

# Physical Activity in Urban School-Aged Children With Asthma

David M. Lang, MD, MPH\*; Arlene M. Butz, ScD, RN‡; Anne K. Duggan, ScD‡; and Janet R. Serwint, MD‡

**ABSTRACT.** *Objectives.* To compare the physical activity levels of children with and without asthma and evaluate predictors of activity level in children with asthma.

*Methods.* Parents of 137 children with asthma and 106 controls 6 to 12 years old who attended an urban primary care pediatric clinic were interviewed by telephone. A structured survey evaluated 1 day's total activity and the number of days active in a typical week; asthma characteristics and treatment; physician advice; opportunities for physical activity; and caregiver beliefs about physical activity. The activity levels of children with and without asthma were compared. Predictors of activity level of children with asthma were evaluated.

*Results.* Children with asthma were less active than their peers. The mean amount of daily activity differed by group: 116 (asthma) vs 146 (nonasthma) minutes; 21% (asthma) vs 9% (nonasthma) were active <30 minutes/day; and 23% (asthma) vs 11% (nonasthma) were active <3 days/week. Among children with asthma, disease severity and parental beliefs regarding exercise and asthma predicted activity level. Children with moderate or severe persistent asthma were more likely to be active <30 minutes/day (odds ratio: 3.0; confidence interval: 1.2–7.5), and children whose parents believed exercise could improve asthma were more likely to be highly active  $\geq$ 120 minutes/day (odds ratio: 2.5; confidence interval: 1.2–5.4).

*Conclusions.* Disease severity and parental health beliefs contribute to the lower activity level of children with asthma. Pediatricians should evaluate exercise level as an indicator of disease control and address exercise and its benefits with patients and caregivers to help achieve the goal of normal physical activity in children with asthma. *Pediatrics* 2004;113:e341–e346. URL: <http://www.pediatrics.org/cgi/content/full/113/4/e341>; asthma, child, exercise, health behavior, physical activity.

ABBREVIATIONS. OR, odds ratio; RRR, relative risk ratio; CI, confidence interval.

Asthma is a chronic inflammatory disease of the airways associated with significant medical and social morbidity.<sup>1–3</sup> The National Asthma Education and Prevention Program and the American Academy of Pediatrics include normal ac-

tivity in their stated goals of asthma therapy.<sup>1,4</sup> With appropriate control, children with asthma can lead normal lives, including participation in physical activity.

Physical activity is an important part of both a healthy lifestyle and a child's daily routine.<sup>5</sup> Development of good health and fitness habits in childhood is associated with physical fitness as an adult.<sup>6</sup> Participation in physical activity is an important part of a child's normal psychosocial development and self-image. Children should not be excluded from physical activity without a compelling medical contraindication.

Physical activity is especially important in children with asthma. Activities such as running<sup>7</sup> and swimming<sup>8</sup> are associated with improved fitness and decreased severity of asthma symptoms. Regular exercise and level of physical conditioning are major determinants of exercise tolerance in children with controlled asthma.<sup>9,10</sup> Recent studies indicate a comorbidity of asthma and obesity in urban children<sup>11,12</sup>; however, the direction of the association is uncertain.<sup>13</sup> Regardless of the cause and effect, physical activity is an important contributor to fitness in children with asthma.

The physical activity level of children with asthma varies in different studies. In the United States, an analysis of the 1988 National Health Interview Survey found that 30% of children with asthma had some parent-reported limitation in physical activity.<sup>14</sup> This analysis of a large data set linked asthma with reported limitations but did not quantify activity or investigate asthma-related predictors of activity. Outside of the United States, a survey of school children in New Zealand found that children with asthma were more active than their peers and had favorable attitudes toward physical activity.<sup>15</sup> A survey of students in Norway found no difference in the frequency of activity between children with and without asthma.<sup>16</sup> The authors of the New Zealand study hypothesized an association with a current publicity campaign about the benefits of exercise for people with asthma. Other reports have found that children may have difficulty with specific activities but that asthma did not prevent their overall participation in sports or physical education.<sup>17</sup> In addition to the influences of activity in all children,<sup>18–21</sup> children with asthma may be influenced by symptoms of bronchospasm,<sup>22</sup> attitudes toward activity,<sup>23,24</sup> and maternal beliefs about the safety of exercise in children with asthma.<sup>12</sup>

The objectives of this study were to compare the activity of inner-city children with asthma to their

From the \*Warren Grant Magnuson Clinical Center, National Institutes of Health, Bethesda, Maryland; and ‡Department of Pediatrics, Johns Hopkins University School of Medicine, Baltimore, Maryland.

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Reprint requests to (D.M.L.) 10 Center Dr, Rm 6C410, MSC 1625, Bethesda, MD 20892-1625. E-mail: [dlang@mail.cc.nih.gov](mailto:dlang@mail.cc.nih.gov)

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peers and to evaluate the factors associated with the activity level of children with asthma. We hypothesized that children with asthma are less active than their peers and that a combination of biomedical and psychosocial factors influence their activity level.

## METHODS

### Setting and Sample

This cross-sectional study was conducted in the Harriet Lane Pediatric Clinic, an urban, hospital-based primary care pediatric clinic in Baltimore, Maryland. The accessible population was defined (using billing records) as any clinic enrollee 6 to 12 years old who had made a visit to the primary care clinic in the preceding 2 years ( $n = 3001$ ). From this group, we selected a sample of children with asthma and randomly selected a sample of age-matched controls. To ensure an adequate number of subjects with asthma, we attempted to recruit any child who had a visit to our clinic or pediatric emergency department resulting in an asthma diagnosis (*International Classification of Diseases, Ninth Revision* code 493;  $n = 357$ ). The asthma diagnosis would be confirmed later by interview, and children without asthma would still be eligible as controls.

Parents of all potential asthma subjects were sent a letter introducing the study and including a preaddressed and stamped reply card. Recipients were instructed to return the card if they wished to refuse participation or if they had a corrected telephone number. If the parent did not return the card and the letter was not returned by the post office as undeliverable, it was considered acceptable to telephone the family. An additional 357 subjects were selected randomly from an age-stratified list of the remaining 2644 children and contacted in the same manner as the asthma subjects (Fig 1).

The combined list was sorted by using computer-assigned random numbers. The parents were phoned in order and asked to participate in the interview with the child available. At least 1 attempt was made to contact the caregiver of all potential subjects. Multiple repeat attempts were made until the interview was completed, the respondent declined participation, or the study period ended. When phone numbers were not in service, reattempts were made if an alternative phone number was available from other

hospital records. Families were offered an incentive of 5 dollars for participation in the interview. Interviews were conducted between the beginning of the school year and the beginning of winter break (late August and mid-December) of 2001. The time period was chosen to limit the effect of seasonal variation on physical activity.

### Exclusion Criteria

Exclusion criteria were evaluated by interview and included medical conditions that would modify physical activity: sickle cell disease, cystic fibrosis, diabetes, cerebral palsy, stroke, neuromuscular problems that affect walking, or any condition that requires use of a wheelchair or walker. Any children who had recent injury or illness that made them temporarily unable to do their usual types of activity or who had been to the emergency department or clinic for an asthma attack in the past 2 weeks were deferred for reinterview after 6 weeks.

### Data Collection

A structured, 76-item questionnaire was administered by telephone interview by 1 of the investigators (D.M.L.) or 1 of 2 trained interviewers to caregivers addressing physical activity; sociodemographic factors; asthma diagnosis, symptoms, and medications; physician advice; parental health beliefs; and community resources and neighborhood safety. Interviewers were blinded to the asthma status at recruitment but would know the child's asthma status from responses to the questionnaire.

Demographic items included the child's age, gender, and insurance type and caregiver's age and education. We attempted to obtain weights and heights from parent recall but found that 44% of caregivers could not give a precise response.

An asthma case was defined by using the criteria established by the Centers for Disease Control and Prevention in surveillance.<sup>25</sup> A child was considered to have asthma if a medical provider had ever diagnosed him or her with asthma and if the child had had some asthma symptom in the past 12 months. A child was considered not to have asthma if the parent was never told that the child had asthma. Asthma severity classification used the 4 steps of the National Asthma Education and Prevention Program guidelines using reported frequency of day and night symptoms in the past month.<sup>26</sup> Parents were asked to list all asthma medications

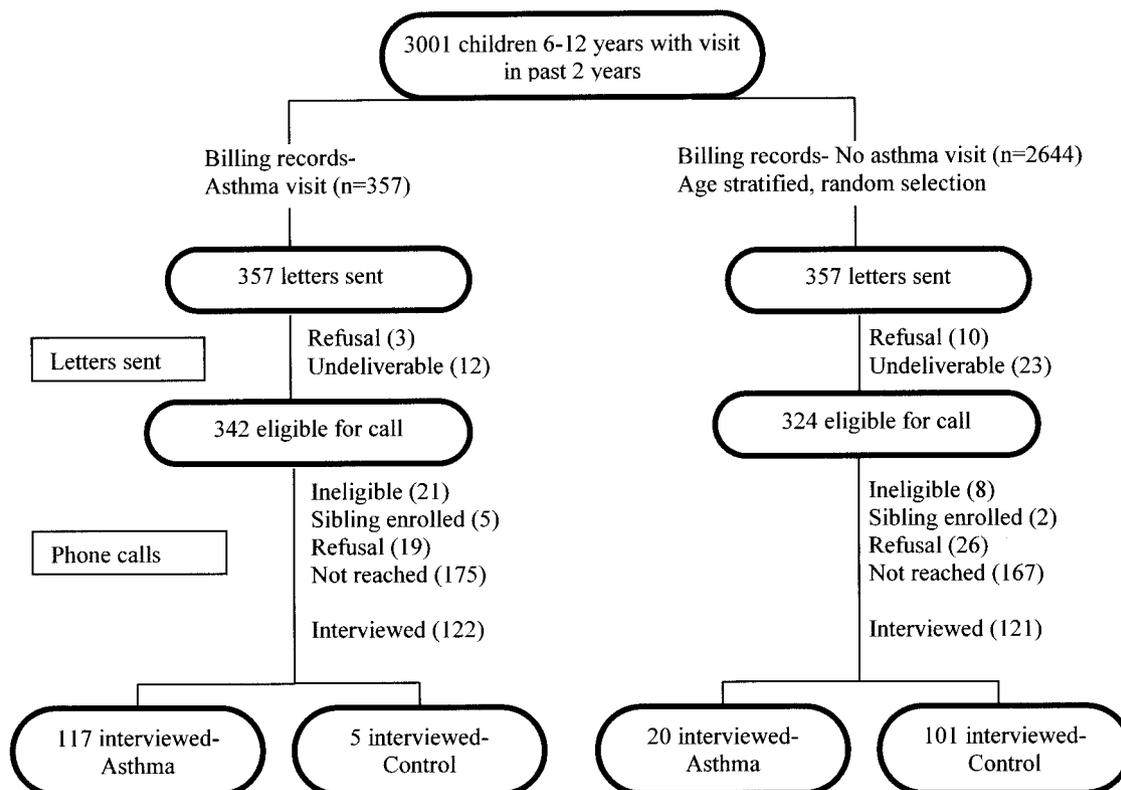


Fig 1. Subject recruitment and disposition.

that the child was using currently. Controller medication was defined as any inhaled mast-cell stabilizer, inhaled steroid, long-acting  $\beta$ -agonist, or leukotriene modifier; rescue medication was defined as any short-acting  $\beta$ -agonist.

Physical activity was measured in 2 ways: total minutes active on 1 day and the number of days active in a typical week. Only 1 recent day's activity was measured because of concerns about recall of specific activities over longer periods.<sup>27</sup> The preferred day of interest was the previous day, but parents were given the option to use 1 day earlier if the previous day was not typical for the child. To assist in recall, the parent was asked how many minutes the child spent on each of a list of specific activities. The checklist concept was based on the "Yesterday Activity Checklist" of the Physical Activity Checklist Interview Protocol,<sup>28</sup> with the specific activities used in this study chosen after discussion with parents of children in our community. The list included sports, active games, and individual activities such as walking, running, and skating. The parent could add unlisted activities. To improve accuracy of recall, the parent was asked to have the child present for the interview so he or she could also be asked the questions. The physical activity interview was pilot tested for same-day test-retest reliability on a sample of 22 volunteer parents from a local elementary school by administering the same 30-minute interview twice.<sup>29</sup> In the pilot study, intraclass correlation for total minutes of activity was 0.97, and variability was 55%. Intraclass correlation for days per week active was 0.83, and variability was 31%. Internal validity evaluation showed more total minutes activity among children whose parents thought the child was "more active" than children whose parents thought the child was "less active" ( $P = .07$ ) and among children who were reported active more days of the week ( $P = .05$ ). The typical days per week was simply a number of days on which the child did strenuous activity.<sup>30</sup>

Parents were asked whether the child's doctor had ever spoken about exercise and whether the advice supported or discouraged exercise. Health beliefs were assessed by using a list of statements that address the benefit of exercise in general, the appropriateness of exercise in children with asthma, and the parent's feelings about exercise in his or her child, with responses on a 5-point Likert-type scale: "strongly disagree," "disagree," "no opinion," "agree," and "strongly agree."

Parents were asked whether the family lived within walking distance of a recreation center or a park and whether an adult exercised with the child. Neighborhood safety was assessed by agreement with the statement: "There is a safe place for my child to get exercise in my neighborhood."

### Sample Size

The desired sample size of 250 (150 with asthma and 100 controls) was calculated to provide a significance level of .05 and a power of .80<sup>31</sup> to detect a hypothesized 25% difference in mean total minutes of physical activity and a 15% absolute difference in proportion of children with and without asthma active <30 minutes/day. More children with asthma were sampled to evaluate the relationship between predictive factors and physical activity level.

### Analysis

The mean total daily minutes of physical activity, proportion of children active for <30 minutes/day, and proportion of children active <3 days/week were compared by asthma study group. Demographic characteristics and parental health beliefs also were compared in the 2 groups. The strength of association between predictive factors and physical activity then was analyzed in the children with asthma. For this analysis, total minutes of physical activity were collapsed into low (<30 minutes), medium (30–119 minutes), and high ( $\geq 120$  minutes) to increase statistical power. The low of <30 minutes of activity was chosen to place the findings in context of national recommendations.<sup>32</sup> Prediction of low activity versus all others and high activity versus all others were analyzed separately for each predictor by comparing percentages using  $\chi^2$  tests or calculating odds ratios (ORs) via univariate logistic regression. For each activity group, a multivariate logistic regression model with ORs was developed by using a stepwise approach by first including any predictor that was associated with activity at a significance level of at least  $P < .10$  in the univariate analysis and then excluding from the final model any

variable that did not reach a significance level of  $P < .05$ . Finally, a multinomial regression compared relative risk of inclusion in the highest activity group versus the lowest activity group, using the factors identified in the multivariate regressions. Data were analyzed by using Stata 7.0 (Stata Corporation, College Station, TX).

### Institutional Review

This study was approved by the Johns Hopkins University School of Medicine Institutional Review Board. The recruitment of parent volunteers in the pilot study was also approved by the Baltimore City Public Schools Research and Evaluation Accountability Officer.

## RESULTS

Interviews were completed on 137 children with asthma and 106 controls (Fig 1) for an overall interview completion rate of 34% of letters mailed and 36% of families eligible for phone contact. The children with and without asthma had no detectable difference in race, gender, or neighborhood attributes (Table 1). The asthma group was slightly older and had a higher proportion of medical-assistance recipients. Severity classification of the children with asthma was 28% mild intermittent, 26% mild persistent, 32% moderate persistent, and 13% severe persistent. The medication-use report revealed that 47% of the children with asthma used controller medications and 34% had persistent asthma but used no controller medications. In the asthma group, 34% reported that exercise had caused an asthma attack.

### Asthma Versus Nonasthma

Children with asthma were less active than their peers, based on 3 activity criteria. The mean activity on 1 day was 116 minutes for children with asthma and 146 minutes for children without asthma ( $P < .05$ ). Children with asthma were more likely to be inactive, defined as <30 minutes of activity per day (21% of children with asthma versus 9% of controls [ $P = .01$ ]) or <3 days activity in a typical week (23% vs 11% [ $P < .05$ ]). There was not a difference, however, in the proportion of children who were highly active, defined as  $\geq 120$  minutes of activity per day (47% vs 56% [ $P > .20$ ]).

### Physical Activity in Children With Asthma

Comparison of inactive versus active children with asthma revealed that low physical activity was strongly associated with reported symptom fre-

TABLE 1. Demographics

Characteristic	Asthma (n = 137)	Control (n = 106)	P
Age in years, mean $\pm$ SD	9.8 $\pm$ 1.7	9.3 $\pm$ 1.7	.01
Race, African American	96%	96%	NS
Gender, male	58%	63%	NS
Relation of respondent to child, mother	76%	75%	NS
Medical assistance	88%	75%	.01
Safe neighborhood*	58%	66%	NS
Within walking distance to recreation center or park*	85%	90%	NS

NS indicates not significant.

\* By parent report.

quency but was not associated with use of controller medications, parent recall of physician advice concerning exercise, neighborhood safety, or access to recreation sites (Table 2). Disease severity was the only nonhealth belief associated with the highest activity level: 34% of the children with asthma who were active at least 120 minutes/day had moderate or severe persistent disease, compared with 56% who were active <120 minutes ( $P = .01$ ).

### Parental Health Beliefs and Activity

Table 3 lists the frequency of health beliefs among parents of children with asthma and controls. Some health beliefs were held by only a few or almost all parents, whereas others had considerable proportions of parents in each category.

Children with asthma whose parents feared that the child would get sick from exercise and those whose parents believed that the child got upset from strenuous play were more likely to be inactive. Alternatively, children whose parents believed the child could do as much activity as peers were less likely to be inactive (Table 4). In multivariate regression, 2 factors significantly predicted that a child with asthma would be active <30 minutes/day: moderate or severe persistent asthma and parental belief that the child gets upset with strenuous activity (Table 5). Female gender was significant as a univariate predictor of low activity but only borderline ( $P = .05$ ) in the multivariate regression.

Children with asthma who enjoyed physical activity, those whose parents believed that they could do as much activity as their peers, and those whose parents believed exercise may make the child's asthma better were more likely to be active at least 120 minutes/day. Alternatively, those whose parents reported that the child got upset with strenuous activity were less likely to be in this most active group (Table 4). On multivariate analysis, agreement that exercise may make the asthma better predicted >120 minutes of activity/day, whereas moderate or severe disease predicted <120 minutes of activity/day (Table 6).

In a final multinomial model, high activity ( $\geq 120$  minutes) was less likely than low activity (<30 minutes) in children with moderate or severe persistent disease (relative risk ratio [RRR]: 0.26; confidence interval [CI]: 0.09–0.74), female gender (RRR: 0.35;

CI: 0.13–0.98), and whose parents agreed that the child gets upset when he or she plays or exercises hard (RRR: 0.27; CI: 0.09–0.80). Agreement that exercise may make the child's asthma better was associated with the high-activity group (RRR: 2.86; CI: 0.94–8.75), but the significance level was 0.06.

### DISCUSSION

Our findings demonstrate that, based on caregiver report, urban school-aged children with asthma are less active than their peers and that >20% of children with asthma are still not reaching the goal of normal physical activity. It is equally concerning that inactivity persists regardless of use of controller medications and exists even in children with mild intermittent disease. Disease severity and parental health beliefs influence the activity level of children with asthma.

This study was strengthened by the use of a structured interview to assess physical activity and related factors. Accuracy and discrimination of the findings were increased by development and validation of a structured, specific activity checklist and by having the parent consult with the child during the interview. In all classifications of activity level used, the finding of lower activity by children with asthma was consistent. The study went beyond previous comparisons of children with and without asthma to investigate factors associated with activity level of children with asthma that could be amenable to interventions. The study focused on urban children, a population at risk for more asthma-related complications, inactivity, and obesity. It was important to address the relationship between asthma and pattern of physical activity in a way that minimizes confounding by the increased asthma prevalence and increased inactivity in this population.

Interestingly, most parents in this study reported living within walking distance of a park, playground, or recreation center. Although these resources are in close proximity, it seems that not many children actually used them regularly. Although approximately half of the parents considered their neighborhood safe, this issue was not associated with activity level. Although limited opportunity for activity in urban children certainly needs to be addressed, it does not seem to explain the disparity in physical activity between children with and without asthma.

Health beliefs of the parent played an important role in the physical activity of the children with asthma. We were pleased to find that very few parents of either group agreed that children with asthma should never exercise. It is concerning, however, that almost one fifth of all parents agreed that exercise is dangerous for children with asthma and that one quarter of parents of children with asthma were afraid that their child would get sick if he or she exercises. The health perception strongly associated with inactivity was that the child gets upset when he or she exercises. This perception was related to activity level even when controlled for disease severity. The direction of the association cannot be determined from this cross-sectional study; nevertheless,

**TABLE 2.** Inactivity in Children With Asthma: Factors Evaluated as Predictors

Characteristic	Inactive* (n = 29)	Active (n = 108)	OR (95% CI)
Moderate or severe persistent asthma	69%	39%	3.5 (1.5–8.4) <sup>†</sup>
Use controller medication	55%	45%	1.5 (0.7–3.4)
Undermedicated <sup>‡</sup>	28%	35%	0.7 (0.3–1.7)
Safe neighborhood	59%	57%	1.1 (0.5–2.4)
Doctor advised about exercise	55%	54%	0.9 (0.4–2.1)
Walking distance to recreation center or park	86%	85%	1.1 (0.3–3.5)

\* <30 minutes/day.

<sup>†</sup>  $P < .01$ .

<sup>‡</sup> Persistent asthma without the use of controller medications.

**TABLE 3.** Exercise-Related Beliefs Among Parents of Children With and Without Asthma

	Asthma (n = 137)	Control (n = 106)	P
Exercise is important for adults	99%	100%	NS
Exercise is important for children	98%	100%	NS
Child enjoys strenuous activities or exercise	72%	79%	NS
For children with asthma, some sports are better than others	64%	70%	NS
Children with asthma can do as much physical activity as children without asthma	63%	40%	<.001
Child can do as much physical activity as children his or her age that do not have asthma	61%	NA*	
When child exercises or runs, he or she has trouble with asthma	58%	NA*	
Exercise may make a child's asthma better	37%	34%	NS
Exercise may make a child's asthma worse	35%	19%	<.01
Child gets upset when he or she plays or exercises hard enough to sweat	27%	11%	<.01
I am afraid that child will get sick if he or she exercises	26%	2%	<.001
Exercise is dangerous for children with asthma	18%	19%	NS
Children with asthma should never run	6%	4%	NS
Children with asthma should never exercise	2%	2%	NS

NS indicates not significant; NA, not asked of controls.

**TABLE 4.** Health Beliefs Associated With Activity Level in Children With Asthma (n = 137)

	<30 min/d, OR (95% CI)	≥120 min/d, OR (95% CI)
Child gets upset with strenuous activity	4.18 (1.76–9.96)*	0.36 (0.16–0.81)*
I am afraid that child will get sick if he or she exercises	2.47 (1.04–5.88)*	0.53 (0.24–1.17)
Child enjoys strenuous activity	0.67 (0.38–1.60)	2.50 (1.13–5.50)*
Exercise may make the child's asthma better	0.43 (0.16–1.14)†	2.71 (1.31–5.61)*
Child can do as much physical activity as children his or her age without asthma	0.35 (0.15–0.82)*	2.76 (1.32–5.74)*

\* The OR is statistically significant ( $P < .05$ ).

† The OR is borderline significant ( $.05 > P > .10$ ).

**TABLE 5.** Logistic Regression to Predict Inactivity (<30 Minutes of Activity Per Day) in Children With Asthma

Variable	Univariate OR (95% CI)	Adjusted OR (95% CI)	P
Moderate/severe persistent asthma	3.49 (1.45–8.39)	3.00 (1.19–7.52)	<.05
Female	2.78 (1.19–6.48)	2.44 (0.99–6.01)	.05
Child gets upset with strenuous activity	4.19 (1.76–9.96)	3.28 (1.32–8.16)	.01

**TABLE 6.** Logistic Regression to Predict High Activity (≥120 Minutes of Activity Per Day) in Children With Asthma

Variable	Univariate OR (95% CI)	Adjusted OR (95% CI)	P
Moderate/severe persistent asthma	0.41 (0.20–0.82)	0.47 (0.22–0.99)	<.05
Female	0.51 (0.26–1.02)	0.57 (0.27–1.21)	.15
Child gets upset with strenuous activity	0.36 (0.16–0.81)	0.48 (0.20–1.13)	.09
Agree exercise may make child's asthma better	2.71 (1.31–5.61)	2.50 (1.17–5.35)	<.05

the association is important. If it is a misperception that is causing parents to discourage activity, this would be addressed by exploring the parent's concerns and providing appropriate health education. On the other hand, if the perception is correct, then the reasons for why the child gets upset would need to be explored. If the child is truly having asthma symptoms from exercise, recommendations for medical therapy and warm-up exercise are needed.<sup>22</sup> It is possible that there are some children classified as having mild intermittent asthma based on infrequent symptoms who in fact have more-frequent symptoms when active. To achieve the goal of normal

activity, these children would need a change in their therapy.

The findings are limited by the use of parent-child report. As described, the main activity outcome was total minutes of activity on a single day to balance concerns about recall of activity over longer periods. Although a child's activity may vary from day to day, the parent was asked not to use the immediately previous day if that day was atypical for some reason. Many parents reported a high number of minutes of physical activity for the child. Although adults may have brief intense workouts, children tend to play for a longer period of time with varying

intensity. Symptom frequency and medication use were measured by parent report rather than medical record review, but parent report may be closer to reality. For example, medication for asthma may have been prescribed but not currently used, leaving children undermedicated. In this survey, we were not able to determine the reason that the child is not on medication. Alternatively, parental report of asthma could be subject to recall bias, with parents who consider their child more affected recalling more symptoms or exacerbations. Similarly, parents who believe their child should be less active or consider their child less fit may report less activity. Opportunities for activity and neighborhood safety are also based on report, thus we measured parental perceptions rather than exact definitions. Again, in considering the motivations for a child to be active, perceptions may be as important as objective observation, if not more so. Subjects were drawn from a clinic list, raising concern about generalizability. The clinic, however, serves as a primary care site for children in Baltimore. Children with other medical conditions were excluded by the protocol, because the goal was to compare otherwise healthy children with asthma to otherwise healthy peers. Because the focus of this study was children in an urban setting, the conclusions may not apply to other populations of children with asthma.

### CONCLUSIONS

Despite advances in the medical therapy for and a better understanding of asthma, beliefs persist to discourage exercise in children with asthma. Exercise has important benefits for children. Medical providers should ask specifically about the amount and frequency of activity in their patients. Equally important, they should explore the health beliefs and perceptions of the parent and child, especially concerning the child's reaction to activity. Pediatricians should address exercise and its benefits with patients and their caregivers to help achieve the goal of normal physical activity in children with asthma.

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