



Adolescent respiratory symptoms—girls are at risk: The Young-HUNT study, Norway

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Summary The objective was to study sex differences in adolescence regarding prevalence of asthma and current wheeze and to explore the association between respiratory symptoms and hereditary, lifestyle and socioeconomic factors.

Young-HUNT included data comprehensive questionnaire on health, disease, lifestyle and social factors from 8817 teenagers 13–19 years conducted in 1995/97 (89% response rate). Questionnaire on respiratory symptoms was based on the International Study of Asthma and Allergy in Childhood (ISAAC).

In age groups 13–16 and 17–19 years, current wheeze was reported by 29.0% and 33.5% among girls and 20.4% and 22.1% among boys, whilst the corresponding figures for asthma were 8.5% and 12.2% among girls and 7.1% and 7.0% among boys. Both wheeze and asthma were significantly more prevalent and increased with age in girls compared to boys. Heredity was associated with asthma, but the association was strongest between parents and children of the same sex. Environmental smoking was associated with asthma and wheeze in girls only. Girls reported more asthma and wheeze in association with overweight compared to boys.

Girls reported more wheeze and asthma than boys and seemed more susceptible to risk factors such as environmental smoking and overweight than boys. Moreover, girls with mothers having asthma were more likely to be diagnosed as asthmatics themselves.

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Introduction

Epidemiological studies from different parts of the world have shown considerable variations in the prevalence of respiratory symptoms. Among children, adolescents and adults, there seem to be an increase in prevalence of asthma of about 0.3% per every 8–10 years time period described in papers from 1966 to 1994.¹ A recent paper have reported a continuous ongoing increase in prevalence of mild symptom asthma and wheeze among children 8–9 years during the last decade,² while others have suggested no further increase in asthma during the 1990s.^{3–5}

Asthma usually starts in early childhood and often persists throughout life.⁶ Childhood asthma has been found to be more common among boys than girls,⁷ while persistent asthma seems to be more frequent in adult females than males.⁸ The teenage group is not previously found to be entirely described. Although respiratory symptoms are common in adolescence, little is known about sex differences in the impact of risk factors in teenage years. The sex difference in prevalence of respiratory symptoms may partly be due to psychosocial factors with girls reporting more symptoms in general with age.⁹ On the other hand, differences might be a result of different susceptibility to environmental factors.

The objective was to study sex differences in adolescence regarding prevalence of asthma and current wheeze and to explore the association between respiratory symptoms and hereditary, lifestyle and socioeconomic factors.

Material and methods

Study population

The county of Nord-Trøndelag, situated in a central area of Norway, has about 127,000 inhabitants. In 1995/97 all inhabitants, 13 years and older, in the county were invited to join the Nord-Trøndelag Health Study (HUNT). Students in Junior High and High Schools, 13–19 years, were invited to the youth part of the study; Young-HUNT.

Methods

Students completed a self-administered questionnaire during one school hour in an exam setting. The questionnaire included respiratory symptoms based on the International Study of Asthma and

Allergy in Childhood (ISAAC) questionnaire.¹⁰ Within a month after completing the questionnaire, the students underwent a clinical examination including standardized measures of height and weight wearing light clothes without shoes. Height was read to the nearest cm and weight to the nearest 1/2 kg. Data from the adult part of the Nord-Trøndelag Health Study (HUNT) containing self-reported information from the mothers and fathers was merged with the student files, allowing adjustment for parental self-reported asthma and socioeconomic status.

Variables

Outcome measures were self-reported current wheeze and current doctor diagnosed asthma (DDA). Subjects who reported “wheeze ever” and “wheeze last 12 months” were defined as having current wheeze. In this paper we have restricted the term asthma to subjects who reported “wheeze last 12 months” and “asthma diagnosed by a doctor”.

Allergy was defined as answering yes to “having allergy” and “having taken an allergy test at the doctor”. Current rhinitis was defined as yes to “ever having sneezing or blocked nose without a cold” and “sneezing or blocked nose without a cold last 12 months”. Environmental smoking was defined as exposure to smoking at home by mothers, fathers or siblings. Current smoking was defined as yes to “daily or occasional smoking” or reported number of cigarettes smoked daily. The question on physical activity, “outside of school, how many days a week do you perform sports or exercise until you get short of breath and/or sweaty”, has been used in previous studies¹¹ and involves frequency, endurance and intensity. Those who exercised less than twice a week were defined as having low physical activity. To define BMI we used the International Obesity Task Force described by Cole et al.¹² Each sex and age (by half year) has percentile cut off points for overweight and obesity. At age 18, adult cut off points are used, overweight being defined as BMI ≥ 25 kg/m². The overweight group included those defined as overweight or obese. Junior High School students have not yet chosen educational approach. Senior High School students who had chosen an academic education were compared to those with vocational training. Low socioeconomic status was defined as father not having academic education beyond Senior High School.

Ethics

All participants, and parents of children under the age of 16 years, signed a written consent to take part in the study. The study was approved by the Regional Committee for Medical Research Ethics and the Norwegian Data Inspectorate Board.

Statistical analysis

Statistical Package for the Social Science version 12.0 (SPSS Inc, Chicago, IL) was used for all analysis.

Current wheeze and asthma were used as dependent variables in separate regression models. All analysis were stratified by sex and age. In order to compare early and late adolescence, age was divided into two groups; 13–16 and 17–19 years, according to school level. All independent variables were tested separately before being included into three logistic regression models; potential hereditary asthma triggers, lifestyle and socioeconomic/education factors. The socioeconomic/education model was, in addition, adjusted by current smoking. In logistic regression analysis missing was recoded as no to the question asked. This procedure did not affect the result.

All hypothesis testing was conducted assuming a 0.05 significance level and a two-sided alternative hypothesis. Odds Ratio was completed with 95% confidence interval and *P*-value.

Results

The participation rate in Young-HUNT 1995/97 was 89%. As the list of invitation was based on school level rate than age, 12-year-old ($n = 127$) and 20-year-old students ($n = 40$) were excluded from further analysis, leaving Young-HUNT data from 5934 students aged 13–16 years (50% girls) and 2883 students aged 17–19 years (49% girls) eligible for analyses.

Prevalence (Table 1)

Crude prevalence of current wheeze was higher in girls compared to boys independent of age. Higher prevalence by age was seen in girls only. Prevalence of asthma showed no significant sex difference in the age group 13–16 years, but in the age group 17–19 years, girls reported more asthma than boys.

Characteristics of the study population (Table 2)

Prevalence of allergy and smoking was significantly higher with age in both sexes. No sex difference was found for allergy in either age groups, but girls were current smokers significantly more often than boys in both age groups. No significant difference was found in prevalence of overweight, mothers/fathers reporting asthma or environmental smoking between sexes or age groups, but significantly more girls exercised less than twice a week compared to the boys independent of age.

Associations (Table 3)

Reported allergy and current rhinitis were associated with asthma and current wheeze in both sexes and age groups. Parental asthma was generally associated with asthma. In sex-stratified analysis, mother having asthma seemed to be more important in girls, especially the youngest, compared to father having asthma. In the older boys the opposite was the case, with higher OR for father than mother having asthma. No significant association was found between current wheeze and father having asthma, while mother having asthma was barely significant for wheeze only in the youngest age groups and for girls in the oldest age group.

Environmental smoking was associated with both asthma and current wheeze in girls, but only with wheeze for the older age group in boys. Current smokers in both sexes and age groups

Table 1 The prevalence of current wheeze and asthma, stratified by gender and age group.

	13–16 years				17–19 years			
	Girls $n = 2970$		Boys $n = 2964$		Girls $n = 1414$		Boys $n = 1469$	
	%	95% CI	%	95% CI	%	95% CI	%	95% CI
Current wheeze	29.0	(27.4–30.6)	20.4	(19.0–21.9)	33.5	(31.0–36.0)	22.1	(20.0–24.2)
Asthma	8.5	(7.5–9.5)	7.1	(6.2–8.0)	10.0	(8.4–11.6)	7.0	(5.7–8.3)

Table 2 The prevalence of potential risk factors for current wheeze and asthma.

Potential risk factors	13–16 years				17–19 years			
	Girls <i>n</i> = 2970		Boys <i>n</i> = 2964		Girls <i>n</i> = 1414		Boys <i>n</i> = 1469	
	%	95% CI	%	95% CI	%	95% CI	%	95% CI
Allergy	15.5	(14.2–16.8)	17.6	(16.2–19.2)	21.4	(19.3–23.5)	21.5	(19.4–23.6)
Current rhinitis	29.7	(28.1–31.3)	26.6	(25.0–28.2)	36.5	(34.0–39.0)	33.7	(31.3–36.1)
Mother asthma	5.9	(5.1–6.8)	6.3	(5.4–7.2)	5.7	(4.5–6.9)	6.1	(4.9–7.3)
Father asthma	4.7	(3.9–5.5)	6.0	(5.2–6.9)	4.7	(3.6–5.8)	5.9	(4.7–7.1)
Environmental smoking	54.6	(52.8–56.4)	53.6	(51.8–55.4)	53.4	(50.8–56.0)	54.6	(52.1–57.2)
Current smoking	17.8	(16.4–19.2)	14.7	(13.4–16.0)	33.9	(31.4–36.4)	27.2	(24.9–29.5)
Overweight	15.9	(14.6–17.2)	16.4	(15.1–17.7)	17.3	(15.3–19.3)	16.3	(14.4–18.2)
Low physical activity	31.6	(29.9–33.3)	26.1	(24.5–27.7)	41.6	(39.0–44.2)	36.4	(33.9–38.9)
Low parental socioeconomic status	48.0	(46.2–49.8)	48.9	(47.1–50.7)	49.6	(47.0–52.2)	49.7	(47.1–52.3)
Non-academic educational approach					30.6	(28.2–33.0)	44.0	(41.5–46.5)

Table 3 Odds Ratio with 95% CI for asthma and current wheeze in three separate models* stratified by gender and age group.

Categories of independent variables	Asthma				Current wheeze			
	Girls		Boys		Girls		Boys	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
<i>13–16 years</i>								
Allergy	6.44	(4.8–8.6)	6.69	(4.9–9.1)	2.81	(2.3–3.5)	2.71	(2.2–3.4)
Current rhinitis	2.73	(2.0–3.6)	2.05	(1.5–2.8)	2.63	(2.2–3.1)	2.59	(2.1–3.2)
Mother asthma	4.12	(2.7–6.2)	2.48	(1.6–3.9)	1.87	(1.3–2.6)	1.46	(1.0–2.1)
Father asthma	1.80	(1.1–3.0)	2.01	(1.2–3.3)	1.15	(0.8–1.7)	1.16	(0.8–1.7)
Environmental smoking	1.58	(1.2–2.1)	1.09	(0.8–1.5)	1.46	(1.2–1.7)	1.14	(0.9–1.4)
Current smoking	1.05	(0.7–1.5)	1.41	(1.0–2.1)	1.93	(1.6–2.4)	2.14	(1.7–2.7)
Overweight	1.57	(1.1–2.2)	1.42	(1.0–2.0)	1.41	(1.1–1.7)	1.51	(1.2–1.9)
Low physical activity	1.04	(0.8–1.4)	0.91	(0.7–1.3)	1.09	(0.9–1.3)	0.97	(0.8–1.2)
Low parental socioeconomic status	0.90	(0.6–1.3)	1.18	(0.8–1.8)	0.90	(0.7–1.1)	0.93	(0.7–1.2)
<i>17–19 years</i>								
Allergy	5.35	(3.6–7.9)	10.27	(6.4–16.6)	2.22	(1.7–2.9)	3.16	(2.4–4.2)
Current rhinitis	2.46	(1.7–3.7)	1.60	(1.0–2.5)	2.38	(1.9–3.0)	1.88	(1.4–2.5)
Mother asthma	2.17	(1.2–4.0)	2.29	(1.1–4.6)	1.57	(1.0–2.5)	1.32	(0.8–2.2)
Father asthma	1.98	(1.0–3.9)	3.50	(1.9–6.6)	1.32	(0.8–2.2)	1.54	(0.9–2.5)
Environmental smoking	1.51	(1.0–2.2)	1.07	(0.7–1.7)	1.40	(1.1–1.8)	1.36	(1.0–1.8)
Current smoking	1.10	(0.7–1.6)	1.27	(0.8–2.1)	2.59	(2.0–3.3)	2.06	(1.5–2.7)
Overweight	1.89	(1.3–2.8)	1.17	(0.7–2.0)	1.43	(1.5–1.9)	1.26	(0.9–1.7)
Low physical activity	1.11	(0.8–1.6)	1.17	(0.7–1.8)	1.11	(0.9–1.4)	1.11	(0.8–1.5)
Low parental socioeconomic status	1.42	(0.8–2.4)	1.23	(0.7–2.2)	1.10	(0.8–1.5)	0.94	(0.7–1.3)
Non-academic educational level	1.17	(0.6–1.6)	1.17	(0.7–1.9)	1.10	(0.8–1.5)	1.10	(0.8–1.6)

* (1) Potential hereditary asthma triggers, (2) lifestyle factors, (3) socioeconomic/educational factors.

reported significantly more wheeze compared to non-smokers, but no difference was found in association with asthma except for the youngest boys.

Overweight was associated with asthma and current wheeze for girls and for the younger boys, but no association to overweight was found for the older boys. No associations were found between

physical activity, socioeconomic status or educational factors and respiratory symptoms.

Discussion

In this cross-sectional study of adolescents 13–19 years, both current wheeze and asthma were significantly more prevalent in girls than boys and was higher with age in girls only. Heredity was associated with asthma, especially with mothers for girls, but fathers for boys. Girls seemed more susceptible to risk factors such as environmental smoking and overweight than boys.

Searching Medline we have found no previous publications with focus on sex differences in current wheeze and asthma and potential risk factors in adolescence.

The strength of the study was the large number of participants from a general population, good response rates and that the data included the entire teenage population. Non-responders might have been absent from school due to more frequent illness. This potential bias would influence our estimates to a minor extent, as the overall response rate was high and a larger number of students with asthma or current wheeze could be expected to strengthen the association. The limitation of the study was self-reported data that may be influenced by the veracity of the students. However, the definitions chosen for outcome measures were strictly defined, confidentiality was stressed and there was a consistency in reporting of health problems, medication and the need for health services (data not shown).

Prevalence

The prevalence of reported wheeze varies between countries.¹³ Our findings for current wheeze are comparable with the results from UK,¹³ while other reports of current wheeze are as low as 9.2–10.9%.⁴ Prevalence of asthma also varies between studies. Ever having had a diagnosis of asthma at age 12–14 years without stratifying for sex has been reported from 9.6% to 20.9%,^{4,14} while other studies have estimated prevalence of current asthma of 13%.^{2,15} Lower prevalence of asthma in the present study may be the result of a more strict definition of the term asthma, involving both the term current and doctor diagnosed. This may be a source of bias influencing prevalence rates due to the improvement in diagnostic criteria over recent years. However, changes in diagnostic criteria have, most

likely, affected the prevalence of asthma to the same degree in both sexes.

The ISAAC questionnaire was designed to clarify the terminology concerning respiratory symptoms.¹⁶ Although previously validated,^{16,17} the intention to clarify terminology has not yet been reached, making comparison between results difficult. In the literature, the terms wheeze and asthma are often used to describe wheezing illness, irrespective of diagnosis. The prevalence of potential risk factors for respiratory symptoms may differ, depending on what term is used.

Associations

Allergy was a strong hereditary asthma trigger for asthma in both sexes throughout adolescence. The association between asthma and rhinitis has previously been described.¹⁸ Our findings, when adjusting for current rhinitis, revealed no increase in OR in the association between asthma and current rhinitis in particular, compared to the more imprecise term current wheeze.

Parental asthma was clearly associated with asthma. In the youngest girls, compared to the boys, mother having asthma seemed to be more important than father having asthma with higher OR in association with asthma. This could indicate that mothers with asthma more easily detect the same symptoms in their young teenage daughters. This sex difference was reverted in the older age group with boys, compared to girls, having a higher OR for father than mother having asthma in association with asthma, raising the question of a new aspect of asthma based on genetic qualities.

Girls were current smokers significantly more often than boys in both age groups. Even though there was no clear association between current smoking and asthma, girl's smoking pattern might be a potential major aspect to their respiratory symptoms. Previous studies have reported a higher prevalence of women with respiratory symptoms among women who smoke, compared to men who smoke¹⁹ and adolescent females seem to have a lower threshold for developing respiratory symptoms when exposed to tobacco smoking than adolescent males.²⁰

The simultaneous rise in both obesity and asthma during the last decades, have led to a discussion about a possible relationship between these two conditions. In our study girls reported significantly more asthma and wheeze in association with overweight compared to boys. This is in concordance with previous studies reporting high BMI to be an independent risk factor for development of

asthma in a population aged 4–17 yr²¹ and that obese women appear to be at higher risk of asthma than men.²²

Own education, more than socioeconomic status, is found to be strongly related to smoking.²³ Previous papers suggest no relationship between socioeconomic status and asthma prevalence in children^{24,25} and The Young-HUNT study supports this finding.

Conclusion

Current wheeze and asthma were significantly more prevalent and increased with age in girls compared to boys. Heredity was associated with asthma, especially with mothers for girls, but fathers for boys. Girls seemed more susceptible to risk factors such as environmental smoking and overweight than boys.

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