

Severity of Childhood Asthma by Socioeconomic Status

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Background. A review of studies on the association between childhood asthma and socioeconomic status (SES) in industrialized countries leads to the conclusion that there does not seem to be a clear association. A study from Aberdeen published 25 years ago, however, shows that among children with asthma, severe asthma is most prevalent in the lower social class, but this distinction between grades of asthma severity has been largely ignored since.

Methods. We screened all fourth grade schoolchildren of German nationality in Munich (4434 children, response rate 87%), distinguishing three severity grades in the same way as the study in Aberdeen.

Results. Prevalences of childhood asthma are reported by severity grade and SES. Prevalence of severe asthma was found to be significantly higher in the low as compared with the high socioeconomic group (Odds ratio = 2.37; 95% confidence interval: 1.28–4.41). This association could not be explained by established risk factors.

Conclusions. More attention should be paid to the association between severe asthma and SES, with measures such as targeting early diagnosis and treatment towards low socioeconomic groups.

Keywords: asthma, children, socioeconomic status, health inequalities

Asthma is one of the most prevalent chronic illnesses among children in industrialized countries,^{1,2} and the prevalence seems to be increasing.^{3,4} Empirical information on the association between childhood asthma and socioeconomic status (SES) can be found in 24 studies published since the late 1960s. The overview presented in Table 1 includes studies published in English only and is not intended to provide more than a brief summary concerning the major features of the studies. Also, it may suffice to express the information on the observed association between childhood asthma and SES in a simplified form in order to show that, overall, the association is less than clear: negative associations (i.e. increasing prevalence with decreasing SES) are about as numerous as positive ones, and most studies show no association at all. This confusing picture could be due, for example, to different definitions of asthma, different methods for assessing asthma (by questionnaire, medical record or medical examination) and the different age groups studied. Similar problems of comparability are well known in asthma research,⁵ but from the studies listed in Table 1 no clear picture emerges concerning the association between childhood

asthma and SES even if studies are compared which use similar designs and methods.

A potential explanation for this puzzling result is provided by a study published by Dawson *et al.*⁶ about 25 years ago. The study does not present prevalences but instead it gives the distribution of severity grades among children who were diagnosed with asthma. Of the 31 children with high SES, 65% were classified as having mild asthma and 6% as having severe asthma; the corresponding figures for the 53 children with middle SES were 32% and 15% respectively, and for the 37 children with low SES, 35% and 27% respectively. Thus, the association between childhood asthma and SES is strongly modified by the degree of asthma severity, indicating that the prevalence of severe asthma increases with decreasing SES. This result seems to have been largely ignored, as only two studies were subsequently published that pursued the idea of distinguishing degrees of asthma severity. One of these studies reports a similar result,² but the second⁷ unfortunately only includes a brief statement that no significant differences by SES were found.

In order to clarify whether the distinction between degrees of asthma severity offers a basis for understanding the association between childhood asthma and SES, we used the approach from the Aberdeen study⁶ for analysing recent data from Germany. There were

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TABLE 1 *Studies on childhood asthma and socioeconomic status*

Authors	(Reference)	Country	Age	Outcome ^a		Result ^b
Anderson <i>et al.</i> 1986	(11)	UK	7,11,16	asthma or wheezing	(q)	0
Dawson <i>et al.</i> 1969	(6)	UK	10–15	mild asthma	(qe)	+
				moderate asthma	(qe)	0
				severe asthma	(qe)	–
Crain <i>et al.</i> 1994	(17)	USA	0–17	asthma	(q)	–
Gortmaker <i>et al.</i> 1982	(18)	USA	0–17	asthma	(q)	0
Graham <i>et al.</i> 1967	(19)	UK	9–11	asthma	(m)	+
Halfon <i>et al.</i> 1993	(14)	USA	0–17	asthma	(q)	–
Hamman <i>et al.</i> 1975	(20)	UK	5,11,14	asthma	(q)	+
Horwood <i>et al.</i> 1985	(21)	NZ	6	asthma or wheezing	(q)	0
Kaplan <i>et al.</i> 1985	(22)	UK	7	asthma	(q)	+
Kaplan <i>et al.</i> 1988	(23)	UK	16	asthma or wheezing	(q)	+
Lebowitz 1977	(24)	USA	0–15	asthma	(q)	0
Leeder <i>et al.</i> 1976	(25)	UK	0–5	asthma or wheezing	(q)	0
Mak <i>et al.</i> 1982	(26)	USA	6,12	asthma	(q)	0
McNichol <i>et al.</i> 1973	(7)	AUS	14	very mild asthma	(qe)	0
				mild asthma	(qe)	0
				moderate asthma	(qe)	0
				severe asthma	(qe)	0
Mitchell <i>et al.</i> 1989	(15)	NZ	8–9	asthma or wheezing	(q)	–
Nathanson <i>et al.</i> 1970	(27)	USA	6–11	wheezing	(q)	0
Peat <i>et al.</i> 1980b	(28)	AUS	9–17	asthma	(q)	+
Peckham <i>et al.</i> 1978	(29)	UK	11	asthma or wheezing	(q)	0
Schenker <i>et al.</i> 1983	(30)	USA	5–14	asthma or wheezing	(q)	0
Schwartz <i>et al.</i> 1990	(31)	USA	1–11	asthma or wheezing	(q)	–
Strachan <i>et al.</i> 1994	(2)	UK	5–17	mild asthma	(q)	0
				moderate asthma	(q)	–
				severe asthma	(q)	–
West <i>et al.</i> 1990	(16)	UK	15	asthma	(q)	0
Weitzman <i>et al.</i> 1990	(32)	USA	2–5	asthma	(q)	–
Wissow <i>et al.</i> 1988	(33)	USA	1–19	asthma	(m)	–

^a Asthma and wheezing assessed by medical examination carried out specifically for the study (e), by medical records (m), by questionnaire or personal interview (q)

^b Association with socioeconomic status: no association (0), positive (+) or negative (–)

two main objectives: first to replicate the study of Dawson *et al.*⁶ and second to try to explain an association between severe asthma and SES. Most studies listed in Table 1 were conducted in the UK or the US, but two were carried out in New Zealand and two in Australia. As the association between childhood asthma and SES could vary between countries, it could be important to add a study from Germany.

METHODS AND SUBJECTS

Data were analysed from a study conducted in 1989–1990 in Munich, West Germany.⁸ The target population comprised all fourth grade schoolchildren in Munich, i.e. 7455 children aged 9–11. The study included information from a questionnaire completed by a parent, and from a skin prick test with six common allergens.⁹

Returned questionnaires were available for 6490 children (response rate 87%). In order to avoid potential biases due to language abilities and ethnicity we restricted our analyses to children of German nationality ($n = 4434$).

The questionnaire was developed according to recommendations of the American Thoracic Society¹⁰ with some additional questions added. The presence of asthma was defined by the parent stating that a physician had diagnosed the child with asthma. Three severity grades were distinguished according to Dawson *et al.*⁶: mild asthma (1–4 attacks per year), moderate asthma (5–10 attacks), severe asthma (constant wheezing with acute attacks >10 times per year). Socioeconomic status was assessed by the highest educational level attained by the parents (e.g. the highest educational level the father had achieved if it is higher than

TABLE 2 *Severity grades of asthma in Munich (1989–1990)*

	Socioeconomic status			Total
	High	Medium	Low	
a) Among all children				
Number of children	2143	1225	1066	4434
Asthma prevalence				
All severity grades	116 5.4%	79 6.5%	55 5.2%	250 5.6%
Mild asthma	3.4%	3.6%	2.2%	3.1%
Moderate asthma	1.2%	1.7%	0.9%	1.2%
Severe asthma	0.9%	1.2%	2.1%	1.3%
b) Among children with asthma				
Mild asthma	72 (62%)	44 (56%)	23 (42%)	139
Moderate asthma	25 (22%)	20 (25%)	10 (18%)	55
Severe asthma	19 (16%)	15 (19%)	22 (40%)	56
	116 (100%)	79 (100%)	55 (100%)	250

the highest educational level of the mother); three levels were distinguished according to the standard cutpoints of the German schooling system.

Multivariate analyses were conducted by logistic regression with severe asthma as the dependent variable using the forward stepwise procedure starting with a model that contained the independent variables SES and gender. In each subsequent step the risk factor which yielded the largest modification of the association between SES and asthma was included until no relevant modification could be observed any more. The following risk factors were analysed: family history of asthma or atopy (past or present atopy in parents or siblings), positive skin prick test of the child, maternal smoking during first year of life, current maternal smoking, birthweight <2500 grams, damp housing conditions, heating or cooling with coal or gas, traffic burden of >75 000 cars per day in the neighbourhood. Traffic burden has rarely been studied as a risk factor for respiratory health in children, but a study based on data from Munich indicates that increasing traffic burden has a negative effect on some indicators of pulmonary function and respiratory symptoms.⁸ In order to test whether the frequency of wheezing attacks required for the diagnosis of asthma differs by SES, additional multivariate analyses were carried out with recurrent wheezing (Did your child experience wheezing more often than once?) included as an independent variable. The analyses were performed using the generalized linear model procedure GENMOD of the statistical software package SAS Version 6.09.

RESULTS

The prevalences of asthma by severity grade and SES are presented in the upper part of Table 2. The results show that there is no association with SES if all severity grades are combined, but by distinguishing between severity grades a clear association with SES emerges, with severe asthma being most prevalent in the low SES group. As the study from Aberdeen⁶ does not present prevalences but the distribution of severity grades among children with asthma, we rearranged our results into the same format (lower part of Table 2). The results are very similar: among those children diagnosed with asthma, cases of severe asthma are much more common in the low than in the high SES group (40% and 16% respectively).

In the logistic regression analyses (Table 3), our initial model controlling for gender (Table 3, model 1) showed that children with low SES have a 2.37 times higher risk of severe asthma than children with high SES (95% confidence interval[CI]: 1.28–4.41). With wheezing included as an independent variable, no significant interaction between wheezing and SES was found, indicating that the association between severe asthma and SES does not differ by the recorded categories of wheezing attacks. Also, our data showed no association between recurrent wheezing and SES.

There were only two significant associations between SES and the risk factors included in the multivariate analyses: with increasing SES the prevalence of family history of atopy increased and maternal smoking decreased. After conducting the stepwise procedure, four risk factors were included in the final

TABLE 3 Logistic regression (forward stepwise) with severe asthma as the dependent variable, Munich (1989–1990)

	Odds ratio	(95% confidence interval)
Model 1:		
low parental education ^a	2.37	(1.28–4.41)
male gender ^b	2.11	(1.20–3.68)
Model 2:		
low parental education ^a	1.81	(0.85–3.86)
male gender ^b	1.86	(0.97–3.57)
positive skin prick test ^c	6.33	(2.79–14.50)
maternal smoking ^d	2.33	(1.18–4.57)
family history of atopy ^e	2.02	(1.05–3.86)

^a Comparison group: high parental education^b Comparison group: female gender.^c Comparison group: negative skin prick test.^d Maternal smoking during first year of life; comparison group: no maternal smoking during first year of life^e Comparison group: no family history of atopy.

model (Table 3, model 2): male gender (Odds ratio [OR] = 1.86), positive skin prick test (OR = 6.33), maternal smoking during first year of life (OR = 2.33), and family history of atopy (OR = 2.02). Their impact on the association between SES and severe asthma, however, is rather small: in the final model the increased risk of low SES is still 1.81, but it is no longer statistically significant given the small number of children with severe asthma (95% CI: 0.85–3.86). Furthermore, family history of asthma and traffic burden were significantly associated with severe asthma in the final model but they did not modify the association between severe asthma and SES. In another model (not presented) which included *all* severity grades of asthma as the dependent variable, no significant association with SES was found in the initial model (OR = 0.80; 95% CI: 0.50–1.27).

DISCUSSION

There are only three published studies on childhood asthma and SES which include a distinction between grades of asthma severity.^{2,6,7} Two studies were published more than 20 years ago; one of them⁶ (based on data from Aberdeen, UK) indicates that severe asthma increases with decreasing SES, and the other⁷ (based on data from Melbourne, Australia) did not find significant differences by SES. All but one² of the more recent studies on childhood asthma and SES do not include an analysis by severity grade (even if severity grades were

assessed in the study¹¹), and the more recent study (based on data from Great Britain) supports the result from the Aberdeen study. Our study intends to clarify the association between SES and severity of childhood asthma, not only by adding analyses based on data from Germany, but also by adding multivariate analyses aimed at explaining the association between SES and severe childhood asthma.

The assessment of asthma in our study corresponds with the assessment in the Aberdeen study, and we used the same definitions for the severity grades. Also, the two studies are comparable in that similar age ranges are covered (10–15 years in Aberdeen, 9–11 years in Munich), and the overall prevalence of asthma is similar as well (4.8% in Aberdeen, 5.6% in Munich). The major difference between the two studies is that social class was assessed by parental occupation in the Aberdeen study and by parental education in the Munich study. The results from the two studies are very similar, indicating that severe asthma is most prevalent in the low SES group. The Tables presented from the Aberdeen study are not based on prevalence rates in the population but on severity grades among children with asthma; if the prevalence rates found in our study are rearranged in the same way, the excess risk for severe asthma in the low SES group (as compared with the medium plus high SES group) is 2.27 in Aberdeen and 2.29 in Munich. Thus, the association between severe asthma and SES seems to be rather stable, as it is found in two independent studies conducted 25 years apart in different countries.

Our results also indicate that no association can be found between childhood asthma and SES if no distinction is made between severity grades. Our additional analyses, however, did not reveal relevant explanations for the association between severe asthma and SES. This uncertainty corresponds with the overall uncertainty concerning the aetiology of asthma.³

Concerning potential biases, selection is a minor problem, as all fourth grade schoolchildren in Munich comprised the target population and as the response rate (87%) was rather high. The major concern focuses on the validity of reported asthma. It was intended to increase the validity by asking for physician diagnosed asthma only (and not just for symptoms of asthma observed by the parents). Overreporting is unlikely, but underreporting could occur if parents did not present an asthmatic child to a physician or if the physician failed to diagnose the asthmatic child with asthma. Both is most likely in cases of mild asthma and least likely in cases of severe asthma. Also, this potential for underreporting of mild asthma could be more frequent in the low as compared with the high socioeconomic group.

We believe, however, that our results concerning the association between severe childhood asthma and SES cannot be attributed to the potential for underreporting.

A thorough evaluation of the potential reporting bias would require the inclusion of detailed information on asthma symptoms. This information is not available in our study, but we were able to include information on the prevalence of recurrent wheezing. The analyses show that the association between SES and severe asthma is not influenced by the occurrence of recurrent wheezing. The assessment that reporting bias does not play a major role in our analyses is further supported by the results from the recent British study:² Frequent attacks of wheezing (e.g. >12 in the last 12 months) are most prevalent in the lowest socioeconomic group and least prevalent in the highest socioeconomic group. Thus, the association between SES and severe asthma does not seem to depend upon the question of whether asthma is defined based on a physician diagnosis (the Munich study) or on asthma symptoms (the British study).

Future studies aimed at explaining the association between severe asthma and SES could be based, for example, on the hypotheses proposed by Bhat *et al.*¹² 'A possible explanation is that the child from the upper class is more likely to receive early and vigorous treatment (...) so that the asthma does not become severe. Patients from the upper social class are more likely to be aware of the implications of a child's first attack of wheezing and to seek medical advice early. In addition to this, the people from the upper class are intellectually more equipped to handle the problem.' (p. 89). Similar arguments have been brought forward by other authors as well.¹ Some studies from the UK,¹³ the US¹⁴ and New Zealand¹⁵ indicate that appropriate care for asthmatic children is less common in lower compared with higher social classes. But in a recent British study,² diagnostic labelling and drug treatment did not differ substantially with SES. To our knowledge, however, no study has yet specifically addressed the question whether differences in treatment could account for socioeconomic differences in severe asthma.

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