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Asthma Prevalence in Low-income Urban Elementary School Students in St. Louis, 1992 and 2004

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Abstract

Objective—We re-examined asthma prevalence in urban public elementary school children after 12-years during which time poverty had worsened.

Study design—We surveyed 152 children in 1992 and 331 in 2004 attending 4th and 5th grade classrooms in a low-income area of St. Louis, Missouri. Prevalences of phenotypes (current asthma, previous diagnosis without current asthma, and frequent wheezing without diagnosis) were based on standard published questions. We assessed age, sex, percentage below poverty level, and asthma experience (household member with asthma; friend, relative, or neighbor with asthma; or ever having seen someone have an attack).

Results—Prevalences were similar in 1992 and 2004 for current asthma (18% and 20%) and frequent wheezing without diagnosis (24% and 26%), despite higher 2004 percentage below poverty level (40% versus 18%). Prevalences of phenotypes were not associated with demographics or percentage below poverty level, but were associated with asthma experience. In multivariate analysis, current asthma was associated with household member with asthma and ever having seen someone have an attack, and previous diagnosis was associated with household member with asthma.

Conclusions—For these 4th and 5th grade urban public school children, self-reported asthma prevalence was similar after twelve years despite worsening poverty.

In national surveys, asthma prevalence in the United States (US) has generally increased over the last 40 years,[1–5] although some authors conclude that changes may be due to differences in labeling, variation in survey methodology, and information bias.[6–8] Nationwide in the US

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approximately 13% of children have been diagnosed with asthma at some point in their lifetime.[9–11] Studies have shown that asthma disproportionately affects minority children[4,5,9,10,,12] and those in lower socioeconomic groups.[13–16] Additionally, studies have identified considerable numbers of children who probably have asthma but remain undiagnosed and under-treated, many of whom have significant morbidity.[17–21]

It is suggested that overall asthma prevalence in the US may have reached a plateau beginning in the 1990s.[9] However, considering the influences of poverty and race on asthma prevalence, such may not be the case for some poor urban areas with relatively high minority populations. In this study, we investigated change in self-reported asthma prevalence after twelve years (1992 to 2004) for high-risk children in an urban area characterized by low and worsening socioeconomic status (SES).

Methods

We conducted a cross-sectional study initially in 1992 and then again in 2004, surveying 4th and 5th grade students attending public schools in a low-income urban area of St. Louis, Missouri. Participating schools were located within the boundaries of neighborhoods served by the Neighborhood Asthma Coalition (NAC)[22–24] in St. Louis city. The NAC intervention had been set in areas with low-income and high proportions of Medicaid-eligible children.[22–24] Students from six schools in 1992 and seven in 2004 participated. Unfortunately, only three schools that participated in 1992 were still operating in 2004. Substitute schools selected in 2004 were closest in location to those from 1992 that were no longer operating. We used the same questionnaire in both time periods.

Survey procedures

The Washington University School of Medicine Human Subjects Committee approved the study at each time period, however, they required parental permission for participation in 2004. Principals and teachers of participating schools agreed to allow time for survey administration during each period. In 1992, individual classroom teachers and staff of the St. Louis City Public Schools Office of Volunteers administered the surveys that the students completed on their own. All but one school completed the process between May 4 and June 11, 1992; one school completed the process in April 1993. In 2004, consent forms were distributed to students to take home for parental consideration and signature, and 55% of children were permitted to participate. A study member administered the questionnaires to consented children in designated areas of the schools. During the first survey administration for 2004, four subjects raised their hands on every question asking for the question and possible answers to be read aloud. In order to eliminate any barrier of illiteracy for this and all subsequent groups, the study member read aloud each question and possible answers. All questionnaires in 2004 were completed between 5/10/04 and 6/1/04.

Questionnaire Content

The human subjects committee allowed collection of individual age data (in years) but no other personal identifying information.

The three prevalence questions were from the second National Health and Nutrition Examination Survey (NHANES II) items for children 3 to 17 years of age as reported by Gergen et al:[2] 1) “During the past 12 months, not counting colds or the flu, have you frequently had trouble with wheezing?”; 2) “Has a doctor or nurse ever told you that you had asthma?”; 3) “Do you still have asthma?”. The questions were sequenced as above, and subjects answered question #3 only if they answered yes to question #2.

Prevalence questions were dichotomous ("yes" or "no"), and prevalence was reported as response to each individual question and also categorized based on the pattern of responses to the questions resulting in four asthma phenotypes of interest (Table I): 1) *no* frequent wheezing and *never* diagnosed with asthma; 2) previously diagnosed with asthma but *not* current asthma; 3) current asthma *(with previous diagnosis)*; and 4) frequent wheezing but *never* diagnosed with asthma. These four categories allowed differentiation of children with diagnoses (previous or current) from those without diagnoses or symptoms (no asthma) and from those with symptoms but no diagnoses (probable undiagnosed asthma as discussed by Gergen et al[2]).

In addition to answering questions about age and sex, participants also answered three items regarding experience with asthma in their daily lives. These were: "Do you live with someone who has asthma?"; "Do you have any friends, relatives (not living with you), or neighbors who have asthma?" and "Have you ever seen someone have an asthma attack?".

Percent Living Below Poverty

Because students' street addresses were not collected, we determined the percentage of persons living below the poverty level according to each school's attendance area, and assigned each participating student percent poverty level based on 1990 and 2000 census data according to their school. A review of the overall residence pattern of students attending these schools using data made available from the St. Louis Public Schools indicated that most students resided in either the same zip code of the school or zip codes with similar socioeconomic status (SES) indices including: median household income and house values; percentage of African-Americans, female-headed households, households with income over $50,000, households with public assistance income, high school graduates, houses lacking plumbing, owner occupied houses; percentage of persons age sixty-five and over, persons in the same house five years or more, and persons unemployed.

Data analysis

Questionnaires were identified according to school and grade level without personal identifiers except age in years. Data analyses included Chi-square or Fisher exact test to report descriptive statistics for student characteristics and prevalence by time period.

As our results showed similar prevalence rates between time periods and our sample sizes were modest for each survey period, we combined data from the two periods for univariate and multivariate analysis of the association of prevalence groups with sex, age, percent poverty and asthma experience. We used a multiple logistic regression model to test potential differences in the effects of factors in the two time periods using appropriate interaction terms. To determine the appropriateness of ignoring the nesting of students within their schools, we fit a multinominal regression model with individual student data at level 1 and school data at level 2. Variances for all random intercepts equaled zero ($p>0.05$). Consequently, we did not use multilevel modeling for this paper. Odds ratios (ORs) with 95% confidence intervals (CIs) were used to quantify the magnitude of association as appropriate.

Results

In 2004, more subjects were female and ten years old (Table I). Poverty was worse in 2004 as the percentage of people living below the poverty level in these areas was greater compared with 1992 (40% versus 18%). Also, in 2004, more subjects reported household members with asthma, but other response rates for questions regarding experience with asthma in their daily lives were similar.

There were no significant differences in prevalence rates of previously diagnosed asthma (prevalence group 2) or current asthma (prevalence group 3) in 1992 and 2004 (Table II). Less than one-half of children in each time period had no asthma (prevalence group 1), whereas nearly one-quarter in each survey had frequent wheezing not associated with colds or flu in the past twelve months and no previous or current diagnosis (prevalence group 4).

As prevalence rates were similar for the two time periods and sample sizes in each period were modest, data were combined in order to more efficiently evaluate associations with other factors. Combined prevalence rates (n=483) were 47% for no asthma, 9% for previously diagnosed asthma (but not current asthma), 19% for current asthma, and 25% for probable undiagnosed asthma. In univariate analysis (Table III), prevalence groups were associated with experience with asthma, but were similar according to sex, percent living below poverty level, and similar overall for age. Current asthma, frequent wheezing without asthma diagnosed, and previous diagnosis without current asthma were associated with reporting household members with asthma. Current asthma and frequent wheeze without diagnosis were associated with ever having seen someone have an asthma attack. Reporting having a friend, relative, or neighbor who has asthma was not associated with any prevalence groups. In adjusted analyses of each prevalence question separately, answering yes was independently associated with household member with asthma and with ever having seen someone have an attack, but not with having a friend, relative, or neighbor with asthma.

In adjusted analysis, experience with asthma was the only factor independently associated with any prevalence groups. In a multiple logistic regression model of the four prevalence groups (using “no asthma” as the reference group), previous diagnosis without current asthma was associated with household member with asthma (OR = 2.65, 95% CI 1.23, 5.70), and current asthma was associated with household member with asthma (OR = 2.15, 95% CI 1.23, 3.71) and ever having seen someone have an attack (OR = 2.43, 95% CI 1.23, 4.78). Probable undiagnosed asthma was not independently associated with any factors.

Discussion

Overall asthma prevalence appears to have reached a plateau in the US. However, prevalence changes in high-risk populations have not been extensively studied. We investigated self-reported asthma prevalence in two time periods twelve years apart (1992 and 2004) among children age 10 to 12 years attending public elementary schools in a low-income urban area. We found that prevalence was similar after twelve years despite significantly worse poverty.

Our prevalence rates indicate the ongoing pervasiveness of asthma for poor urban children. The rates of current asthma (18% in 1992 and 20% in 2004) are comparable with other studies in similar urban pediatric populations (18.2% – 19.9%).[20,25] If we consider lifetime asthma simply as report of a previous diagnosis without further categorization, as is done in many studies, our rate of 28% is relatively high compared with other studies of urban public school children (range 10.8 – 24.4%).[18–20,26] Also, our rates of probable undiagnosed asthma (24% in 1992 and 26% in 2004) are at the high end of the range reported in other studies (6.2% – 30%).[17–21]

There are limited studies of changes in asthma prevalence over time for children in urban areas of the US. A study of middle school students in Seattle, Washington, who self-reported asthma diagnoses and symptoms found an increase in diagnoses after eight years (3% in 1995 to 6.2% in 2003), but a decline in the number of children with symptoms but no diagnoses (12% in 1995 and 6.2% in 2003).[17] This Seattle study did not report factors related to SES. Although we did not record information on race, the schools involved in our study are attended predominantly by African American children. In the Seattle study, students were approximately

30% white, 20% African American, and 20% Asian, different from our inner city sample[H2].

Our study area has been previously associated with higher asthma morbidity compared with other areas in the St. Louis metropolitan area,[27] which makes it of particular interest when investigating asthma trends. Although poverty in this area had increased significantly after twelve years, prevalences of current asthma, frequent wheezing without asthma diagnosed, and previous diagnosis without current asthma were similar. Other studies have shown that increased prevalence and morbidity are found with minority patients and associated with lower SES.[4,5,9,10,12–16] We may not have found an effect of our SES measure, percentage of persons living below the poverty level, on prevalence for several reasons. Because we did not measure this percentage at the individual level, we may not have had sufficient discriminating ability using this broader method. It is also possible that percent poverty is only one element among many unmeasured factors influencing high asthma prevalence for this urban area.

In adjusted analysis, prevalence groups were not associated with age, sex, time period, or percentage of persons living below the poverty level, but were associated with experience with asthma. With regard to age, the relatively narrow range may have prevented finding any significant associations with prevalence. With regard to sex, asthma prevalence seems to change from male predominance to female predominance between 10 and 15 years old,[28] which may be the reason why no differences were identified for our sample of children with ages within this range.[H3] Reporting living with someone who has asthma was associated with reporting an asthma diagnosis (previous diagnosis with or without current asthma). This finding may not be surprising considering what is known about the heritability of asthma. In adjusted analyses of each prevalence question, reporting living with someone who has asthma and ever having seen someone have an attack were both independently associated with answering yes to prevalence questions. However, reporting having a friend, relative, or neighbor who has asthma was not associated with prevalence perhaps because of the high prevalence of asthma in this area. Although these two questions were associated with reporting frequent wheezing, they were not associated with probable undiagnosed asthma.

This study has some limitations. By design we included children from an urban low-income area, and results are certainly not generalizable to all children. However, this is a population of particular interest when considering changes of asthma prevalence and associated factors for those most burdened with the disease. Selection bias may have occurred in 2004 when parental permission was required for student participation. Fifty-five percent of consents were signed and returned, and we were unable to obtain information about non-participants. Consequently, we are unable to assess direction and magnitude of this possible selection bias. Survey administration procedures also differed between time periods and may have introduced some bias. As mentioned, we collected self-reported data that was possibly affected by recall bias with either exaggerations or minimizations of symptoms or diagnoses. Although we did not verify subject's answers through parental survey or chart audit, studies have reported relatively good agreement between child and parental report of wheezing and asthma diagnosis,[29,30] and it is likely that our sample would have similar agreement. There is also the possibility of children reporting symptoms of which their parents are unaware, which may have increased the rate of those with probable undiagnosed asthma. We did not ask about severity of symptoms which might influence the interpretation of this result. As previously mentioned, we assigned percentage of persons living below the poverty level according to school attendance area and not at the individual level which would have provided more explanatory power to our analysis. Finally, we used non-validated questions to assess experience with asthma. Results may differ using other questions, and further research into these or similar exposures questions will help clarify these associations and utility in other prevalence studies.

In conclusion, for these 4th and 5th grade children attending public school in a low-income urban area, self-reported asthma prevalence was related to previous experience with asthma and was similar after twelve years despite significantly worse poverty in this area. Although other studies suggest that low SES is indirectly related to prevalence, our data suggest that worsening poverty may not be a strong influence on asthma prevalence for children living in low-income urban areas.

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Table I

Characteristics of Participants by Year

	1992 (n=152)	2004 (n=331)
Age (years)*		
10	17%	47%
11	51%	42%
12	32%	11%
Sex*		
Male	55%	43%
Female	45%	57%
Percent of persons below poverty level*	18%	40%
Experience with Asthma		
Household member with asthma*	45%	55%
Friend, relative, or neighbor with asthma	91%	92%
Ever seen someone having an asthma attack	72%	71%

Data reported as percentages of totals by year,

* $p < 0.05$

Table 2

Prevalence by Year

	1992 (n=152)	2004 (n=331)
Prevalence Questions (% answering yes by year)		
Frequent Wheezing not associated with colds or flu in past year?	43 (36–52)	48 (43–54)
Ever Diagnosed with Asthma?	28 (21–36)	28 (24–34)
Current Asthma?	18 (12–24)	20 (16–25)
Prevalence Groups (% of four groups by year)		
1 - No frequent wheezing, no previous diagnosis, no current asthma	48 (40–57)	46 (40–51)
2 - Previous diagnosis but no current asthma	10 (6–16)	8 (5–12)
3 - Current asthma	18 (12–25)	20 (16–25)
4 - Frequent wheezing, no previous diagnosis or current asthma	24 (17–31)	26 (21–31)

Data reported as percentages by year, 95% CI based on exact binomial distribution method

Table III

Univariate Analysis of Characteristics by Prevalence Groups

	No Frequent wheeze, never diagnosed	Previous diagnosis, not current asthma	Current asthma	Frequent wheeze, no diagnosis
Age				
10	Reference	Reference	Reference	Reference
11	Reference	2.38 (1.12, 5.12)	1.41 (0.83, 2.40)	1.13 (0.68, 1.87)
12	Reference	1.20 (0.39, 3.72)	1.12 (0.54, 2.35)	1.83 (0.99, 3.38)
Sex				
Male	Reference	Reference	Reference	Reference
Female	Reference	0.90 (0.46, 1.75)	1.10 (0.68, 1.78)	1.12 (0.72, 1.75)
Time Period				
1992	Reference	Reference	Reference	Reference
2004	Reference	0.88 (0.44, 1.76)	1.21 (0.72, 2.06)	1.17 (0.73, 1.89)
Percent living below poverty level	32.4 (13.8)	32.6 (13.1)	33.3 (13.4)	34.6 (13.0)
Experience with Asthma (Reference=No)				
Household member with asthma	Reference	2.41(1.18, 4.91)	2.40(1.44,4.02)	1.72(1.07,2.74)
Friend, relative, or neighbor with asthma	Reference	0.79(0.25,2.51)	2.35(0.67,8.29)	0.71(0.32,1.56)
Ever seen someone having an attack	Reference	1.59(0.75,3.36)	3.20(1.73,5.94)	2.39(1.41,4.05)

Percent Poverty, F=0.76, p=0.52, Other results reported as OR (95% CI)