Factors Influencing Gender Differences in the Diagnosis and Treatment of Asthma in Childhood: The Tucson Children’s Respiratory Study

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Summary. Studies identified gender differences in diagnosed asthma, but the extent to which they can be attributed to differences in symptom experience and frequency rather than factors influencing diagnosis has not been established. We investigated prevalence of, and consultation for, asthma symptoms, as well as diagnosis and treatment in 533 boys and 556 girls enrolled in the Tucson Children’s Respiratory Study, a population-based birth-cohort study. Questionnaires regarding respiratory symptoms and diagnoses were obtained at ages 2, 3, 6, 8, 11, 13, 16, and 18 years. Boys were significantly more likely than girls to experience both wheeze and frequent wheeze most years in the first decade of life. However, girls with symptoms were less likely than boys to see a physician (74.1% vs. 83.4%, P < 0.001) and to be labeled as having asthma (43.3% vs. 53.8%, P < 0.009), even after adjusting for symptom frequency. A difference in symptom presentation also appeared to influence diagnosis: nocturnal cough without frequent wheeze was more prevalent among girls, and was associated with reduced diagnosis of asthma. Among subjects who consulted a physician for wheeze, boys were significantly more likely than girls to have taken medication (81.5% vs. 73.5%, P < 0.01). The lag time between age at first wheeze and first use of medication among those consulting a physician for wheeze or asthma was greater for girls, especially among subjects with frequent wheeze (2.8 vs. 1.6 years, P < 0.005). These findings indicate that gender differences in the diagnosis and treatment of asthma cannot be explained completely by differences in symptom prevalence and frequency. Pediatr Pulmonol. 2006; 41:318–325.

INTRODUCTION

There is good evidence that both the incidence and prevalence of asthma vary by gender, and that these differences change with age.1 In the first decade of life, both wheeze and doctor-diagnosed asthma are more common among boys,2–5 with the cumulative incidence of asthma being approximately 64% higher among boys than girls by age 7.6 However, after puberty, the gender differences in prevalence and incidence of asthma are reversed.7,8 One study9 found that the adjusted odds ratio for current asthma among 13–18-year-old girls relative to boys was 1.86 (confidence interval (CI), 1.42–2.44). Longitudinal studies clearly show this switch from male to female predominance in asthma symptoms and diagnosis in the second decade of life.10 For example, Anderson et al.11 showed that the male-to-female incidence ratio for asthma or wheezing changed from 1.23 between 0–7 years and 1.48 at 12–16 years, to 0.59 between ages 17–23. Other studies indicate that the changing gender ratio in prevalence is attributable primarily to a greater incidence of asthma among girls after puberty.12

To some extent, these differences in diagnosed asthma reflect disparities in the prevalence of asthma symptoms. However, there is also evidence that even among children with asthma-like symptoms, diagnosis varies with gender.

Key words: asthma; gender; wheeze; cough; consultation; diagnosis; treatment.

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Sears et al.\textsuperscript{13} showed that while the prevalence of recurrent wheeze at age 13 did not differ by gender, boys were significantly more likely to have been diagnosed with asthma. Similarly, among middle school-aged children from a large population in North Carolina, girls with frequent wheeze were more likely than boys with frequent wheeze to lack a diagnosis of asthma (odds ratio for no diagnosis, 1.56; CI, 1.47–1.69).\textsuperscript{14} Even in the second decade of life, when the prevalence of wheeze\textsuperscript{15} or other asthma-like symptoms\textsuperscript{16} is greater among girls, there appears to be no concomitant increase in diagnosed asthma among girls in these studies.

To our knowledge, the factors that contribute to the gender differences in diagnosis of asthma among children with asthma symptoms have not been investigated. It is possible that gender disparities in diagnosis are attributable to the earlier onset of symptoms in boys, which gives them more time to be identified as having asthma.\textsuperscript{15} As a corollary, if having more frequent asthma symptoms among boys leads to more frequent consultation with physicians, there are more opportunities to be diagnosed. Alternatively, the disparity in diagnosis may be due to gender differences in the presentation and thus recognition of asthma. This might occur if there were differences between boys and girls in the prevalence of allergic symptoms such as eczema, atopy, and allergic rhinitis that often support the diagnosis of asthma in a wheezing child, or if girls are less likely to present with wheeze. If this is the case, it is important to identify the differences in presentation that may contribute to reduced diagnosis among girls.\textsuperscript{16}

This analysis uses data from the Tucson Children’s Respiratory Study, a population-based birth-cohort study, to investigate how clinician and parent behaviors, as well as differences in presentation, may influence gender differences in the diagnosis and treatment of asthma symptoms, from birth through adolescence.

\textbf{MATERIALS AND METHODS}

The Tucson Children’s Respiratory Study (CRS) is a prospective, longitudinal study of the risk factors for acute and chronic respiratory illness in childhood. Healthy newborns enrolled in a large local health maintenance organization were eligible. In total, 1,246 newborns, representing 78\% of those eligible, were enrolled at birth between 1980–1984. More detailed descriptions are available in previous publications.\textsuperscript{17}

\textbf{Symptoms, Diagnoses, and Medication Use}

Questionnaires regarding the child’s respiratory symptoms and diagnoses were completed by parents at age 2 (mean age $\pm$ SD, 1.6 $\pm$ 0.4 years, $n = 1,055$), 3 (2.9 $\pm$ 0.5 years, $n = 940$), 6 (6.3 $\pm$ 0.9 years, $n = 1,017$), 8 (8.6 $\pm$ 0.7 years, $n = 822$), 11 (10.9 $\pm$ 0.7 years, $n = 941$), 13 (13.5 $\pm$ 0.7 years, $n = 679$), and 16 (16.6 $\pm$ 0.6 years, $n = 736$) years. At age 18 (18.7 $\pm$ 0.7 years), questionnaires were self-completed by the child ($n = 700$). Only children with questionnaires completed at one or more of these ages ($n = 1,089$, 87.4\% of those enrolled) were included in the present analysis. Data regarding parental education level, age, history of asthma, smoking habits, and ethnicity were obtained from questionnaires administered shortly after the child’s birth.

Respondents were asked whether the child had ever wheezeed, and if so, how many episodes he or she experienced in the past year. Different answer categories were provided for frequency of wheeze in the early years, so of necessity, the definition of “frequent wheeze” varied slightly over time. At ages 2 and 3, a 5-point scale was provided for rating frequency of wheeze, with labels attached to the low (”very rarely”) and high (”on most days”) ends of the scale. Children reported to wheeze at $\geq 3$ points on this scale in either year were defined as having frequent wheeze. Beginning at age 6, reports of $<4$ episodes of wheezing during the past year on any survey were classified as infrequent wheeze, reports of $\geq 4$ episodes on only one questionnaire as occasional wheeze, and reports of occasional wheeze on more than one questionnaire as recurrent wheeze. “Frequent wheeze” refers to children with $\geq 4$ episodes on any questionnaire. Other questions ascertained the presence of exercise-induced wheeze, and physician consultation for wheeze in the past year. Information was also obtained on the frequency of cough without a cold and, at ages 16 and 18, on the frequency of nocturnal cough. Frequent cough was defined as $>3$ episodes of cough without a cold in the past year.

Respondents were asked on each questionnaire if the child ever had asthma, and if so, whether the asthma had been diagnosed by a physician. The child was considered to have “MD asthma” if asthma diagnosed by a physician was reported on one or more questionnaires through age 18.

At age 6, parents were asked if the child had ever had eczema. Data were also obtained on whether the child ever had a runny, itchy, or stuffy nose not due to a cold, and whether a physician had said that this condition was due to allergies (“allergic rhinitis”).

At each survey, respondents were asked whether the child took any medication for either wheeze or asthma. At surveys conducted at ages 11, 16, and 18 years (surveys initiated after national guidelines for asthma treatment appeared), more detailed questions assessed the frequency of use of inhaled steroids.

Age at first wheeze was calculated as the age midway between the questionnaire at which active wheeze was first reported and the age at which the previous survey was completed. Similarly, age at onset of frequent wheeze, age at first diagnosis of asthma, and age at first use of
asthma medications were defined as the midpoint between the questionnaire when the outcome was first reported and the age when the previous questionnaire was completed. The lag time between the first episode of wheeze and diagnosis of asthma was obtained by calculating the difference between age at first wheeze and age at first diagnosis of asthma, both as defined above. Lag times were similarly calculated for the period between first wheeze and first medication use, and between diagnosis and medication use.

Markers of Atopy

At age 6, allergy skin-prick tests were applied to assess the response to aeroallergens common in the Tucson area (Hollister-Stier Laboratories, Everett, WA). Allergens included house-dust mix, *Alternaria alternata*, Bermuda grass, careless weed, mesquite, mulberry, and olive. Skin tests were read after 20 min, and a ≥3-mm wheal reaction, after subtracting the control value, was defined as “atopy.”

Statistical Analysis

Frequencies of wheeze and cough were compared for boys and girls at each age surveyed, using contingency tables; the significance of relationships was assessed by chi-square test. The prevalence of diagnosed asthma and medication use among children who saw a doctor for their symptoms was compared for boys and girls, with stratification by frequency of wheeze. Gender differences in age at first wheeze and frequent wheeze, as well as age at first diagnosis and treatment, were assessed using means and t-tests. Survival analysis, a statistical technique for calculating and comparing incidence rates for individuals “at risk” of newly developing a particular condition, was used to determine the relative numbers of boys with new onset (incident) wheeze at each age. Percent with atopy, eczema, or allergic rhinitis was compared by chi-square test for boys and girls to assess whether differences in prevalence might account for the disparity in asthma diagnosis overall and among frequent wheezers. A logistic regression model was used to assess whether the gender differences observed in asthma diagnosis or medication use remained significant after adjusting for allergic conditions. Finally, gender differences in symptom complexes and their relationship with asthma diagnosis were assessed. An alpha level of <0.05 (two-tailed) was considered statistically significant for all analyses.

The study was approved by the Institutional Review Board of the University of Arizona. Informed consent was obtained from parents at time of enrollment and at ages 6, 11, and 16 years.

RESULTS

Study Population

A total of 1,089 children (87.4% of those enrolled) provided data on wheeze at least once between ages 2–16 years. Characteristics of boys and girls included in the analysis are given in Table 1. Children who were excluded from the analysis because they never provided data on wheeze (n = 157) were similar to those included in terms of gender and maternal asthma, but were significantly more likely to have Hispanic or non-Hispanic white parents, nonasthmatic fathers, and fewer years of parental education (data not shown). The proportion of boys in the population remained relatively constant over time, being 49.2% at enrollment and 46.3% at age 18. More than 76% of children with data on wheeze were still being followed at either age 16 or 18. These subjects did not differ from other children included in the analysis in gender or parental asthma, but they were significantly more likely to be non-Hispanic white, and their parents had more years of schooling.

Symptom Prevalence and Age of Onset

Most children (75.0%) wheezed at least once before age 18. As shown in Figure 1A, boys were significantly more likely than girls to experience wheeze at age 3 (*P* < 0.001), 6 (*P* < 0.00001), 8 (*P* < 0.00005), and 11 (*P* < 0.0005) years. By age 13, the difference in prevalence had declined substantially, with boys only slightly (*P* < 0.05) more likely to wheeze, and by age 16, no gender difference was apparent. At each survey prior to age 16, boys were also significantly more likely than girls to have wheezed ≥4 times in the past year (Fig. 1B).

Cough without a cold tended to be more common among boys before age 11, but became significantly more common among girls by age 18 (*P* < 0.01, Fig. 2A). Frequent cough was also more prevalent among girls at age 18 (Fig. 2B), a relationship of borderline statistical significance (16.5% vs. 11.6%, *P* = 0.056). A significantly

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Girls</th>
<th>Boys</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>556</td>
<td>533</td>
</tr>
<tr>
<td>Maternal asthma (%)</td>
<td>9.0</td>
<td>13.1</td>
</tr>
<tr>
<td>Paternal asthma (%)</td>
<td>14.3</td>
<td>10.9</td>
</tr>
<tr>
<td>Parental ethnicity (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Both non-Hispanic white</td>
<td>62.6</td>
<td>64.5</td>
</tr>
<tr>
<td>≥one Hispanic parent</td>
<td>24.5</td>
<td>23.3</td>
</tr>
<tr>
<td>Other ethnicity</td>
<td>12.9</td>
<td>12.2</td>
</tr>
<tr>
<td>Mean years maternal education (n)</td>
<td>14.4</td>
<td>14.3</td>
</tr>
<tr>
<td>Mean years paternal education (n)</td>
<td>14.9</td>
<td>14.8</td>
</tr>
</tbody>
</table>

1Information was lacking for some characteristics on some subjects. *P* < 0.03.
higher percentage of girls than boys reported nocturnal cough at both age 16 (41.6% vs. 29.1%, \( P < 0.0005 \)) and 18 (40.5% and 28.7%, \( P < 0.001 \)), the only years at which these data were obtained.

As anticipated from the predominance of wheeze among boys in early life, the mean age at onset of wheeze was significantly earlier in boys compared to girls (mean age \( \pm \) SD, 3.7 \( \pm \) 4.0 vs. 4.4 \( \pm \) 5.0 years, respectively, \( P < 0.007 \); Fig. 3). In addition, the age at which frequent wheeze was first reported was significantly earlier for boys (6.2 \( \pm \) 5.3 vs. 8.1 \( \pm \) 5.6 years, \( P < 0.003 \)). For every year but one before age 10, more boys than girls had incident wheeze, but beginning at age 10, more girls than boys had incident wheeze each year (\( P < 0.001 \)).

**Consultation for and Diagnosis of Asthma**

Boys were significantly more likely than girls to have been diagnosed as having asthma by age 18 (35.7% vs.
Among those with asthma, girls received the diagnosis at a later age than did boys (9.0 ± 5.0 vs. 7.3 ± 4.5 years, respectively, \( P < 0.001 \)). This difference was of borderline significance when analyses were limited to children who saw a physician (8.4% vs. 7.5%, respectively, \( P < 0.08 \)). However, there was no gender difference in the time lag between age at either first wheeze or first experience of frequent wheeze and diagnosis of asthma, either overall or when considered separately by frequency of wheeze.

**Presentation of Asthma**

As shown in Table 2, boys were significantly more likely than girls to be atopic at age 6 (42.5% vs. 33.7%, \( P < 0.01 \)). In contrast, the prevalence of two other clinical manifestations of allergy associated with asthma, eczema and allergic rhinitis, did not differ by gender.

To determine whether gender differences in the prevalence of these allergic conditions might account for the disparity in asthma diagnosis, we assessed by gender the proportion of subjects who received a diagnosis of asthma overall and if the child had frequent wheeze (Table 3). Atopic children with frequent wheeze were equally likely to be diagnosed with asthma regardless of gender, as were children with rhinitis and frequent wheeze. However, boys with frequent wheeze and eczema were significantly more likely to be diagnosed with asthma than were girls with both conditions. Results were similar when limited to children with infrequent wheeze, although the proportion of both boys and girls with a diagnosis of asthma was reduced (data not shown). The gender difference in diagnosis of asthma remained significant after including atopy, eczema, and rhinitis in the logistic model (data not shown).

While there was no gender difference with regard to ever reporting frequent cough without a cold, as noted above, girls were more likely than boys to report nocturnal cough. We assessed whether there were gender differences in symptom presentation that might influence diagnosis. As shown in Table 4, nocturnal cough without frequent wheeze was more common among girls, while frequent wheeze without nocturnal cough was more common among boys. Nocturnal cough alone was associated with lower rates of asthma diagnosis than any presentation that included frequent wheeze.

**TABLE 2—Prevalence of Allergic Conditions to Age 6 Years by Gender**

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>% atopy</th>
<th>% eczema</th>
<th>% allergic rhinitis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Girls</td>
<td>556</td>
<td>33.7%</td>
<td>14.5%</td>
<td>35.9%</td>
</tr>
<tr>
<td>Boys</td>
<td>533</td>
<td>42.5%</td>
<td>15.1%</td>
<td>39.8%</td>
</tr>
<tr>
<td>( P )-value</td>
<td>0.01</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
</tr>
</tbody>
</table>
Asthma Treatment

As anticipated, there was a strong association between having a diagnosis of asthma and ever taking asthma medications: 92.4% of diagnosed asthmatics with wheeze took medicine at least once for their disease, as compared to 46.1% of those who wheezed but did not have a diagnosis of asthma ($P < 0.00001$). Among children who reported wheeze at least once, boys were significantly more likely than girls to have medication prescribed for either wheeze or asthma at some time in the first 18 years of life (69.4% vs. 57.7%, $P < 0.0005$). This difference remained significant even when analyses were limited to those who consulted a physician (boys vs. girls, 81.5% vs. 73.5%, $P < 0.01$; Fig. 5). While similar trends were evident for both children with infrequent and frequent wheeze, the gender difference was statistically significant only for those with recurrent wheeze (87.0 for girls vs. 94.4, $P < 0.03$). There were no significant gender differences in ever using inhaled steroids among those with either wheeze or diagnosed asthma.

TABLE 3—Percent With Asthma by Age 18 in Presence of Allergic Condition by Age 6, Overall and If Frequent Wheeze, by Gender

<table>
<thead>
<tr>
<th>Age 6 atopy</th>
<th>Age 6 eczema</th>
<th>Age 6 allergic rhinitis</th>
</tr>
</thead>
<tbody>
<tr>
<td>All subjects</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Girls</td>
<td>47.2% (60/127)</td>
<td>32.0% (24/75)</td>
</tr>
<tr>
<td>Boys</td>
<td>51.3% (81/158)</td>
<td>57.5% (42/73)</td>
</tr>
<tr>
<td>$P$-value for gender</td>
<td>NS</td>
<td>0.002</td>
</tr>
</tbody>
</table>

| Subjects with frequent wheeze | | |
| Girls | 74.1% (40/54) | 63.2% (12/19) | 81.4% (48/59) |
| Boys | 78.9% (56/71) | 96.8% (30/31) | 80.4% (74/92) |
| $P$-value for gender | NS | 0.002 | NS |

TABLE 4—Percent With Nocturnal Cough/Frequent Wheeze Combinations by Gender, and Relationship of Combination to Asthma Diagnosis

<table>
<thead>
<tr>
<th>Symptom combination (n)</th>
<th>Prevalence</th>
<th>% with diagnosed asthma</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheeze &lt;4, no nocturnal cough in past year (n = 325)</td>
<td>48.0%</td>
<td>52.0%</td>
</tr>
<tr>
<td>Wheeze &gt;3, no nocturnal cough in past year (n = 93)</td>
<td>35.1%</td>
<td>64.9%</td>
</tr>
<tr>
<td>Nocturnal cough, wheeze &lt;4 in past year (n = 250)</td>
<td>66.4%</td>
<td>33.6%</td>
</tr>
<tr>
<td>Wheeze ≥4, nocturnal cough in past year (n = 151)</td>
<td>49.7%</td>
<td>50.3%</td>
</tr>
<tr>
<td>$P$-value for relationship with symptom combination</td>
<td>0.00001</td>
<td>0.00001</td>
</tr>
</tbody>
</table>

Among children with at least one report of wheeze who consulted a physician for their symptoms, the mean age at receiving asthma medications was significantly later for girls compared to boys (mean age $\pm$ SD, 6.7 $\pm$ 4.7 vs. 5.4 $\pm$ 4.1 years, $P < 0.006$). Further, the lag between first episode of wheeze and first use of medicine for wheeze among those who saw a physician was longer for girls compared to boys (2.6 $\pm$ 3.9 vs. 1.9 $\pm$ 3.1 years), a trend of borderline significance ($P < 0.06$). The difference was even more pronounced when limited to those with frequent wheeze (2.8 $\pm$ 3.8 for girls vs. 1.6 $\pm$ 2.5 years, $P < 0.005$).

There were no significant gender differences in having ever sought medical attention for asthma on an urgent basis. However, among asthmatics, boys were significantly more likely than girls to have been hospitalized for their asthma (19.7% vs. 10.1%, $P < 0.05$). When the comparison was limited to asthmatics with frequent wheeze, hospitalization was still significantly more common among boys than girls (29.3% vs. 13.6%, $P < 0.02$).

DISCUSSION

This analysis confirms that there are significant gender differences in the experience of asthma-like symptoms, in the diagnosis of asthma, and in the use of asthma medications. Boys are more likely to have respiratory symptoms potentially indicative of asthma in the first decade of life, after which the gender disparity in symptoms largely disappears. However, treatment-seeking behavior also differs by gender, with girls being less likely to be taken to the doctor if they have infrequent wheeze. Further, girls who saw the physician for wheeze...
are significantly less likely to be labeled as having asthma and to receive medication for their asthma, and the disparity is particularly evident among those with more frequent symptoms. Finally, the lag time between diagnosis and treatment is greater for girls. These differences in diagnosis and treatment cannot be attributed to gender differences in the prevalence of allergic conditions among children with frequent wheeze, although symptom presentation does play a role.

While the majority of children in most populations wheeze in the first 18 years of life, there are distinct gender differences in prevalence and frequency of wheeze, and these differences vary with age. In the present study, boys had a higher prevalence of both infrequent and frequent wheeze for each year up through age 13; similar results were reported by others.3,7,11 Boys were more likely than girls to have incident wheeze in virtually all years up to age 11, whereas for each year after age 11, incidence was greater among girls. Others similarly showed an increased incidence of wheeze among girls beginning around puberty.8,10 For example, using cross-sectional data from adults surveyed in the European Community Respiratory Health Survey, de Marco et al.3 showed higher rates of incident asthma among boys through the first decade of life, roughly equal rates around puberty, and an excess of incident asthma among girls after puberty. Also of interest is the clear excess of cough, particularly nocturnal cough, among girls beginning after puberty. Our data suggest that the prevalence and frequency of both wheeze and cough will become more common among girls relative to boys as they enter the third decade of life.

The effect of this disparity in symptom prevalence on asthma diagnosis is compounded, at least for this population, by the fact that boys with wheeze are more likely than girls with wheeze to be taken to see a physician. Analyses stratified by frequency of wheeze indicated that this pattern is not attributable to gender differences in frequency of symptoms. To our knowledge, gender differences in consultation for asthma were not studied previously in population-based samples. Thus, it is unclear to what extent this disparity may contribute to differences in the prevalence of asthma diagnosis and treatment reported in the literature. However, even after limiting the analysis to children who saw a physician for wheeze, the gender disparity in diagnosed asthma persists, suggesting that health-seeking behavior does not entirely explain the differential labeling by gender.

Another factor that may contribute to the gender disparity in asthma diagnosis is that boys have more severe disease. Boys in this population are clearly more likely to have frequent wheeze at most ages in the first decade of life, and boys with frequent wheeze are significantly more likely to be hospitalized than girls with frequent wheeze. Others similarly showed higher rates of hospitalization among boys.20 For example, Debley et al.21 showed that the adjusted rate of hospitalization for asthma among a large population of children in Washington state is significantly higher among boys to age 11, but becomes significantly greater for girls beginning at age 15. Having more severe disease increases the likelihood that symptoms will be labeled as asthma and treated.

It is often suggested that the disparity in diagnosed asthma between boys and girls can be attributed to gender differences in the prevalence of atopy.22 The present analysis supports this speculation by showing an excess of atopy among boys and no difference between atopic boys and atopic girls in diagnosis of asthma if they had frequent wheeze. In this regard at least, the diagnosis of asthma among girls with frequent wheeze is similar to that of boys when their presentation conforms to the expected pattern. However, eczema, another known risk factor for asthma, is significantly less likely to be associated with a diagnosis of asthma among girls with frequent wheeze than among boys, despite an equal prevalence in both genders and no difference in age of onset (data not shown). It is not clear why this condition is less likely to initiate a diagnosis of asthma among girls in the presence of frequent wheeze. Also of interest is the observation that nocturnal cough in the absence of wheeze, which is reported significantly more often for girls, was associated with a reduced diagnosis of asthma relative to frequent wheeze, which is more common among boys. Whether these differences in symptom presentation reflect a different form of asthma, predict later development of classic asthma symptoms, or are independent of asthma remains to be studied.

In the current study, girls who saw a physician were less likely than boys to have taken medication for their asthma, and this was particularly true of subjects with recurrent symptoms. Other studies showed14,23 that children with frequent wheeze who are labeled as asthmatic are 4–6 times more likely to receive inhaled medications than frequent wheezers who lack this diagnosis. Although a diagnosis of asthma was only associated with a 2-fold increased likelihood of medication use in the current population, it must be remembered that children in the CRS were born before the development of national guidelines for asthma management, which likely explains the relatively low use of inhaled steroids in this population. The more important observation is that girls waited a longer period of time after their first episode of wheeze to have medication prescribed. Persistent wheeze prior to age 6 appears to be associated with permanently reduced lung function,25 which suggests that treatment disparities in early life may have long-term consequences in terms of both lung-function deficits and symptoms into adulthood. However, it has not been conclusively demonstrated that early medical intervention will eliminate the lung-function deficits associated with early persistent wheeze. As yet unpublished data presented at recent national meetings26 suggest that early intervention among
high-risk asthmatics may not forestall later symptoms, hospitalization, or lung-function decline. Finally, while the gender disparity is usually interpreted as indicating undertreatment among girls, it is also possible that boys are overtreated, particularly among those with infrequent symptoms.

This analysis has certain limitations. Questions regarding frequency of wheeze differed slightly in the first two surveys, which makes it difficult to identify completely equivalent levels of frequent wheeze. Similarly, the respondent changed with the subject’s age: questionnaires were completed by parents during the first 16 years, but by the subject herself/himself at age 18. Whether the changes in either phrasing or respondent differentially affect symptom-reporting by gender has not, to our knowledge, been studied. Finally, our assessment of severity of asthma was limited, relying primarily on reports of frequency and recurrence of symptoms and hospitalization.

In conclusion, girls who wheeze are significantly less likely than boys to be diagnosed as having asthma in the first decade of life, a disparity attributable in part to gender differences in frequency and age at onset of wheeze, as well as consultation practices. In contrast, the gender disparity in treatment for asthma, which arises in part from a longer lag time between symptom onset and treatment for girls, is particularly evident among those with more frequent symptoms, and thus is not explained by either symptom prevalence or frequency. Clearly, gender is an important determinant of whether consultation occurs for asthma-like symptoms, as well as how they are labeled and treated.

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