Does Your Child Have Asthma?

Parent Reports and Medication Use for Pediatric Asthma

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Objective: To assess parental reporting of diagnosis used in surveys as an indicator of pediatric asthma prevalence.

Methods: Analysis of the Medical Expenditure Panel Survey, 1996 and 1997 (10404 children aged from 0 to 17 years). All values are expressed as mean (SE).

Results: Asthma medications were purchased for 2.5% (0.2%) of children. Parents of 45.4% (4.0%) of these children failed to report asthma, including 41.3 (10.5%) of those for whom maintenance medications were purchased. These findings remained unchanged when very young children were excluded from the sample. Controlling for insurance coverage, no racial, ethnic, or socioeconomic disparities in reported asthma were found; however, poor children were more likely to have maintenance medications purchased (odds ratio, 4.9; 95% confidence interval, 2.3-10.4).

Conclusions: Surveys of parental reports of asthma overlook many children with active disease. Dependence on parental reports may underestimate the prevalence of serious asthma among poor children. The parents in this study who fail to report asthma may represent a group that perceives their children’s disease as less serious a problem despite active purchasing of medications.


Asthma has been identified as the leading chronic illness among US children.1 Two facts about the epidemiology of the disease are particularly worrisome and have been targeted among the public health community as meriting particular attention. One is that serious morbidity due to the disease appears to be on the increase over the past few decades, while the other is that stark race and class disparities in asthma prevalence are evident. Children in African American, Puerto Rican, and/or low-income families specifically appear to be the most severely affected by the disease.2

A great deal of what we know about childhood asthma—including prevalence, trends, and racial and socioeconomic disparities—is based on surveys asking the question in the title of this article. “Has a doctor or other health professional ever said your child has asthma?” is the question posed in the National Health Interview Survey (NHIS) and the National Maternal and Infant Health Survey, and is the foundation of many epidemiological reports.1,3-8 The National Health and Nutrition Examination Surveys (NHANES) I through III and the Hispanic Health and Nutrition Examination Survey (HHANES) ask this question, although they also gather further information regarding children’s health care use, symptoms, and family medical histories. Investigators using these data sources9-18 may report such corroborating data along with parental report of diagnosis in their findings, although only some do so.14-18

Other investigators have collected corroborating data when estimating the prevalence of pediatric asthma. These studies tend to involve local populations, however,19-25 or recruit only children with previously identified asthma from inner-city communities.26-29 Therefore, one is prevented from making statements about national prevalence or comparisons between racial, ethnic, or socioeconomic groups based on these sources. Investigators reporting hospitalization and mortality rates show persistent race and income disparities as well as increases in incidence over time,30-38 although the implications for disparities in less severe asthma, which is far more common as a disease condition, are unclear.

In general, dependence on parental report for the study of pediatric asthma prevalence, particularly regarding race and
class disparities in the disease, is problematic. Several authors have noted that reported diagnosis of asthma does not correlate with symptom prevalence, more extensive clinical findings, or even (in adults) pulmonary function test results. Culturally specific interpretations of children’s symptoms or diagnostic labels, as well as the absence of clinical guidelines for the diagnosis of the resolution of asthma, make reliable statements about disparities based on such survey data difficult to make.

The goal of the present study is to test this indicator, parent-reported diagnosis of asthma, against corroborating evidence provided by purchasing patterns of asthma medications. Medication purchasing was chosen for corroborating evidence for several reasons. Unlike phenomena such as hospitalization or mortality, the purchase of asthma medication represents a far more common event for most children with asthma. Furthermore, with the growing universality of computerized record keeping in health care in general, medication purchasing may represent an easily accessible source of public health data, although the manner in which these data can be used in epidemiological studies remains to be worked out.

The populations of children with labeled asthma and for whom medications are purchased (hereafter referred to as “children purchasing medications,” for simplicity) would be expected to overlap, although not perfectly. This is to say that many children whose parents report that they have asthma would be expected to purchase asthma medications, and most children for whom medications specific to asthma are purchased would have the diagnosis reported by their parents on surveys. For the present study, a nationally representative data set describing labeled diagnoses and medication purchasing will be used to assess how much this is so. Once this is done, further analysis will explore how measurements of race and income disparities in asthma prevalence are altered by the substitution of medication purchasing for parental report as an indicator of asthma prevalence.

METHODS

Data were drawn from the Medical Expenditure Panel Survey (MEPS), an ongoing study conducted by the Agency for Healthcare Research and Quality. The MEPS uses a complex sampling process designed to produce a sample that is representative of the civilian, noninstitutionalized population of the United States, including oversampling of African American, Hispanic, and low-income households. For the present analysis, children aged 0 to 17 years were included. For the years 1996 and 1997, data from round 1 (covering roughly January through June of each year) were combined for a total sample of 10,404 children. In rounds 2 though 5 of each sample cycle, data on chronic conditions (including asthma) were imputed if mentioned in earlier cycles and, therefore, did not solely reflect the responses of the parents surveyed. Therefore, only disease and medication information from round 1 of each year were counted for this study.

Participants were asked to enumerate physical or mental health problems, accidents, or injuries as part of an extended, computer-driven survey. The following context was provided verbatim to the respondents during the interview:

We're interested in learning about health problems that may have bothered (PERSON) since (START DATE). Health problems include physical conditions, accidents, or injuries that affect any part of the body as well as mental or emotional health conditions, such as feeling sad, blue, or anxious about something.

Please include all conditions, accidents or injuries for which (PERSON) saw a medical provider or took medications. Also include other physical or mental health problems affecting (PERSON) since (START DATE), even if no treatment or medications were received for the problems during this period (italics added).

Word-for-word responses were then coded into a series of clinically relevant categories (of which asthma was one) by Agency for Healthcare Research and Quality personnel, with a coder reliability of 97.5%. Therefore, parent responses such as “reactive airway disease” or “wheezy bronchitis” were recorded in the data set as asthma; “acute bronchitis” and other diseases with infectious causes were not coded as asthma.

Participants were also questioned about the purchase of prescription medication during the study period, as well as where any purchases would have occurred. With the permission of the participants, responses were then corroborated with pharmacy records for quantity, form, and identity of medication; these data abstracted from pharmacy records by Agency for Healthcare Research and Quality personnel were used in the present analysis. Medications were identified in the data using the National Drug Code list constructed by the federal Food and Drug Administration. I designated medications on the list as asthma medications through clinical reasoning; these included both long- and short-acting bronchodilators, mast cell stabilizers, methylxanthines, and leukotriene receptor inhibitors. Corticosteroids, which may be used for many other purposes if administered orally or topically, were only considered asthma medications if purchased in inhaled form. Likewise, nasal corticosteroids were not considered asthma medications.

Common clinical practices may entail the use of some of these medications for diagnoses besides asthma among very young children (eg, bronchiolitis or respiratory syncytial virus pneumonia). The extent to which these diseases are related to the future development of asthma is presently unclear. Therefore, analyses were conducted both including and excluding children younger than 3 years and these results were compared.

Further information regarding respondent demographics and insurance coverage during the study period was also abstracted from the MEPS data set. As a summary variable, insurance coverage was coded as “any private” if the child was covered by a nonpublic policy during any month of that year, “only public” if the child had only public coverage for all or part of the year, and “uninsured” if the child lacked coverage during all months of that year. Prevalence rates of labeled asthma and the incidence of medication purchases were estimated using the statistical software SUDAAN (Research Triangle Institute, Research Triangle Park, NC), which is specifically designed to adjust for the stratified, partially random sample used in MEPS. Frequency analysis was conducted to calculate prevalence estimates, while logistic regression procedures were used to calculate multivariate odds ratios. All values are given as mean (SE).

RESULTS

Overall, asthma was reported by the parents of 3.8% (0.3%) of the children, while asthma medications were purchased for 2.5% (0.2%) of the children during the two 6-month periods of the study; these values are represented as a Venn diagram in the Figure. The populations had significant nonoverlap: of those purchasing any...
asthma medication, 45.4% (4.0%) were not reported to have asthma (Table 1, top). When this calculation was repeated considering only chronic maintenance medications (inhaled corticosteroids or mast cell stabilizers), 41.3% (10.5%) of those purchasing these medications failed to report asthma.

The nonoverlap of populations extended to children who did have reported asthma as well. Among children whose parents did report asthma, 64.4% (3.2%) did not purchase any medications.

Because of concerns that (1) clinicians would be reticent to diagnose asthma in very young children and (2) these medications could be used among these children for other diagnoses such as bronchiolitis, these analyses were repeated on a subsample of children that excluded those younger than 3 years (Table 1, bottom). In all cases, the resulting changes in nonoverlap were smaller than their SEs. Furthermore, this analysis revealed that all of the children for whom chronic asthma medications were purchased in the absence of a reported diagnosis were 36 months of age or older, making the argument that these medications were prescribed for bronchiolitis or respiratory syncytial virus pneumonia unlikely.

Male children were much more likely than female children to have labeled asthma ($P<.001$); they were also more likely to have asthma medications purchased for them (Table 2, $P<.001$). African American children and those covered by public insurance were more likely to have parents report asthma than their peers. Interestingly, however, significant differences in medication purchasing for these groups were not observed. When examining asthma reporting by poverty status, the lowest rates were found among near-poor households, which may reflect the relative abundance of uninsured children (ie, those having neither public nor private insurance) in this group.

On average, children with reported asthma did fill about twice the number of prescriptions over the study period than those without reported asthma (2.5 for those with asthma vs 1.3 for those without asthma, $P<.001$). The mix of medications was statistically similar, however. For example, of the children from whom asthma medications were purchased (unweighted $n=258$), 17% of the children with reported asthma purchased inhaled corticosteroids, the most commonly prescribed prophylactic medication, vs 12% of the children without reported asthma ($P=.42$). The sole exception to this similarity was that parents of children with identified asthma were more apt to purchase cromolyn sodium, also a prophylactic medication, than those without (15% for those with vs 6% for those without children with identified asthma, $P<.03$).

Racial, ethnic, and class disparities in asthma prevalence using the indicators of reported asthma, purchase of asthma medications, and purchase of chronic asthma maintenance medications are given in Table 3. Since both medication use and diagnosis reporting are likely to be associated with health care access, odds ratios are shown in both crude form and adjusted for insurance status. Interestingly, racial or ethnic disparities in any of these indicators became nonsignificant when insurance status was held constant ($P=.16$). Children living in poverty, however, were much more likely to purchase chronic asthma maintenance medications (adjusted odds ratio,
6.7%, for example. The origin of this discrepancy is than the value estimated from the NHANES III data of 3.8% among 0- to 17-year-olds. This is substantially lower asthma, these data produce a population prevalence of Using the conventional indicator of parent-reported symptoms, regardless of parental report of asthma diagnosis, is 19.5% as calculated from the NHANES III.

**Table 2. Percentage of US Children With Reported Asthma and/or for Whom Asthma Medications Were Purchased**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Children Reported to Have Asthma</th>
<th>Children for Whom Asthma Medications Were Purchased</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>3.8 (0.3)</td>
<td>2.5 (0.2)</td>
</tr>
<tr>
<td>Age, y</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-2†</td>
<td>3.4 (0.3)</td>
<td>2.5 (0.2)</td>
</tr>
<tr>
<td>3-5</td>
<td>4.5 (1.1)</td>
<td>2.8 (0.9)</td>
</tr>
<tr>
<td>6-12</td>
<td>5.0 (0.8)</td>
<td>2.4 (0.5)</td>
</tr>
<tr>
<td>13-17</td>
<td>4.4 (1.1)</td>
<td>2.4 (0.7)</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male†</td>
<td>4.8 (0.4)</td>
<td>3.3 (0.3)</td>
</tr>
<tr>
<td>Female</td>
<td>2.7 (0.3)†</td>
<td>1.5 (0.2)†</td>
</tr>
<tr>
<td>Race/ethnicity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>African American†</td>
<td>5.1 (0.6)</td>
<td>2.6 (0.5)</td>
</tr>
<tr>
<td>European American</td>
<td>3.4 (0.3)†</td>
<td>2.6 (0.3)</td>
</tr>
<tr>
<td>Latin American</td>
<td>4.3 (0.5)</td>
<td>2.1 (0.3)</td>
</tr>
<tr>
<td>Insurance type</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Any private†</td>
<td>3.3 (0.3)</td>
<td>2.6 (0.3)</td>
</tr>
<tr>
<td>Only public</td>
<td>5.8 (0.6)†</td>
<td>2.3 (0.4)</td>
</tr>
<tr>
<td>Uninsured</td>
<td>3.0 (0.7)</td>
<td>1.7 (0.4)</td>
</tr>
<tr>
<td>Household income</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Below PL†</td>
<td>5.5 (1.1)</td>
<td>2.4 (0.6)</td>
</tr>
<tr>
<td>100%-200% of PL</td>
<td>2.4 (0.7)†</td>
<td>1.2 (0.7)</td>
</tr>
<tr>
<td>&gt;200% of PL</td>
<td>3.7 (0.3)</td>
<td>2.5 (0.2)</td>
</tr>
</tbody>
</table>

Abbreviation: PL, poverty level.
*Data are given as percentage (SE).
†Indicates reference group.
‡Indicates statistically significant difference from the reference group, P<.05.

The question of which of the aforementioned is the superior estimate highlights the limits of our ability to quantify asthma or any disease with a similarly subjective diagnosis and no gold standard. A more tractable question may be which children represent the most immediate concern among public health, medical, and nursing professionals. These data suggest that the NHANES/NHIS prevalence estimates may be high if used to answer this question. Considering the children for whom medications were purchased alone yields a period prevalence of 2.5%, although this figure excludes children with adequate stores of medicine already in their possession or children with a mere 6-month quiescence from wheezing. A more reasonable response may be to group children whose parents reported asthma in the MEPS in addition to those for whom medications were purchased, yielding a prevalence estimate of 4.9% (0.3%).

Of possibly more pressing concern is the mismatch between children for whom asthma is reported and those for whom medications were purchased during the study period. This finding has 2 implications. The first is that our understanding of how parents answer these questions must become more nuanced. The second is that, given that the population of children with reported asthma is substantially different from that for whom medications are purchased, our view of race and class disparities in pediatric asthma may need to be revised. Although previously documented sex disparities in asthma appear to be robust regardless of which indicator is used (Table 2), race and ethnic disparities do not. These issues are discussed in turn in the sections below.
Children With Asthma for Whom Asthma Medications Are Not Purchased

Overall, parents of nearly two thirds of the children with reported asthma purchased no medications during the study period. The question arises of whether the nonpurchasing parents’ children really have asthma (in this context a problem of false-positive results), although intuitively the diagnosis is likely to be inaccurate for only a fraction of them. While no criteria are established for diagnosing the resolution of asthma, a period of longer than 6 months without active medication use might reasonably be expected to be part of those criteria. Furthermore, medication purchasing is only measured for the study period; children who have long-term asthma may have been actively using medications that were purchased prior to the study without needing to buy more.

As noted earlier, it is possible that the smaller population of children with asthma, those for whom asthma medications were purchased during the study period, might be on the whole more important to discussions of epidemiology and public policy. This is because that population is more likely to be composed of children with active symptoms, while the population of children with reported asthma may include many with a much lesser degree of ongoing pathology. Further research analyzing health service use by each population may reinforce or negate this interpretation.

Children Without Reported Asthma for Whom Asthma Medications Are Purchased

Possibly most surprising is the finding that the parents of more than 40% of the children for whom asthma medications were purchased (unweighted n = 101) failed to report an asthma diagnosis on open-ended, yet careful questioning. Furthermore, this finding was consistent even when only chronic asthma maintenance medications were considered. Nearly one third of these children (31%) were recorded as having upper respiratory tract infections (including otitis media), while 20% were recorded as having noninfectious lung disease that was either unspecified or listed as chronic obstructive pulmonary disease, an exclusively adult diagnosis. Thirty-seven percent of these children had diagnoses listed that bore no relation either to the respiratory system or to allergies. While the possibility exists that these children did not have asthma but simply coughed associated with an acute illness, the large number of patients and their high rate of purchasing maintenance medications make this interpretation less likely.

The quantity of medications purchased by parents of children without reported asthma, although smaller, was substantial, and included drugs commonly regarded as maintenance medications for children with active disease. These children are routinely excluded from estimations of asthma prevalence that pay attention solely to labeled disease as reported by parents. This finding suggests that many parents may view their child’s asthma not as a disease, or at least not as one worth mentioning, even when asthma medications are being actively consumed.

IMPLICATIONS FOR SURVEY STUDIES

While these data suggest that race and ethnic disparities may be overestimated, socioeconomic disparities may be underestimated. This is because, in accord with previous findings, increases in reported asthma are not associated with decrements in household income. Concurrently, children in poverty were nearly 5 times as likely to have parents who purchased inhaled corticosteroids or cromolyn while controlling for insurance status. While it is conceivable that clinicians may prescribe symptomatic medications such as bronchodilators for children in the absence of a perceived diagnosis of asthma, the supposition that they would prescribe ongoing prophylaxis of moderate or severe outbreaks, for which corticosteroids and mast cell stabilizers are indicated, is much less likely. This finding suggests that income disparities in serious disease due to asthma may be much greater than estimates produced using parent-reported diagnosis as the sole indicator. Further investigation including information on school absences, emergency department visits, and hospitalizations may help corroborate this interpretation.

IMPLICATIONS FOR RACE AND CLASS DISPARITIES IN ASTHMA

Racial and Ethnic Disparities

Once differences in insurance status are controlled, racial differences in both reported asthma and medication purchasing become nonsignificant (Table 3). In light of these data, some of our perceptions of who has asthma may deserve revision. Earlier studies have suggested that, although children in African American families are more likely to have an asthma diagnosis reported, they are equally likely to report symptoms or to have corresponding physical findings or a family medical history. While studies of hospitalization and mortality leave little room for doubt that African American children suffer a greater burden from serious asthma, symptom, physical finding, and now medication use data suggest that this disparity may not hold for asthma of lesser, but more common, levels of severity. Racial and ethnic disparities may exist for such nonemergent asthma, but the subjectivity of both symptom and diagnosis reporting prevent us from knowing for certain at this time.

Income Disparities

While these data suggest that race and ethnic disparities may be overestimated, socioeconomic disparities may be underestimated. This is because, in accord with previous findings, increases in reported asthma are not associated with decrements in household income. Concurrently, children in poverty were nearly 5 times as likely to have parents who purchased inhaled corticosteroids or cromolyn while controlling for insurance status. While it is conceivable that clinicians may prescribe symptomatic medications such as bronchodilators for children in the absence of a perceived diagnosis of asthma, the supposition that they would prescribe ongoing prophylaxis of moderate or severe outbreaks, for which corticosteroids and mast cell stabilizers are indicated, is much less likely. This finding suggests that income disparities in serious disease due to asthma may be much greater than estimates produced using parent-reported diagnosis as the sole indicator. Further investigation including information on school absences, emergency department visits, and hospitalizations may help corroborate this interpretation.

CLINICAL IMPLICATIONS

Most surprising to clinicians is the finding that parents of more than 40% of the children for whom asthma medications were purchased failed to report asthma in response to open-ended questioning. Because of the coding procedures used by Agency for Healthcare Research and Quality personnel, we also know that these parents failed to report asthma using other labels, such as “reactive airway disease” or “wheezy bronchitis.” Although it is known that health care providers may be reluctant to diagnose asthma among very young children, these findings were unchanged when children younger than 3 years were excluded from the sample.
Clearly, more focused questions using the actual terms asthma or reactive airway disease are required to obtain an accurate history for these patients, but the concern does not end there. One has to question whether the parents who failed to report asthma view their children as having an illness, much less a serious one. If not, then the motivation of these parents to abstain from smoking, relinquish pets, or use mattress covers is likely to be limited.

LIMITATIONS

Several limitations to this study should be kept in mind. Chief among these is that, although the usability of parent report of diagnosis in the estimation of asthma prevalence is investigated, its validity as an indicator cannot be quantified. This is because validity assessment requires the use of a gold standard for disease diagnosis, which is lacking in the case of asthma.

Another limitation is that medication purchasing was measured, but not medication consumption. Therefore, children with ongoing pathology who had stores of medication in their possession during the study period are not noted to have had asthma medications purchased. Furthermore, children receiving free samples of medication are not noted in the data set. At the time of this study, however, the proportion of children receiving newly marketed medications, such as leukotriene receptor inhibitors, was very small. The vast majority of medications consumed, those being bronchodilators, inhaled corticosteroids, and mast cell stabilizers, are nonrecent entrants to the pharmaceutical market that are readily available as generic equivalents. Therefore, the quantity available as free samples is likely to be quite small.

Another caveat is that some asthma medications may be used in the absence of a clinical asthma diagnosis (e.g., acute bronchitis), although clinical guidelines are lacking regarding the benefit of this practice among children. The fact that the nonasthmatic users of chronic asthma medications are all older than 36 months suggests that these patients were not consuming medications for diseases of infancy, such as bronchiolitis.

This round of the MEPS occurred during a 6-month period, covering roughly January through June. Peak asthma symptoms tend to occur in the winter months, only some of which were covered by this time frame. The sample period did include the onset of allergy season in the late spring, however. Comparisons to surveys that inquire about symptom patterns over 12-month periods, such as the NHANES or NHS, are limited.

Given the cross-sectional design of this study, causality cannot be determined. Therefore, it may be that conditions of poverty predispose children to asthma, but it may also be that near-poor parents of children with serious asthma are forced to spend down or otherwise actively pursue enrollment in state Medicaid programs.

Finally, there are limitations from the data quality of the MEPS itself. Of the 1.1% of children for whom asthma medications were purchased in the absence of a reported asthma diagnosis, an unknown fraction could have had conditions that were miscoded during data processing. The MEPS, like the NHANES and NHS, represents the state of the art in nationally represented data gathering and processing, yet no data set is perfect. It is consistent with the thesis of this article, however, to reiterate that conservatism is warranted in describing what we know about both prevalence and disparities in asthma.

While the population of children for whom medications are purchased is smaller than that of children with labeled asthma, it is likely to be composed of children with active disease, as suggested by the quantities of maintenance medications purchased. Furthermore, a large fraction of children included in this population, although highly relevant to discussions of population asthma morbidity, are excluded if parental report is used as the sole indicator of disease prevalence. Many of these parents may not view their child as having a serious illness, and they may be less inclined to take measures to control their child's asthma. Finally, the finding that poor children were much more likely to have maintenance medications purchased than non-poor children suggests that the use of labeled asthma as a prevalence indicator may substantially underestimate class disparities in serious asthma morbidity.

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REFERENCES


