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ORIGINAL ARTICLE

Diagnostic and treatment behaviour in children with chronic respiratory symptoms: relationship with socioeconomic factors

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Background: The prevalence and severity of asthma is believed to increase with increasing socioeconomic deprivation. The relationship between asthma diagnosis, symptoms, diagnostic accuracy, and socioeconomic deprivation as determined by Townsend scores was determined in Sheffield schoolchildren.

Methods: All 6021 schoolchildren aged 8–9 years in one school year in Sheffield were given a parent respondent survey based on International Survey of Asthma and Allergies in Childhood (ISAAC) questions.

Results: 5011/6021 (83.2%) questionnaires were returned. Postcode data were available in 4131 replies (82.4%) and were used to assign a composite deprivation score (Townsend score). Scores were divided into five quintiles, with group 1 being least and group 5 being most deprived. A positive trend was observed from group 1 to group 5 for the prevalence of wheeze in the previous 12 months, wheeze attacks ≥ 4 /year, nocturnal wheeze and cough (all $p < 0.001$), cough and/or wheeze “most times” with exertion ($p < 0.03$), current asthma ($p < 0.001$), and significant asthma symptoms ($p < 0.001$). No significant trend was observed for lifetime wheeze or attacks of speech limiting wheeze. There were no significant trends in the prevalence of current asthmatic children without significant symptoms (overdiagnosis) or children with significant asthma symptoms but no current asthma diagnosis (underdiagnosis) across the social groups. There was a significant negative trend in the ratio of asthma medication to asthma diagnosis from least to most deprived groups ($p < 0.001$).

Conclusions: Asthma morbidity and severity increase according to the level of socioeconomic deprivation. This may be due to differences in environment, asthma management, and/or symptom reporting. Diagnostic accuracy does not vary significantly across deprivation groups but children living in areas of least deprivation and taking asthma medication are less likely to be labelled as having asthma, suggesting diagnostic labelling bias.

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There are major inequalities in health between different socioeconomic groups. The prevalence and severity of asthma and wheeze related illness in children has been shown to increase with increasing deprivation measured using various socioeconomic markers,¹ and asthma mortality for the age group 5–55 years has been found to increase with worsening deprivation.² The underlying mechanisms of these associations have not been elucidated, as socioeconomic factors may influence both symptomatology and behaviour arising from symptoms, both in carers and in health workers. We have examined the relationships between asthma symptoms, diagnostic labelling, and treatment in a cohort of Sheffield children, and investigated the different patterns observed in areas of varying socioeconomic deprivation to test the hypothesis that asthma symptoms and health behaviour related to asthma might vary with degree of deprivation.

METHODS

As previously described, we surveyed a single school year of Sheffield schoolchildren aged 8–9 years in 1999 using a parent respondent survey based on the International Survey of Asthma and Allergies in Childhood (ISAAC) questions.³ Information obtained included history of wheeze ever, wheeze frequency and severity in the previous 12 months, sleep disturbance due to cough and wheeze, cough frequency, exertional cough or wheeze, and “chestiness” with colds and breathlessness. Additional questions obtained information about eczema and hayfever and drug medication and whether the child had a current diagnosis of asthma. Respondents were asked to give details of specific drug medication taken for chest problems.

All schools with pupils aged 8–9 years were approached and asked to provide a list of names for all pupils in year 4 (aged 8–9 years). Individually labelled questionnaires were distributed to schools with instructions for children to take them home for their parents to complete. To increase the return rate, non-responders were given a second identical questionnaire after 2 weeks. Postcode data obtained from the questionnaire were used to assign a Townsend score (derived from home and car ownership, employment status, and household size obtained from census data) to each respondent household based upon electoral ward. Before analysing the responses to the questionnaire, the 29 Sheffield electoral wards were divided into five “deprivation quintiles” based on Townsend score and each respondent was placed into the corresponding group (1=least deprived, 2=below average deprived, 3=average, 4=above average deprived, 5=most deprived). Data were stored in accordance with the Data Protection Act and were analysed using the χ^2 test for trend. The study was approved by the South Sheffield research ethics committee and the Sheffield Education Authority.

RESULTS

5011/6021 (83.2%) questionnaires were returned. 156/5011 respondents (3.1%) did not wish to take part in the survey. Postcode data were available in 4353/4855 remaining replies (89.7%). The number of replies where postcode data were available for least deprived, below average, average, above average, and most deprived groups were 1098, 942, 761, 833, and 719, respectively.

Table 1 Asthma diagnosis and symptom prevalence across deprivation quintiles

	Deprivation quintile					χ^2 for trend
	1 (least)	2	3	4	5 (most)	
Asthma ever	290/1090 (26.4%)	274/936 (29.4%)	241/753 (31.9%)	277/825 (33.5%)	230/711 (32.0%)	10.9 (p<0.001)
Odds ratio (95% CI)	1	1.14 (0.94 to 1.39)	1.30 (1.06 to 1.59)	1.39 (1.15 to 1.70)	1.32 (1.07 to 1.62)	
Current asthma	110/1090 (10.0%)	120/935 (12.7%)	108/756 (14.4%)	134/821 (16.2%)	111/709 (15.4%)	16.9 (p<0.001)
Odds ratio (95% CI)	1	1.31 (1.00 to 1.73)	1.49 (1.12 to 1.97)	1.74 (1.33 to 2.28)	1.65 (1.25 to 2.19)	
Wheeze ever	362/1093 (33.0%)	338/936 (36.4%)	289/754 (38.6%)	317/825 (38.7%)	269/708 (38.1%)	7.1 (p<0.01)
Odds ratio (95% CI)	1	1.14 (0.95 to 1.37)	1.26 (1.03 to 1.52)	1.26 (1.04 to 1.52)	1.24 (1.02 to 1.51)	
Wheeze in previous 12 months	172/1091 (15.6%)	182/936 (19.6%)	178/753 (23.9%)	169/823 (20.7%)	170/708 (24.3%)	19.9 (p<0.001)
Odds ratio (95% CI)	1	1.29 (1.03 to 1.62)	1.65 (1.31 to 2.10)	1.38 (1.09 to 1.75)	1.69 (1.33 to 2.14)	
"Significant asthma symptoms"*	102/1098 (9.3%)	116/942 (12.3%)	138/761 (18.1%)	153/833 (18.4%)	140/709 (19.7%)	38.7 (p<0.001)
Odds ratio (95% CI)	1	1.37 (1.04 to 1.82)	2.16 (1.64 to 2.85)	2.20 (1.68 to 2.88)	2.40 (1.83 to 3.16)	
Undiagnosed asthma**	35/1090 (3.2%)	40/935 (4.3%)	55/756 (7.3%)	60/821 (7.3%)	64/709 (9.0%)	30.6 (p<0.001)
Odds ratio (95% CI)	1	1.35 (0.85 to 2.14)	2.37 (1.53 to 3.65)	2.38 (1.55 to 3.64)	2.99 (1.96 to 4.57)	

Figures given as number/denominator (%).

*Defined by the presence of one or more of the following reported symptoms, irrespective of diagnostic label: wheeze attacks >3/year; nocturnal wheeze or cough at least once a week; cough and/or wheeze symptoms "most times" with exertion.

**Defined as significant asthma symptoms in the absence of a current asthma diagnosis.

Table 2 Severity of asthma symptoms and treatment across deprivation quintiles

	Deprivation quintile					χ^2 for trend
	1 (least)	2	3	4	5 (most)	
Wheeze attacks >3 per year	52/1087 (4.8%)	66/931 (6.9%)	78/750 (10.7%)	66/813 (8.3%)	68/700 (9.6%)	16.8 (p<0.001)
Odds ratio (95% CI)	1	1.52 (1.04 to 2.21)	2.31 (1.61 to 3.32)	1.76 (1.21 to 2.56)	2.14 (1.47 to 3.11)	
Night wheeze \geq 1/week	32/1088 (3.1%)	40/928 (4.3%)	59/745 (7.9%)	55/812 (6.5%)	52/700 (7.7%)	22.8 (p<0.001)
Odds ratio (95% CI)	1	1.49 (0.93 to 2.39)	2.84 (1.83 to 4.41)	2.40 (1.54 to 3.74)	2.65 (1.69 to 4.16)	
Night cough \geq 1/week	47/1089 (4.3%)	62/932 (6.7%)	75/759 (9.9%)	92/819 (11.3%)	88/708 (12.6%)	50.7 (p<0.001)
Odds ratio (95% CI)	1	1.58 (1.07 to 2.33)	2.43 (1.67 to 3.55)	2.81 (1.95 to 4.04)	3.15 (2.18 to 4.55)	
Speech limiting wheeze	21/1089 (1.6%)	26/927 (2.7%)	33/743 (4.2%)	22/810 (2.6%)	16/695 (2.4%)	1.56 (NS)
Odds ratio (95% CI)	1	1.47 (0.82 to 2.63)	2.36 (1.36 to 4.12)	1.42 (0.78 to 2.60)	1.20 (0.62 to 2.31)	

Figures given as number/denominator (%); NS=no significant difference.

Asthma diagnosis and symptom severity

Increasing deprivation was significantly associated with the prevalence of reported wheeze ever, wheeze in the previous 12 months, asthma ever, and current asthma (defined by a positive answer to the question "does your child have asthma at present?") (table 1). Significant positive trends were also observed for "significant asthma symptoms" (arbitrarily defined as the presence of one or more of the following reported symptoms: wheeze attacks \geq 4/year, nocturnal wheeze or cough at least once a week, cough and/or wheeze symptoms "most times" with exertion), and undiagnosed asthma (defined as significant asthma symptoms in the absence of a current diagnosis of asthma) (table 1). Significant increases in symptom frequency and severity were seen in more deprived areas despite considerable variation in prevalence within the most deprived group. Night cough was the symptom most highly correlated with deprivation (table 2). Interestingly, there was no significant difference in the prevalence of significant symptoms (as defined above) within the diagnosed asthmatic subjects across deprivation groups (data not shown).

Diagnostic accuracy

We considered the proportion of children with "significant asthma symptoms" (see above) who had a reported diagnosis of current asthma to be an index of diagnostic pick up rate. In the whole sample this proportion was 383/637 (60.1%), and

there was no significant association with deprivation quintile. The converse of this—the proportion of children with reported current asthma who did not have "significant asthma symptoms"—was considered to be an index of overdiagnosis rate and amounted to 82/583 (14.1%) with no significant trend across deprivation quintiles (table 3).

Appropriateness of asthma treatment

Overall, 821/4047 (20.3%) of the sample were taking asthma medication, with a slight but significant increase with increasing deprivation quintile (table 3). In children with significant asthma symptoms 456/629 (72.3%) reported taking asthma medication. When analysed by deprivation group no significant trend was observed (χ^2 for trend = 0.59, NS), which suggests that there were no differences in the prevalence of appropriately treated children between groups. In addition, there was no significant trend in the use of asthma medication in children reporting current asthma and significant asthma symptoms (table 3). However, there were significant negative trends in the prevalence of children with undiagnosed asthma receiving (appropriate) asthma medication, and children with no objective symptoms plus no current asthma diagnosis receiving asthma medication which is presumably inappropriate (table 3). These data suggest that children living in areas of least deprivation are more likely to receive asthma medication, both in the absence of a diagnosis of asthma and in the absence of symptoms of asthma.

Table 3 Concordance of asthma diagnosis, asthma symptoms, and treatment across deprivation quintiles

	Deprivation quintiles					χ^2 for trend
	1 (least)	2	3	4	5 (most)	
"Diagnostic pick up" (diagnosed asthma in those with significant symptoms*)	63/98 (64.3%)	76/116 (65.5%)	81/136 (59.6%)	90/150 (60.0%)	73/137 (53.3%)	0.98 (NS)
Odds ratio (95% CI)	1	1.06 (0.6 to 1.85)	0.82 (0.48 to 1.40)	0.83 (0.49 to 1.41)	0.63 (0.37 to 1.08)	
"Overdiagnosis" (no significant asthma symptoms* but current asthma diagnosis)	20/110 (18.2%)	12/120 (10.0%)	8/108 (7.4%)	27/134 (20.1%)	15/111 (13.5%)	0.04 (NS)
Odds ratio (95% CI)	1	0.50 (0.23 to 1.08)	0.36 (0.15 to 0.86)	1.14 (0.6 to 2.16)	0.70 (0.34 to 1.46)	
Asthma treatment (any)	191/1044 (18.3%)	171/886 (19.3%)	158/717 (22.0%)	158/747 (21.2%)	143/653 (21.9%)	4.79 (p<0.01)
Odds ratio (95% CI)	1	1.07 (0.85 to 1.34)	1.26 (1.0 to 1.60)	1.20 (0.95 to 1.52)	1.25 (0.98 to 1.60)	
Asthma treatment in undiagnosed asthmatics with significant symptoms*	23/34 (67.6%)	18/40 (45.0%)	21/53 (39.6%)	11/34 (32.4%)	16/34 (47.1%)	8.95 (p<0.01)
Odds ratio (95% CI)	1	0.39 (0.15 to 1.01)	0.31 (0.13 to 0.75)	0.23 (0.08 to 0.63)	0.43 (0.16 to 1.14)	
Asthma treatment despite no significant symptoms* or current asthma diagnosis	78/938 (8.3%)	53/768 (6.9%)	37/586 (6.3%)	31/607 (5.1%)	31/520 (6.0%)	4.82 (p<0.05)
Odds ratio (95% CI)	1	0.82 (0.57 to 1.17)	0.74 (0.50 to 1.11)	0.59 (0.39 to 0.91)	0.70 (0.45 to 1.08)	

Figures given as number/denominator (%); NS=no significant difference.
 *Defined by the presence of one or more of the following reported symptoms, irrespective of diagnostic label: wheeze attacks >3/year; nocturnal wheeze or cough at least once a week; cough and/or wheeze symptoms "most times" with exertion.

Atopic conditions

A significant negative trend across quintiles was seen for eczema (current or "used to have"), although exact symptoms were not asked for, with a prevalence of 33.9%, 31.5%, 34.4%, 27.9%, and 26.7% for groups 1–5, respectively (χ^2 for trend=12.62, p<0.001). No significant trend was observed for reported hayfever.

DISCUSSION

We have studied the association between asthma morbidity and socioeconomic deprivation in a large cohort of schoolchildren in the same school year in the city of Sheffield. There were significant positive trends in prevalence across deprivation groups for current asthma, current wheeze, wheeze attacks, and nocturnal symptoms. The greatest trend was observed for nocturnal cough.

Studies relating socioeconomic measures and asthma have suggested that composite deprivation scores are a good proxy for morbidity.⁴ By assigning Townsend scores by electoral ward area, we have assumed that everyone within a specific electoral ward is equally deprived.

Children in the same school year in all primary schools in Sheffield were surveyed and a good overall response rate was obtained. In the subgroup where postcode data were available, the questionnaire response rate was greatest from the least deprived and lowest from the most deprived groups. While this may represent behavioural differences across socioeconomic groups which could affect the validity of the results, the sample size from each deprivation group is large. Ethnic minority groups tend to be over-represented in less deprived groups. We did not translate questionnaires into non-English languages as this did not affect the overall return rate of questionnaires in a school survey performed in Sheffield in 1991,⁵ nor did we follow up all non-respondents. Although this may have biased the results, it is unlikely to have caused the variations seen with deprivation unless a complex interaction between deprivation, health behaviour, and questionnaire response is postulated. In a study of New Zealand adults Salmond *et al*⁶ observed that asthma prevalence associated with deprivation at an area level was unlikely to be attributable to study biases and confounding factors including ethnicity.

Our study has shown that the prevalence and severity of asthma increase with worsening socioeconomic deprivation, as measured by Townsend score at electoral ward level. A number of previous reports have found lower socioeconomic status to be associated with increased reported wheeze,^{7–9} while other studies have not.^{10–13} Other factors such as health

care utilisation, medication use, and asthma diagnosis rates are undoubtedly linked to social class. Anderson¹¹ found that asthma medication usage was associated with social class, although wheeze prevalence was not. Poorer families are more likely to use emergency services for asthma and to require admission during attacks,^{14–17} and some authors have found that severe asthma appears more common in poorer families.¹⁸ Although we found more frequent symptoms to be commoner in more deprived areas, the most severe indicator—speech limiting wheeze—was not affected by deprivation. Maternal reporting behaviour may also vary across social class. A further potential confounding influence on questionnaire based studies is the finding that poorer mothers were more likely to report a diagnosis of asthma in a child in the absence of a diagnosis in the medical records.¹⁹ Nevertheless, objective measures such as exercise induced bronchospasm have been shown to be more prevalent in children from lower socioeconomic backgrounds.¹⁰

Nocturnal cough was the symptom for the whole population which was most strikingly related to deprivation. Not all nocturnal cough is due to asthma, and previous studies in Italy, Canada and the UK have found cough to be the respiratory symptom most strongly related to socioeconomic deprivation.^{8 10 12} Clearly poverty per se does not cause the respiratory morbidity, but the mechanism by which deprivation might cause respiratory symptoms is uncertain. Interestingly, allergic sensitisation appears to decrease with increasing poverty level.²⁰ Possible explanations for the deprivation related differences include differences in parental smoking, variation in housing conditions, or reporting or medication behaviour. We did not collect data on parental smoking habits or housing, so cannot comment on the most likely mechanism in our population. It has been reported previously that smoking prevalence, particularly in mothers, is strongly associated with Townsend score, and children from smoking households have an increased risk of most respiratory symptoms,²¹ particularly in more deprived families,²² so it is likely to be a contributing factor to our findings.

Duran-Tauleria *et al*²³ in a national cross sectional study performed in 1990 in children aged 5–11 years suggested that the risk of underdiagnosis and undertreatment of asthma was higher in children from ethnic minority groups in English inner city areas. Socioeconomic factors may also be important in adherence to treatment,²⁴ subsequently determining whether or not persisting symptoms are reported. In our study there was a positive trend in reported medication usage from least to most deprived groups, probably as a result of the increased symptomatology observed. There was no evidence

that undertreatment in the more deprived groups was responsible for the increased symptom prevalence.

Our study examined the prevalence of underdiagnosis in children with significant asthma symptoms and overdiagnosis in children diagnostically labelled as having asthma but without significant objective symptoms. We interpreted these rates to represent diagnostic accuracy and found no significant differences across deprivation groups. When treatment with asthma medication was examined, there was a significant positive trend from least to most deprived groups which mirrored trends in current asthma diagnosis and asthma symptoms. The opposite observed trend for children with undiagnosed asthma receiving appropriate treatment suggests that there may be differences in diagnostic labelling behaviour between deprivation groups. We found that, in areas with the lowest deprivation scores, children with asthma symptoms and receiving medication are less likely to be labelled as asthmatic, and children with no significant symptoms of asthma are more likely to receive unnecessary asthma treatment. We believe that our study is the first to observe socioeconomic differences in diagnostic labelling behaviour in childhood asthma.

This study has shown that asthma morbidity and diagnosis increase with increasing level of socioeconomic deprivation, without a general increase in atopic disease. No significant differences were found in diagnostic accuracy between deprivation groups. However, our findings that, in the least deprived areas, children on asthma medication are less likely to be labelled as having asthma and children without significant asthma symptoms are more likely to be on inappropriate medication suggest differences in drug prescribing and diagnostic labelling behaviour between deprivation groups.

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