

RESEARCH ARTICLE



Worsening asthma at school is associated with poor psychosocial well-being

Eerika Finell^a, Asko Tolvanen^b, Caroline Stridsman^c, Helena Backman^c and Linnéa Hedman^c 

^aFaculty of Social Sciences and Business Studies, Kuopio Campus, University of Eastern Finland, Kuopio, Finland; ^bMethodology Centre for Human Sciences, University of Jyväskylä, Finland; ^cDepartment of Public Health and Clinical Medicine, The OLIN and Sunderby Research Unit, Umeå University, Umeå, Sweden

ABSTRACT

Objective: To study whether worsening asthma at school was related to generic health-related quality of life (HRQoL) and asthma-related impact and worry among 15-year-olds with current asthma in Sweden. In addition, we studied the association between worsening asthma at school at age 15 and the change in the degree to which asthma interfered with daily activities between ages 15 and 19 years.

Methods: Within the Obstructive Lung Disease in Northern Sweden (OLIN) studies, a cohort of schoolchildren has been followed from age 8 years until 19 years of age. In the current study, the sample included 266 adolescents with physician-diagnosed asthma, and either wheeze or use of asthma medication during the last 12 months at age 15 years.

Results: At age 15, HRQoL scores were lower among those who reported worsening asthma at school (standardised beta (β) = -0.18 , $p = 0.003$), they had more asthma-related worries ($\beta = -0.33$, $p < 0.001$) and asthma impacted their life during activities more ($\beta = -0.46$, $p < 0.001$) than those whose asthma did not worsen. Furthermore, the more adolescents reported that asthma worsened at school at age 15, the more it was associated with the increase in the degree to which asthma interfered with their activities between 15 and 19 years ($\beta = 0.14$, $p = 0.038$).

Conclusions: Worsening asthma at school was associated with lower generic health-related quality of life, higher asthma-related worry and impact on daily activities among teenagers with asthma.

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Introduction

Asthma is one of the most common chronic conditions among children and teenagers globally [1]. With the rising prevalence in many countries, it produces an increasing burden for patients, higher treatment costs and loss of productivity in society [2]. The disease impacts adolescents' psychosocial well-being in many ways, for instance, by decreasing the health-related quality of life (HRQoL) [3–5]. HRQoL refers to the individual's perception and subjective evaluation of their health and well-being within their unique cultural environment [6]. Furthermore, asthma may also affect sleep quality [7], increase anxiety and depression [8,9] and increase school absenteeism [10,11]. Good symptom control is an important treatment goal for asthma [2]. Unfortunately, uncontrolled asthma is common among teenagers, and it is associated with an increased risk of symptom exacerbations, particularly among girls [5].

Adolescence can be a challenging time due to significant personal, social and physiological changes. At this age, a teenager with asthma often assumes the responsibility for their health and treatment from the parents [12], and developmental norms may play a role, as the need for conformity or feelings of embarrassment often outweigh using an inhaler in front of classmates [13]. It has been shown that having asthma may expose children and adolescents to stigmatisation and school bullying [14,15]. Moreover, teenagers spend substantial time in school buildings that can be significant sites of exposures and triggers related to asthma exacerbations, especially if their asthma is not in control. For instance, teenagers with asthma report that poor air quality, poorly cleaned environments, allergens, strong fragrances, rebuilding projects, physical education and stress were the main asthma triggers at school [16]. There may also be other exposures such as infections and other socio-environmental factors that may exacerbate their symptoms [17–19]. Since teen-

CONTACT Linnéa Hedman  linnea.hedman@norrbottn.se 

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agers' social and academic lives are strongly dependent on the time spent in school buildings, worsening asthma at school may be especially harmful to them.

Our aim was to study whether worsening asthma at school is related to generic HRQoL and asthma-related impact and worry among 15-year-olds with current asthma in Sweden. In addition, we studied the association between worsening asthma at school at age 15 and the change in the degree to which asthma interfered with daily activities between the ages of 15 and 19 years. We hypothesised that worsening asthma at school is related to decreased generic HRQoL and increased asthma-related worry. Furthermore, we hypothesised that worsening asthma at school is related to an increase in the degree to which asthma interferes with and impacts adolescents' daily activities.

Materials and methods

Study design and sample

Within the Obstructive Lung Disease in Northern Sweden (OLIN) studies, a population-based paediatric cohort was recruited in 2006 [4,20]. The starting point was that the parents to all children in first and second grade (age 7–8 years, median age: 8 years) in three municipalities (Luleå, Piteå and Kiruna) were invited to complete a questionnaire and 2,585 participated (response rate 96%) (Figure 1). The open paediatric cohort was followed up by questionnaire surveys at ages 12, 15 and 19 years [4]. At recruitment of the cohort, the parents gave consent for their child to participate. The participants gave written informed consent at the follow-ups at age 15 years and 19 years. The study was approved by the Regional Ethical Review Board, Umeå, Sweden (Dnr: 2005-157 M; Dnr. 2012-469-31 M; Dnr. 2015-404-31).

When the children of the cohort were 8 and 12 years old, the questionnaire was completed by their parents, and 2,819 participated at either 8 or 12 years of age. In the follow-up surveys at ages 15 and 19 years, the teenagers completed the questionnaire themselves at school. At the age of 15 years, 2,392 participated (response rate 88%; 2 were deceased, 7 could not be traced, and 101 had moved from the study area). The last follow-up was performed during the last term of upper secondary school at age 19 years, 2,430 participated (response rate 91%; 4 were deceased, 19 could not be traced, and 125 had moved from the study area).

In this study, we analysed the responses of those who reported that they had current asthma at age 15 years old (Figure 1). That is, they reported that they had had a physician-diagnosed asthma and either wheezed or used asthma medication during the last 12 months ($n = 266$, 11% of the total sample).

Questionnaires

For all questionnaire surveys, the International Study of Asthma and Allergies in Childhood (ISAAC) core questionnaire about asthma, rhinitis and eczema was included [21]. It was expanded with additional questions about asthma and allergic diseases, including physician diagnosis, symptoms, medicine use and heredity. Other questions included possible risk factors such as living conditions, physical activity, parental smoking and socio-economic status [20]. At the age of 15 years, questions about health-related quality of life (HRQoL) were added.

HRQoL was self-reported and assessed by the validated generic KIDSCREEN-10 questionnaire [6], consisting of 10 items, and each item was answered on a 5-point ordinal scale. The internal reliability of KIDSCREEN-10 for children aged 12–18 years is α

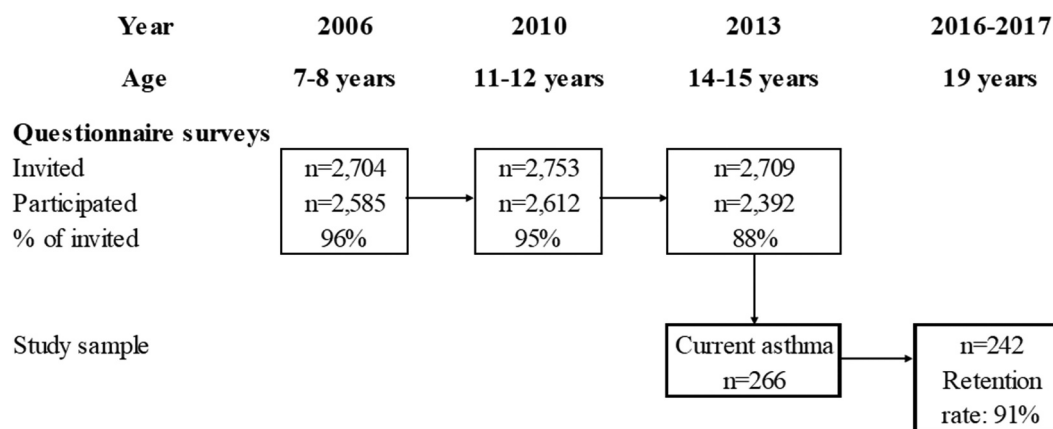


Figure 1. Flow chart of the study design, participation and study sample.

= .81. In accordance with the KIDSCREEN manual, the crude responses were transformed into a single HRQoL score. In a general population sample, the group mean of this generic HRQoL score should be approximately 50, and the standard deviation (SD) should be approximately 10. A normal score is defined as the sample's mean \pm 0.5 standard deviation [22]. A higher value indicates better generic HRQoL.

Asthma-specific HRQoL was measured using the DISABKIDS asthma module questionnaire [23]. DISABKIDS consists of two domains: *impact* (six items) that describes limitations and symptoms during activities and *worry* (five items) that describes fears related to asthma. The internal reliability of impact is $\alpha = .83$ and worry $\alpha = .84$. The score ranges from 0 to 100, and a higher score indicates a better asthma-specific HRQoL. Although no minimal important difference (MID) for the DISABKIDS score has been presented, a change of 0.5 SD has been suggested as clinically relevant [24].

Definitions

Physician-diagnosed asthma: Affirmative answer to the question, 'Have you been diagnosed by a physician as having asthma?' [20].

Current wheezing: Affirmative answer to the question, 'Have you had wheezing or whistling in the chest in the last 12 months?' [21].

Current asthma: Physician-diagnosed asthma and either current wheezing or use of asthma medication during the last 12 months.

Asthma worsening at school: 'In your opinion, do your breathing problems or asthma worsen at school?' with the following ordinal responses: 0. Did not have any problems; Not at all; 1. A little, 2. A moderate amount; and 3. A lot.

Asthma interfering with daily life: 'In the last 12 months, how much did your breathing problems or asthma interfere with your daily life?' with the following ordinal responses: 0. Did not have any problems; Not at all, 1. A little, 2. A moderate amount, and 3. A lot.

Socio-economic status was based on parental occupation, and the highest level of adults in the household was chosen. In accordance with Statistics Sweden, the occupations were categorised into the following groups: professionals or executives, non-manual employees, manual workers, self-employed, retired, housewives or unemployed.

Statistical analyses

To answer our research questions, we built and analysed five linear regression models and one latent change model [25] by Mplus statistical software version 8.1 [26]. We used full information maximum likelihood estimation (FIML) with bootstrapping (5,000), and we reported the bootstrapped confidence intervals. We used bootstrapped regression modelling because it addresses the non-normality of the data [27], it can be used with ordinal variables [28] and it allowed us to compute a latent change model. The significance level was set at 0.05. The question about asthma worsening at school had the highest percentage of missing values (14%). We assumed that values were missing at random, and we dealt with the missing data using FIML estimation. It generates unbiased values of parameters by determining the value that maximises the likelihood function based on all available data [29]. Sex and socio-economic status were included as covariates in all the models. We also report descriptive analyses using IBM SPSS Statistics (Armonk, N.Y., United States of America).

Results

The prevalence of the asthma outcome variables is reported in Table 1. Among the 266 teenagers with asthma at the age of 15 years, the mean generic HRQoL score was 50.07, similar to those without asthma at 50.99 ($p = 0.204$). For the asthma-specific HRQoL questionnaire, the mean score for asthma-related worry was 77.73, and the score for impact was 76.76 at the same age. Asthma interfered with students' lives significantly more at age 15 than at age 19 ($t(259) = 0.21$, $p = 0.001$, bootstrapped CI 95% = 0.08–0.34). Similarly, asthma worsened more at school at age 15 than at age 19 ($t(258) = 0.11$, $p = 0.033$, bootstrapped CI 95% = 0.01–0.21).

In Table 2 we report the bivariate correlates. All the variables were significantly correlated except for asthma-related worry and the generic HRQoL with asthma worsening at school at age 19 and the generic HRQoL with asthma interfering with daily life at age 19 years, which were not significantly associated.

In Table 3 we report five linear regression models using *single timepoint data*. At age 15, the generic HRQoL (standardised beta (β) = -0.18 , $p = 0.003$) was lower among those who reported worsening asthma at school than among those who did not. Similarly, asthma-related worry ($\beta = -0.33$, $p < 0.001$) and asthma-related impact ($\beta = -0.46$, $p < 0.001$) were

Table 1. Demographics and the prevalence of asthma outcomes and health-related quality of life among teenagers with asthma ($N = 266$).

	<i>N</i>	mean (SD) ^a	min – max [Median]
Girls	136	51%	
Parental socio-economic status			
Professionals and executives	64	[26]	
Non-manual employees	100	(40)	
Manual employees	63	[25]	
Self-employed	13	[5]	
Retired, housewives, students or unemployed	8	[3]	
Asthma worsening at school at 15 years	232	0.40 (0.66)	0–3 [0]
Asthma worsening at school at 19 years	228	0.29 (0.60)	0–3 [0]
Asthma interfering with daily activities at 15 years	236	1.03 (0.75)	0–3 [1]
Asthma interfering with daily activities at 19 years	235	0.81 (0.78)	0–3 [1]
Generic health-related quality of life at 15 years (KIDSCREEN-10 score)	263	50.07 (11.23)	23.97–83.81
Asthma-related worry at 15 years (DISABKIDS score)	247	77.73 (17.62)	0–100
Asthma-related impact at 15 years (DISABKIDS score)	247	76.76 (18.70)	8.33–100

^aSD = standard deviation.

stronger among those who reported worsening asthma at school than those who did not (Figure 2). Furthermore, there were significant associations between reporting asthma worsening at school and asthma interfering with daily life, both at age 15 and 19 years (15-year-olds: $\beta = 0.46$, $p < 0.001$; 19-year-olds: $\beta = 0.41$, $p < 0.001$) (Table 3).

Finally, using *two timepoint longitudinal data* and latent change modelling, we tested whether asthma worsening at school at age 15 years was related to the change in the degree to which the participants reported that asthma interfered with their daily activities between 15 and 19 years of age. Asthma worsening at school at age 15 years predicted the change significantly. If an adolescent reported that asthma worsened at school at age 15 years, this was related to an increase in reports that asthma interfered with adolescent's daily activities between 15 and 19 years of age (Figure 3). Asthma interfering with daily activities at age 15 years did not predict a change in

asthma worsening at school. The models explained 43% (latent change factor of asthma worsening at school) and 45% (latent change factor of asthma interfering with daily life) of the total variance.

Discussion

In this observational, prospective questionnaire study of 266 adolescents with current asthma, we showed that at age 15 years, worsening asthma at school was associated with poorer health-related quality of life, higher asthma-related worry and a higher impact of asthma during activities. In addition, asthma worsening at school at the age of 15 years predicted the degree to which asthma interfering with adolescents' daily activities increased between ages 15 and 19 years.

We could confirm both our hypotheses that worsening of asthma at school is related to lower generic HRQoL and increased asthma-related worry and that worsening of asthma at school is related to an increase

Table 2. Bivariate correlations of main variables with full information maximum likelihood estimation and bootstrapping approach, presented as correlation coefficients ($N = 235$ –266).

	1	2	3	4	5	6
1. Asthma interfering with daily life at age 15	1					
2. Asthma worsening at school at age 15	0.43***	1				
3. Asthma-related worry	–0.37***	–0.32***	1			
4. Asthma-related impact	–0.50***	–0.43***	0.80***	1		
5. Generic health-related quality of life	–0.24***	–0.17**	0.39***	0.46***	1	
6. Asthma interfering with daily life at age 19	0.15*	0.21**	–0.25***	–0.28***	–0.03	1
7. Asthma worsening at school at age 19	0.14*	0.24*	–0.08	–0.15*	–0.06	0.39***

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

Table 3. Linear regression (full information maximum likelihood estimation and bootstrapping approach), adjusted for sex and parental socio-economic status and presented as unstandardised betas (B) with bootstrapped 95% confidence intervals and standard error (SE) of i) the associations between asthma worsening at school and generic health-related quality of life, asthma-related worry and impact at age 15 (see figure 2, panel 1) and ii) the associations between asthma worsening at school and asthma interfering with daily life at age 15 and age 19 (see figure 2, panel 2).

	Generic health-related quality of life at age 15 ^b			Asthma-related worry at age 15 ^c			Asthma-related impact at age 15 ^d			Asthma interfering with daily life at age 15 ^a			Asthma interfering with daily life at age 19 ^a		
	B	S.E.	CI	B	S.E.	CI	B	S.E.	CI	B	S.E.	CI	B	S.E.	CI
Asthma worsening at school at age 15 ^a	-3.12	1.04	-5.12- (-1.01)	-8.75	2.25	-13.52- (-4.75)	-12.81	1.86	-16.53- (-9.32)	0.51	0.08	0.34-0.66			
Asthma worsening at school at age 19 ^a										0.52	0.08	0.35-0.67			

N = 204–217.
^a0 (Did not have any problems/Not at all) – 3 (A lot).
^bThe score ranges from 0–100. A higher value indicates better HRQoL.
^cThe score ranges from 0–100. A higher value indicates less asthma-related worry.
^dThe score ranges from 0–100. A higher value indicates fewer limitations and symptoms during activities.

in the degree to which asthma interferes with and impacts adolescents' daily activities. Psychosocial well-being refers to the interaction of an individual's character, behaviour, relationships and overall physical and mental state. Although there is evidence showing that a school can sometimes be an unhealthy environment for children and adolescents with asthma [30], there is limited literature on how asthma worsening at school influences their psychosocial well-being and quality of life compared to those whose asthma does not worsen at school. There are many reasons why worsening asthma at school can influence adolescents' daily life in a negative way. For example, teenagers suffering from asthma at school may be inclined to stay at home from school, which could partly explain the association between asthma and school absenteeism shown in many studies [10,11,16,31]. School absenteeism is closely linked to decreased academic performance [32,33]; teenagers with asthma have an increased risk of having worse school performance than those without asthma [11,34,35].

In addition to absenteeism, worsening asthma at school can also negatively impact teenagers' lives at school in other ways. In line with our findings, other studies have shown that adolescents with asthma have

an increased risk of being bullied at school, they may find it challenging to participate in sport activities or being selected for sport games, and they may have difficulties getting to classes on time on large campuses [14,15,35]. Being bullied or not being able to partake in sports activities could lead to a feeling of social isolation and experiences of stigmatisation, which could worsen their quality of life and thus explain the findings in our study. Previous research has shown that asthmatic children have a higher risk of suffering from loneliness than their peers [15,36] and they try to hide their condition in order to avoid asthma-related stigma [37].

It is well known that many factors at school can trigger asthma symptoms [16,30]. Therefore, in addition to proper asthma management with medication, attention should be paid to the school's social and built environments. For example, the school building should be well maintained, the teachers and students should be informed not to use irritating fragrances, and the school nurse should be educated to support the asthmatic students [38]. Furthermore, a supporting and inclusive social climate is essential to avoid stigmatisation and exclusion. To achieve this goal, school personnel should be aware of the possible social stressors that adolescents with current asthma can face at school.

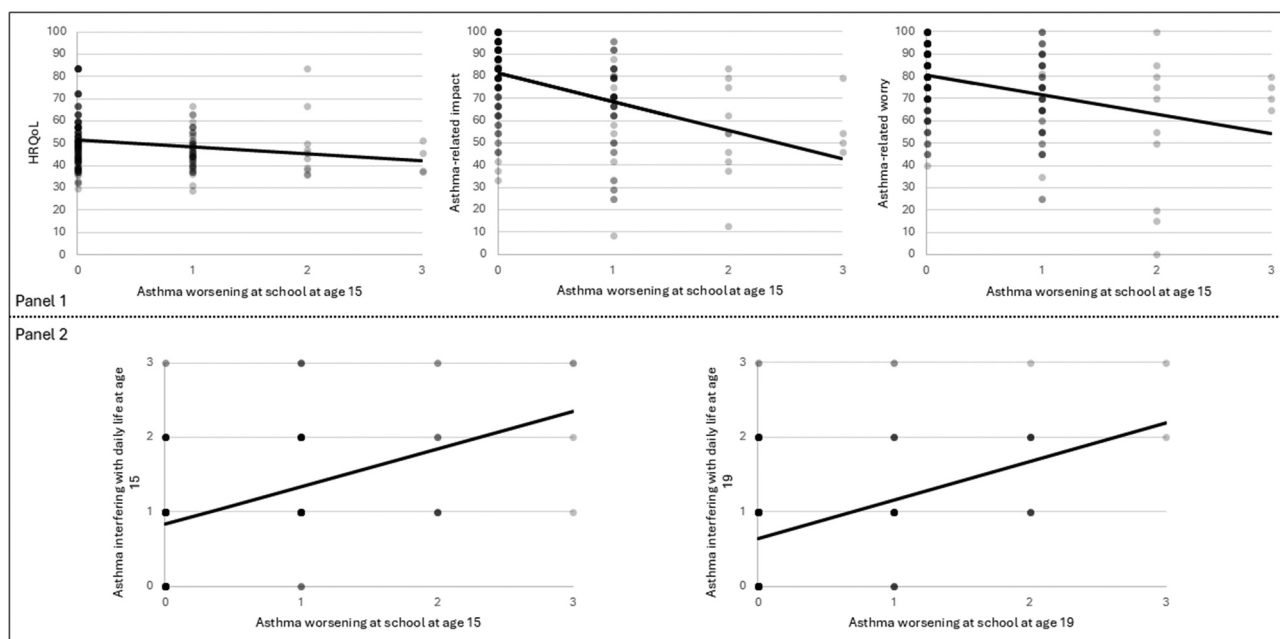


Figure 2. Scatter plots and regression lines of the analyses presented in table 3. Panel 1: the associations between asthma worsening at school at age 15 and generic health-related quality of life, asthma-related worry and impact at age 15. Panel 2: the associations between asthma worsening at school at ages 15 and 19 and asthma interfering with daily life at ages 15 and 19 ($N = 204\text{--}217$).

Analysed by linear regression (full information maximum likelihood estimation and bootstrapping approach), adjusted for sex and parental socioeconomic status and presented as unstandardised betas with bootstrapped 95% confidence intervals. The darker the points, the more observations.

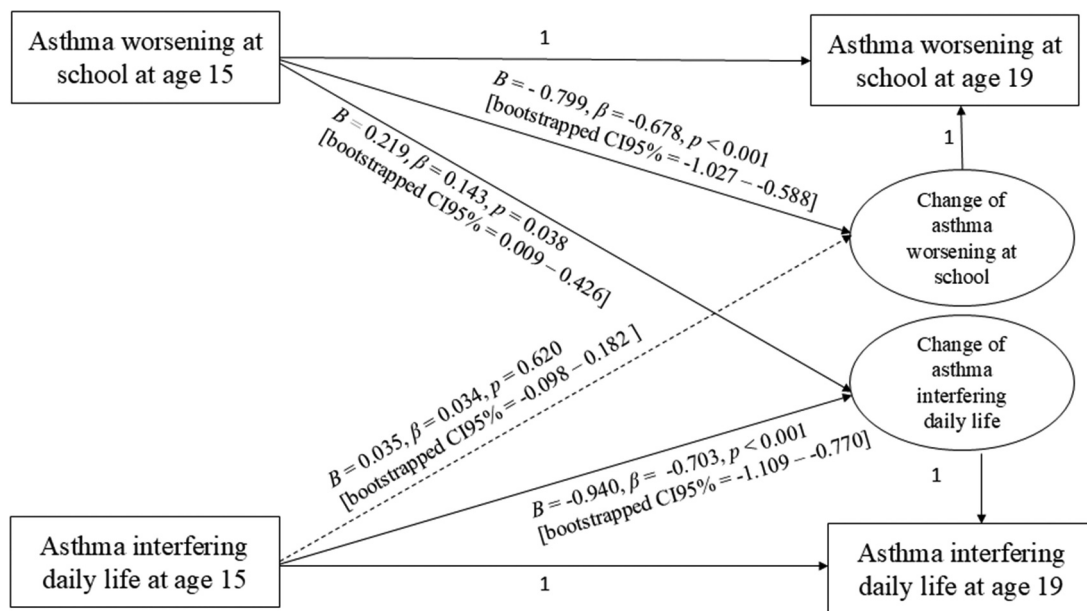


Figure 3. Latent change model. Asthma worsening at school at age 15 predicts the change of asthma interfering with daily life between ages 15 and 19 years.

B indicates unstandardised slope and β indicates standardised slope. The confidence intervals and p -values were reported from the unstandardised model ($N = 266$). The number 1 indicates that latent change captures all residual variation.

Finally, if adolescents' asthma worsens at school and leads to continuous absenteeism, other possibilities, such as changing schools, might be worth considering.

The strengths of the study include the representative and relatively large sample size of teenagers with asthma. The questionnaire included the internationally used ISAAC protocol, and the question about physician-diagnosis of asthma has been clinically validated [39]. The study is part of an ongoing longitudinal cohort study since the children were 8 years old, and the participation and retention rates have been high throughout the study period. Although the generic and asthma-specific quality of life questionnaire was measured only at one time point, the other asthma questions were studied prospectively. A limitation of the study is that we do not have information from the schools regarding the presence of dampness, mould or other environmental exposures that could explain or support our findings. Another limitation was that the questionnaire did not include questions about whether the participants had been bullied or experienced other social stressors at school. The questionnaire items assessed symptoms and interference on daily activities within the last 12 months, which may imply a risk of recall bias, i.e. those with a more severe asthma can recall the impact on daily activities while those with a milder disease tend to forget. However, both the

KIDSCREEN and DISABKIDS questionnaires are based on the last 4 weeks, supporting low risk of recall bias. Finally, unfortunately, the generic HRQoL was not measured at age 19, and therefore, we could not test its change over time. For future studies, it would be relevant to include questions about social stressors and to collaborate with the schools in order to obtain information about the indoor environment.

In conclusion, worsening asthma at school was associated with lower generic health-related quality of life, higher asthma-related worry and impact on daily activities among teenagers with asthma. Asthma interfered with students' lives less at age 19 than at age 15 years. Furthermore, asthma worsening at school at age 15 years predicted the degree to which asthma interfering with adolescents' daily activities increased between ages 15 and 19 years. Our study suggests that more attention should be paid to achieving a high quality of both the physical and social environment at schools and asthma management.

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Data availability statement

Data are available from Region Norrbotten (dataskyddsbud@norrbotten.se) upon reasonable request and after a confidentiality evaluation of researchers who meet the criteria for access to confidential data.

ORCID

Linnéa Hedman  <http://orcid.org/0000-0002-1630-3167>

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