. Nowak[†] and W. Leupold*

ABSTRACT: Asthma prevalence is increasing in adult and paediatric patients. In the present study, the association between different leisure time activities and new onset of wheezing was analysed in adolescents aged 16–18 yrs taking part in a questionnaire-based follow-up of the International Study on Asthma and Allergies in Childhood in Munich and Dresden, Germany.

Of the 3,785 adolescents who took part in the follow-up (76% response), 2,910 adolescents without earlier episodes of wheezing in childhood were included in the analyses. Of these, 330 (11.3%) reported new onset of wheeze during the previous 12 months.

In the bivariate analyses, exercising more than once per week or performing computer work >1 h·day⁻¹ were inversely related to new onset of wheeze. In contrast, visiting discotheques on a regular basis increased the risk of new onset of wheeze (12.9 versus 9.9%). The observed inverse relationship between physical activity and new onset of wheeze was not an independent effect but mediated by differences in active smoking.

The association between physical activity and new onset of wheeze disappeared when active smoking was taken into account. However, the present data do not allow for determining whether smoking operated as a confounder or as an intermediate factor, *i.e.* whether physical activities prevented active smoking.

KEYWORDS: Asthma, incidence, leisure time activity, smoking

Asthma is a chronic inflammatory disease with increasing prevalence both in adult and paediatric patients [1]. Several explanations for this phenomenon have been discussed, such as genetic factors, environmental influences or a western lifestyle [2]. One aspect of western lifestyle is reduced physical activity. Several studies have shown an inverse association between the prevalence of asthma and physical activity.

NYSTAD *et al.* [3] investigated 2,188 schoolchildren aged 6–16 yrs and found that the prevalence of bronchial responsiveness increased with decreasing hours of exercise per week in asthmatic children. In a prospective community-based study with 757 asymptomatic children, RASMUSSEN *et al.* [4] reported an inverse relationship between physical fitness and the development of physician-diagnosed asthma. In a study involving twins, HUOVINEN *et al.* [5] showed that twins undergoing conditioning exercise had a lower risk of asthma than sedentary twins. Among males, leisure time physical activity seems to have a slightly protective effect on asthma risk [6]. From a pathophysiological view, only limited data exist to explain this protective effect. Deep inspiration

prevents bronchoconstriction in healthy subjects and induces bronchodilation in asthmatics [7]. Several factors might influence the grade of physical activity, such as residential area (*e.g.* safety of the neighbourhood, rural versus urban area), distance to the next playground or park, or health belief of the parents [8]. Due to the popularity and easy access to computer games, many children and adolescents tend to spend their leisure time at home.

The objective of the present study was to analyse the association of different types of leisure time activity with the development of wheeze in young adolescents. It was hypothesised that adolescents with less physical activity in their leisure time had a higher prevalence of wheezing compared with their active counterparts.

MATERIAL AND METHODS

Study population

The Study on Occupational Allergy Risks (SOLAR) I is a prospective population-based cohort study concerning the natural history of atopic and respiratory diseases performed in 2002 in Dresden and Munich, Germany. During 1995–1996, 6,399 subjects aged 9–11 yrs had originally

AFFILIATIONS

*University Children's Hospital, Technical University, Dresden,

[#]Paediatric Dept, Sana Hospital Ruegen, Bergen,

[†]Institute for Occupational and Environmental Medicine, and

⁺Dr. von Haunersches Children's Hospital, Ludwig-Maximilians-University, Munich, and

[§]Dept of Epidemiology, University of Ulm, Ulm, Germany.

CORRESPONDENCE

C. Vogelberg

University Children's Hospital
Fetscherstr. 74

01307 Dresden

Germany

Fax: 49 3514585868

E-mail: christian.vogelberg@uniklinikum-dresden.de

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participated in the International Study of Asthma and Allergies in Childhood (ISAAC) II [9]. Of these, 4,893 subjects were located for the follow-up in 2002. A total of 3,785 (76%) returned the questionnaire and gave informed consent to combine the baseline and follow-up data. However, only 3,693 answered the question whether they had ever wheezed in their life. The present analysis is based on 2,910 adolescents who had never had an episode of wheezing in childhood when assessed at the first survey. At the time of follow-up, 330 (11.3%) of them reported wheezing within the previous 12 months (fig. 1). Of these, 54 (16.3%) had doctor-diagnosed asthma.

Questionnaire

All subjects had to complete a questionnaire [10] with 121 questions focusing on: genetic factors; respiratory symptoms and diseases; housing; pets; active and passive smoking; occupational choice and working environment; leisure time activity; physical development; and stress factors, as previously published [11]. Subjects with asthma-related symptoms within the previous year were identified by the question: "Have you had wheezing within the previous 12 months?" Information on leisure time activity was categorised as follows: 1) four categories of sport frequency between not more than once per month and 3 times per week; 2) computer work and TV watching ≥ 1 h·day⁻¹; and 3) visiting a discotheque (yes or no). The selection of the categories was performed with the objective of getting subgroups of approximately equal size. Potential confounders were: socioeconomic status (SES), as reflected by parental education; sex; body mass index (BMI; kg·m⁻², >95th percentile); and passive and active smoking (defined as having smoked ≥ 1 yr in lifetime).

Statistical methods

First, the crude associations between the three types of variables (outcome: current wheeze; potential predictors: leisure time activities; and confounders) were calculated using 2xN tables and Chi-squared tests. The adjusted odds ratios (ORs) were

then analysed for new onset of wheeze in multiple logistic regression models. One of the predictors was initially introduced and all five potential confounders were then included stepwise. Differences were considered significant at p-values <0.05.

RESULTS

When analysing the crude association of leisure time activity and new onset of wheeze, a significantly negative association was found between wheeze and increasing frequency of sport (p=0.001 for linear trend) and computer work (p=0.01; table 1). Analysing the association of new onset of wheeze with different types of exercise (e.g. running, swimming, fitness centre) or with the number of hours spent doing sport, similar (not statistically significant) tendencies as for sport frequency were found (data not shown). In contrast, visiting a

TABLE 1 Crude association of leisure time activity and different potential confounders with 12-months prevalence of wheeze

	n/N	% (95% CI)
Sports		
≤Once per month	76/546	13.9 (11.0–16.8)
≤Once per week	124/937	13.2 (11.0–15.4)
2–3 times per week	93/946	9.8 (7.9–11.7)
>3 times per week	37/453	8.2 (5.7–10.7)
Computer work		
≤1 h·day ⁻¹	216/1766	12.2 (10.7–13.7)
>1 h·day ⁻¹	71/808	8.8 (6.8–10.8)
TV watching		
≤1 h·day ⁻¹	103/936	11.0 (9.0–13.0)
>1 h·day ⁻¹	214/1864	11.5 (10.1–12.9)
Visiting discotheques		
No	107/1082	9.9 (8.1–11.7)
Yes	181/1404	12.9 (11.1–14.7)
Active smoking		
No	143/1900	7.5 (6.3–8.7)
Yes	186/970	19.2 (16.7–21.7)
Passive smoking		
No	71/974	7.3 (5.7–8.9)
Yes	255/1895	13.5 (12.0–15.0)
BMI kg·m⁻²		
≥95th percentile	15/139	10.8 (5.6–16.0)
<95th percentile	315/2755	11.4 (10.2–12.6)
Sex		
Female	214/1611	13.3 (11.6–15.0)
Male	116/1283	9.0 (7.4–10.6)
SES		
Low	160/1326	12.1 (10.3–13.9)
High	156/1506	10.4 (8.9–11.9)

n: number of subjects with wheeze; N: number of subjects who answered affirmative; CI: confidence interval; BMI: body mass index; SES: socioeconomic status. Sport and computer work were significantly negatively associated with wheeze (p=0.001 and 0.01). In contrast, visiting discotheques was significantly positively associated with current wheeze (p=0.02). Smoking and female sex were significantly associated with incidence of wheeze in adolescence.

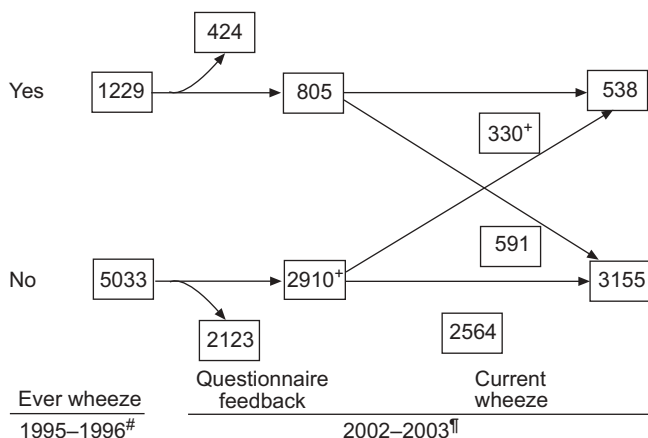


FIGURE 1. Identification of the study population. Of the 6,262 children who participated in the study in 1995–1996, 3,785 took part in the follow-up in 2002. However, only 3,693 answered the question concerning current wheeze in the period 2002–2003. The present analysis was based on 2,910 adolescents who never had an episode of wheezing in childhood. #: 9–11-yr-olds; †: 15–17-yr-olds; +: included in the present analysis.

TABLE 2 Leisure time activity and 12-months prevalence of wheeze

Activity	New onset of wheeze					
	Nonsmokers			Smokers		
	n/N	% (95% CI)	p-value	n/N	% (95% CI)	p-value
Sports			0.18			0.46
≤Once per month	21/260	8.1 (4.8–11.4)		55/281	19.6 (15.0–24.2)	
≤Once per week	56/612	9.2 (6.9–11.5)		67/317	21.1 (16.6–25.6)	
2–3 times per week	44/670	6.6 (4.7–8.5)		49/269	18.2 (13.6–22.8)	
>3 times per week	22/351	6.3 (3.8–8.8)		15/98	15.3 (8.2–22.4)	
Computer work			0.13			0.30
≤1 h·day ⁻¹	93/1134	8.2 (6.6–9.8)		122/616	19.8 (16.7–22.9)	
>1 h·day ⁻¹	37/598	6.2 (4.3–8.1)		34/206	16.5 (11.4–21.6)	
TV watching			0.91			0.26
≤1 h·day ⁻¹	52/694	7.5 (5.5–9.5)		51/234	21.8 (16.5–27.1)	
>1 h·day ⁻¹	85/1157	7.3 (5.8–8.8)		128/694	18.4 (15.5–21.3)	
Visiting discotheques			0.51			0.52
No	62/855	7.3 (5.6–9.0)		45/217	20.7 (15.3–26.1)	
Yes	62/764	8.1 (6.2–10.0)		118/629	18.8 (15.7–21.9)	

n: number of subjects with wheeze; N: number of subjects who answered affirmative; CI: confidence interval. Stratifying the analysis in smokers and nonsmokers, there was no significant association between leisure time activity and wheeze.

discotheque was significantly positively associated ($p=0.02$) with current wheeze (table 1). Subsequently, the association of different confounders with wheeze was investigated (table 1). When analysing active smoking as a confounding factor, a highly significant positive association was found with wheeze, as well as with TV watching and visiting discotheques ($p<0.001$), while the association with frequency of sport and computer work was significantly negative ($p<0.001$). Passive smoking, female sex and low SES were further significantly positively associated with wheeze ($p<0.001$, $p<0.001$ and $p=0.08$, respectively), while no statistical significance was

found for TV watching or BMI ($p=0.71$ and $p=0.77$, respectively). In addition, more TV watching was associated with lower parental SES and personal education, while there was no clear association between computer work and social attributes (data not shown). In addition, low SES was significantly associated with smoking ($p<0.0005$). When stratifying the analysis for smokers and nonsmokers, no significant association was found between leisure time activity and wheeze (table 2). Consequently, in the multivariate logistic regression analysis adjusted for smoking, the leisure time activities were not associated with a significant risk of new onset of wheeze. Passive and active smoking, however, remained highly significant risk factors with an adjusted OR of ~ 2.5 for active smoking (table 3). However, no effect modification was found by sex of the actively or passively smoking subject (data not shown). Besides smoking, only female sex implied a significant risk for new onset of wheeze.

The ORs for leisure time activities remained significant in models with all other potential confounders (SES, sex, BMI or increase in BMI between the period 1995–1996 and 2002, early asthma, passive smoking) except active smoking (table 3).

A parental history of asthma did not significantly increase the risk of new onset of wheezing.

DISCUSSION

In a recently published study [12], the association between smoking and the incidence of asthma during adolescence was investigated. The objective of the present study was to analyse the association between leisure time activities and onset of wheezing in young adolescents. To the best of the present authors' knowledge, the current study is the first that simultaneously investigated the association of leisure time

TABLE 3 Adjusted odds ratios (OR) for incident wheeze

	OR (95% CI)
Potential predictors[#]	
Sport >3 times per week <i>versus</i> ≤once per month	0.8 (0.5–1.3)
Computer work >1 h·day ⁻¹ <i>versus</i> ≤1 h·day ⁻¹	1.1 (0.8–1.5)
TV watching >1 h·day ⁻¹ <i>versus</i> ≤1 h·day ⁻¹	1.1 (0.9–1.5)
Visiting discotheques yes <i>versus</i> no	1.0 (0.8–1.3)
Potential confounders	
SES high <i>versus</i> low	0.9 (0.7–1.2)
BMI kg·m ⁻² †	1.1 (0.6–2.1)
Male <i>versus</i> female	1.4 (1.1–1.8)
Passive smoke exposure yes <i>versus</i> no	1.4 (1.0–1.9)
Active smoking yes <i>versus</i> no	2.5 (1.9–3.2)

CI: confidence interval; SES: socioeconomic status; BMI: body mass index. ORs for leisure time activities result from three separate models. Each model included one leisure time activity and all potential confounders. [#]: leisure time activities; †: <95th *versus* ≥95th percentile.

activity and active or passive smoking with wheezing in adolescents. The results showed a significant positive association between wheezing and visiting discotheques, and significant negative associations between wheezing and sport or computer work. However, active smoking was significantly associated with wheeze, as well as with all investigated leisure time activities, which means that active smoking is a substantial confounder of the association of leisure time activity and wheeze. This is an important aspect that has to be taken into account when analysing the effects of leisure time activities on asthma. Studies on adults reflecting the confounding role of smoking on leisure time activity and wheezing showed different results. HUOVINEN *et al.* [6] found no effect of smoking on the adult onset of asthma, while in another study [5], the same group reported an association only in females. In childhood and adolescence, both active and passive smoking are known risk factors for wheezing [13, 14]. Therefore, a strong confounding effect appears obvious. The present data were evaluated cross-sectionally and do not necessarily reflect the chronological onset of smoking and wheezing in the participating subjects. For this reason, it is not possible to differentiate whether adolescents do not smoke because they are actively sporty or whether they are inactive due to active or passive smoking. In the former case, sport would be the true reason for the lower prevalence of wheezing.

Another important result of the present study was that adolescents working frequently with a computer smoked less; conversely, watching TV was associated positively with active smoking and negatively with social status and sport. To the present authors' knowledge no data exists focusing on computer work and smoking in adolescents, and only limited data are available on smoking and television viewing. Results from two studies [15, 16] suggest that television viewing is a significant predictor of smoking volume, with a stronger relationship for higher levels of viewing. In addition, higher levels of television viewing appear to relate to earlier onset of smoking [17]. So far, explanations for these phenomena can only be speculated. Although watching TV and working with the computer are sedentary activities, the former might be a more social activity where adolescents are joined by their smoking parents or friends [15]. Results of a Finnish cohort study [18] and a study on 11–13-yr-old schoolchildren from Marseilles (France) [19] showed that adolescent smoking is associated with parental smoking. However, parental smoking habits were not registered in detail in the present study nor whether the adolescents had their own television set in their rooms. A further explanation might be that heavy smokers watch more television due to a poorer physical condition. However, this aspect might be more relevant in elderly subjects than in adolescents. Interestingly, lower social status was associated with higher frequency of TV watching. Although data focusing on the association between prevalence of smoking and SES are controversial, many studies show a strong inverse association between parental or own SES and smoking in children and adolescents [20, 21], especially in Germany [22–24]. For further epidemiological studies on asthma and leisure time activity, the present results show that computer work cannot be used synonymously with TV watching in analysing the effects of leisure time activities on asthma.

Potentially due to the small number of participants with a parental history of asthma (125 with maternal and 112 with paternal diagnosis of asthma), this aspect did not significantly increase the risk of new onset of wheezing.

A limiting factor of the present study was that all data were collected by questionnaire, without physical examination of the subjects. However, the questionnaire used in the present prospective study was previously validated against clinical examinations [25]. While the parents answered the baseline questions in 1995–1996, the adolescents themselves replied to the follow-up questionnaire. This process was carried out in order to increase the validity of the data [26].

In conclusion, the current study implicates that sport, computer work or TV watching are not independent risk factors for new onset of wheezing in adolescents. All risk factors are strongly associated with active smoking, which itself is a powerful predictor for the onset of wheezing. Thus, any study focusing on the association of leisure time activity and wheezing should include active smoking into the analysis. Computer work and TV watching seem to be associated with different socioeconomic status and lifestyle; therefore, they cannot be used synonymously with potential predictors for wheezing.

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