Published in final edited form as:

J Pediatr Health Care. 2011 ; 25(2): 105–113. doi:10.1016/j.pedhc.2009.10.003.

Adolescents' Perception of Asthma Symptoms and Health Service Utilization

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Abstract

Introduction—Pediatric asthma is accountable for a substantial use of health care services. The purpose of this study was to systemically examine the extent to which inaccurate perception of asthma symptoms is associated with the use of health care services.

Methods—This exploratory study included 126 adolescents with asthma, aged between 13–20 years. Subjects were classified as having inaccurate symptom perception (IG), well controlled, accurate symptom perception (WCA), and poorly-controlled accurate symptom perception (PCA). These groups were compared with respect to health care utilization including emergency department (ED) visits, hospitalization and office visits and school absenteeism in the past 3 months.

Results—More adolescents in the inaccurate group had at least one hospitalization compared to adolescents in the PCA or WCA groups (23.1% vs. 11.1% vs. 2.6% respectively). A similar trend was seen for emergency department visits. Compared to WCA group, adolescents in the inaccurate group were nearly 9 times more likely to have been hospitalized, 3.4 times more likely to have visited an emergency department (ED), and 4 times more likely to have missed school days.

Discussion—Adolescents with inaccurate symptom perception are more likely to have hospitalizations, ED visits, and missed days from school as compared to those with accurate perceptions. The findings underscore the importance of screening for perceptual accuracy of asthma symptoms and call for interventions promoting accurate symptom assessment in adolescents with asthma to assure appropriate care.

Introduction

According to 2006 data from the Center for Disease Control and Prevention (CDC), an estimated 6.8 million children under the age of 18 were affected by asthma, of which 4.1 million suffered from an asthma attack or episode (American Lung Association, 2007). Asthma in children accounts for a substantial use of health care services annually in the

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United States. In 2004, asthma in children accounted for 7 million outpatient physician visits, over 754,000 emergency department (ED) visits, and nearly 200,000 hospitalizations (CDC, 2007). Estimated annual health care costs for treating asthma in children in the U.S. are approximately \$14.7 billion, and indirect costs (e.g. lost productivity by adult caretakers) add another \$5 billion, for a total of \$19.7 billion dollars (National Heart, Lung, and Blood Institute [NHLBI], 2007). Pediatric asthma, the leading cause of school absenteeism, is responsible for 12.8 million missed school days in the U.S. annually (CDC, 2007).

Children's inability to accurately recognize asthma symptoms have been linked to greater functional impairment and asthma-related morbidity (Apter et al., 1997; Baker et al., 2000; Banzett, Dempsey, O'Donnell, & Wamboldt, 2000; Boulet, Deschesnes, Turcotte, & Gignac, 1991; Feldman et al., 2007; Fritz, McQuaid, Spirito, & Klein, 1996; Horak, Grässl, Skladal, & Ulmer, 2003; Magadle, Berar-Yanay, & Weiner, 2002; McQuaid et al., 2007; H. L. Yoos & McMullen, 1999a; H. L. Yoos & McMullen, 1999b). Because asthma management begins with symptom monitoring, inaccurate perception can result in poor asthma management and control (Bijl-Hofland, Cloosterman, Folgering, Akkermans, & van Schayck, 1999). Poor asthma control can ultimately lead to acute health service use. Nonetheless, the literature is limited in demonstrating a relationship between perceptual inaccuracy in adolescents with asthma and their use of healthcare services.

Recent national asthma guidelines by the Expert Panel Report 3 (EPR3) (NHLBI, 2007) state that achieving asthma control is the ultimate goal of asthma therapy. According to the guidelines, asthma control can be classified into three levels (well controlled, not well controlled, or very poorly controlled) depending on the degree of asthma symptoms or impairments manifested in the patients. The four key symptoms used to determine the level of asthma control are daytime asthma symptoms, nocturnal awakening due to asthma symptoms, frequency of use of short acting beta agonists (SABA), and interference with normal activities. The most severe impairment in any of the four symptoms determines the level of control. When asked to rate the level of asthma control, children and their parents often rely on their perception without reference to the symptoms recommended by the national guidelines. As a result, researchers and clinicians have raised concerns regarding the accuracy of patients' perception (Baker et al., 2000; Fritz et al., 1996; Mittal, Khanna, Panjabi, & Shah, 2006).

According to a recent study (Rhee, Belyea, & Elward, 2008), adolescents showed a tendency toward underperception; a failure to perceive their asthma as not being adequately controlled. Using latent class analysis, Rhee et al. classified adolescents with asthma into three subgroups based on the accuracy of control perception: "Well-controlled Accurate Group (WCA)," "Poorly-controlled Accurate Group (PCA)" and "Inaccurate Group (IG)." Accuracy of control perception was determined by comparing the participants' response to their overall perception of asthma control and self-reported symptoms of asthma including daytime and nighttime symptoms, use of SABA and interference with activities (NHLBI, 2007). Consistency between the perception and symptom reports indicated accuracy whereas discrepancy suggested inaccurate perception. Further detailed descriptions about the classification can be found in Rhee et al.'s article.

As a continuation of the investigation, this paper explored whether the three groups differed in their use of healthcare services. The purpose of this study was to examine the extent to which inaccurate symptom perception is associated with the use of health care services; including hospitalization, Emergency Department (ED) visits, asthma specialist visits, outpatient visits (acute and scheduled), school clinic visits and absenteeism.

Methods

Design and Sampling Methods

This was a cross-sectional, exploratory study examining the relationships between perceptual accuracy of asthma control and health services utilization among adolescents. This research is based on the analysis of baseline data collected as part of a larger study examining the feasibility and effectiveness of an asthma self-management program targeting adolescents. Adolescents between the ages of 13 and 20 were enrolled if they had symptoms consistent with persistent asthma as specified by EPR3 or reported the use of a preventive asthma medication. Adolescents who had other major chronic health concerns or were unable to understand spoken and written English were excluded. Participants were recruited from the communities through flyers and by referrals from health care providers and local middle and high schools. To facilitate the recruitment of minorities, schools with the highest enrollment of minority students were used for recruitment. A total of 126 adolescents participated in the study. Of those, the WCA group consisted of 78 adolescents, the PCA group 9 adolescents, and the IG 39 adolescents. Despite the small sample size and unequal group size there is enough power (.80) to find a difference of roughly .20 in the event rates for health services utilization between the inaccurate groups and the accurate group.

Measurements

Asthma Control Questionnaire—This questionnaire measured both participants' asthma control perception and four asthma symptoms. Individual perception of asthma control was measured by a single item (from “completely controlled [1]” to “not controlled at all [5]”). The other 4 items captured the level of actual impairment as recommended by EPR3 on a 4-point scale ranging from 1–4. The four items were asthma symptoms, nighttime symptoms, activity limitations and use of short-acting beta agonists (SABA) use during the prior four weeks. High values indicate poorer symptom control.

Classification of Perceptual Accuracy of Asthma Control—For the grouping of perceptual accuracy, we used the three group classification (“well-controlled accurate group (WCA),” “poorly-controlled accurate group (PCA)” and “inaccurate group (IG)”) that was obtained as a result of latent class analysis (LCA) in our earlier report (Rhee et al., 2008). LCA is similar to other methods for identifying classes or subgroups, such as cluster analysis, but is model-based, allowing the researcher to determine the optimal solution using fit indices. LCA identifies meaningful subgroups according to distinctive patterns based on the individual's values on a set of variables. The LCA classified the adolescents based on the patterns of their responses to the Asthma Control Questionnaire. Those who exhibited patterns that were characterized by consistency between individuals' control perception (item 1) and the levels of asthma control determined by the remaining 4 items of asthma symptoms were classified into accurate groups. Adolescents who showed a pattern that indicated the perception of well-controlled asthma and their actual symptom reports corroborated (i.e., daytime symptoms ≤ 2 times/month, no activity limitation, nighttime symptoms ≤ 2 times/week, and use of SABA ≤ 2 times/week), were classified into the WCA group. Adolescents who manifested a pattern of perceived poorly-controlled asthma and their symptoms were indicative of persistent asthma, were classified into the PCA group. The IG represented two subgroups who presented with a pattern of inconsistency in which individuals perceived well-controlled asthma while their actual symptom reports indicated otherwise (i.e., reporting daytime symptoms ≥ 3 –4 times/month or nighttime symptoms > 2 days/week). Because the two IG subgroups did not differ substantially in terms of sociodemographic characteristics and psychosocial functioning, they were combined into one group (Rhee et al., 2008).

Health Service Utilization—We constructed a 7-item questionnaire to obtain information about health service use and school absenteeism that occurred during the past 3 months prior to data collection (ranging from February to May 2007). The questionnaire is provided in Table 1. Health services included hospitalization, Emergency Department (ED) visits, office visits (primary care providers, asthma specialist) and school clinics. The seven items were measured on a dichotomized scale (“Yes” and “No”), and when the adolescent responded positively (i.e., “Yes”), further questions were directed to obtain the number of days or times that the incidence had occurred. The questionnaire was pilot tested for understanding by adolescents prior to the current study. The reading levels of the measurement ranged from 4th to 7th grade by the Flesch-Kincaid method.

Procedure

The study protocol for subject recruitment and data collection was reviewed and approved by the Institutional Review Board. Prior to obtaining parental consent and adolescent assent, the study purpose and procedures were explained by a trained research assistant. Adolescent participants completed the questionnaire in the researcher affiliated university facility in the summer of 2007. Participants received a small monetary incentive as a token of appreciation for their time.

Data Analysis

We conducted logistic regression to examine the extent to which the three groups based on perceptual accuracy predicted health service utilization and school absenteeism. Odds ratios (ORs) and 95% confidence intervals (95%CI) for the group comparisons are reported. The association between the latent class groups and number of days or number of times each health service was utilized in the last 3 months was analyzed using negative binomial regression, given that the outcome variables are in the form of a count. Although Poisson regression is often used for count data, the variances for the health utilization outcomes exceeded their means and are what is referred to as over-dispersed. Negative binomial regression is an extension of the Poisson model that allows for over-dispersion, and gives a much better fit of the model to the data. Data preparation and analyses were conducted using SAS Version 9.1 software (SAS Institute Inc. 2004).

Due to our earlier findings indicating differences by race and socioeconomic status (SES) among the three groups (Rhee et al., 2008), race, family income and parental education were included as control variables in the logistic and negative binomial regression models. For models that reached overall significance, pair-wise contrasts (IG vs. PCA; IG vs. WAC; PCA vs. WAC) were constructed.

Results

Sample Characteristics

A total of 126 adolescents participated in the study. The sample included 40.5% males; 38.1% African Americans; and about 41% living in a household with an annual income below \$30,000. Sample characteristics are described in detail elsewhere (Rhee et al., 2008). Based on the classification of asthma control by EPR3 (NHLBI, 2007), well-controlled asthma was reported in 24% of the sample, while 38% reported not-well-controlled and 38% reported very poorly-controlled asthma. Almost all of the participants reported current use of quick relief medications (e.g. SABA), and the majority were on long-term controller medications (71.4%). Long-term controller medications included inhaled corticosteroids (ICSs) (26.2%), leukotriene receptor antagonists (LTRAs) (27%), long acting beta₂ agonists (LABA) in combination with ICSs (41.3%) and theophylline derivatives (1.6%). Combinations of two or more controller medications were found in 20% of the sample.

Health Service Utilization and School Absenteeism

During the 3 months preceding the data collection: about 10% were admitted to the hospital for asthma exacerbation; 14% visited an emergency department (ED) at least once; 22% had seen an asthma specialist; nearly 32% had unscheduled visits to their primary care providers (PCPs) to treat worsening asthma; 45% had scheduled PCP visits for routine check-up for asthma; 33% visited a school clinic for asthma; and over 25% of adolescents missed school due to asthma. Participants missed on average 2 school days during the 3 month time frame.

Group Differences in the Use of Health Services “at Least Once”

Figure 1 illustrates differences in health service use at least once during the past 3 months among the three groups. Logistic regression analyses - adjusting for race, family income, and parental education - revealed a significant association between the three groups and the odds of an adolescent having been hospitalized because of asthma (see Table 2). Compared to the WCA group, adolescents in the inaccurate group were nearly 9 times more likely to have been hospitalized and 3.4 times more likely to have visited an ED. There was no difference between the PCA and WCA group or between the IG and PCA group in hospitalization and ED visits. For going to an asthma specialist, the PCA group showed an increased odds (OR = 5.64) compared to the WCA group, while there was no difference between the IG and WCA group or between the IG and PCA group. Significant associations were found among the three groups in the odds of having visited a PCP because of worsening asthma (acute PCP visits). Participants in the PCA group were almost 18 times and those in the IG group was about 3 times more likely to report acute PCP visits than those in the WCA group. Compared to the PCA group, the IG group showed a decrease in the odds of acute PCP visits (OR = .16, 95% CI = .02, .94). No significant difference was noted between the three groups for having visited PCPs for routine check-ups for asthma. Looking at the school outcomes, adolescents in the PCA and the IG groups were 6.5 times and 3 times more likely to have visited the school clinic, respectively, than the WCA group. On the other hand, the odds of having missed school days due to asthma in the IG group were 4 times greater than the WCA group, while no difference was found between the IG and the PCA groups or between the PCA and WCA groups. Regarding use of daily long-term controller medications including ICSs, LTRAs and LABAs (i.e., users vs. nonusers), these three groups were not significantly different.

Group Differences in the Number of Days or Times of Each Health Service

The average number of days or number of times each health service was utilized is depicted in Figure 2. Table 3 presents the results of the negative binomial regression models for health service utilization. There was a significant difference between the adolescents in the IG group and those in the WCA group, such that the former was associated with more days of hospitalizations than the latter. Similarly, the PCA group was associated with more days of hospitalization than the WCA group. There was no significant difference between the IG and PCA groups on the days of hospitalization. For ED visits, there was a significant difference between the IG group and the WCA group, with the IG group having a greater frequency of ED visits than the WCA group. On the other hand, the three groups were not significantly different in the frequency of seeing an asthma specialist. However, there was a significant association between group membership and the frequency of visiting PCPs for worsening asthma and for routine check-ups. Both the IG group and the PCA group had a significantly higher frequency of utilizing a PCP for asthma exacerbation than the WCA group. Only the PCA group was significantly different than the WCA group for routine check-ups with the PCP.

Regarding visits to school clinics, there were two outliers who responded that they visited school clinics every day (which is equivalent to 60 times for the past 3 months): one in the

IG group and the other in the WCA group. We conducted two analyses; one with outliers and the other without. Analysis with outliers indicated that IG used school clinics significantly more often than two accurate groups; but when the analysis was done without the outliers, the significant difference disappeared. (Table 2 presents the results after removing the outliers.) Regarding missed school days there was a significant difference between the IG group and the WCA group with the IG group missing significantly more school days than the WCA group ($\beta = 1.99$, 95% CI = .97, .3.10).

Discussion

This study showed that adolescents with inaccurate control perception have high rates of hospitalization, ED visits, and missed days from school. The findings are in line with an earlier study (Fritz et al., 1996) that reported higher rates of ED visits and school absenteeism in children aged 8 to 15 years with poor symptom perception. As an extension of our earlier study, we examined the impact of inaccurate symptom perception on health care utilization including various other types of health services such as hospitalization, outpatient-based services (e.g. asthma specialist and PCP), and school clinics. The positive associations between the inaccurate perception and acute health service utilization and school absenteeism were independent of subjects' race and socioeconomic status. This is a compelling indication that those who manifest poor symptom perception, particularly under perception, are at risk for high asthma morbidity.

While the inaccurate group consistently reported high levels of health service use, the patterns of health service utilization between the poorly-controlled accurate group and the inaccurate group are complex. Both groups are defined by the presence of poorly controlled symptoms, with one group having accurate perception of poor control and the other inaccurately perceiving good control. It is noteworthy that the inaccurate group used more inpatient-based acute health services such as hospitalization and ED than the accurate group while the poorly-controlled accurate group used more outpatient-based health services such as PCP visits for both routine care and asthma exacerbation as well as asthma specialist care. These findings suggest that frequent acute inpatient service utilization among those with inaccurate perceptions may be in part due to failure to initiate preventive management and failure to recognize deteriorating asthma, thus delaying the utilization of outpatient services such as PCP visits at the onset of asthma symptoms. Inaccurate perception is often accountable for serious health consequences including life-threatening asthma attacks and death in children and adolescents because of failure to take timely treatment actions (Barnes, 1992; Kifle, Seng, & Davenport, 1997; Lai et al., 2003; McQuaid et al., 2007; Strunk, Mrazek, Fuhrmann, & LaBrecque, 1985). The reports of frequent inpatient service use in the inaccurate group may reflect the serious levels of asthma acuity suffered by adolescents with poor symptom perception. Our findings provide evidence that inaccurate perception can potentially increase use of health care services especially ED visits, and therefore impose considerable financial burden on health care system and family.

Unlike most studies of symptom accuracy which adopt a simplistic dichotomized approach (accurate vs. inaccurate) (Dozier, Aligne, & Schlabach, 2006; Feldman et al., 2007; Fritz et al., 1996; Horak et al., 2003; H. L. Yoos & McMullen, 1999b), we classified adolescents based on their level of symptom control (i.e., well- vs. poorly-controlled asthma). This empirically-driven classification allowed us to capture a more detailed snapshot of health services utilization; not only by perceptual accuracy, but also by the degree of asthma control. The poorly-controlled accurate group was found to have high use of health services. However, as described earlier, the types of services used by the poorly-controlled accurate group and the inaccurate group were different.

It is interesting to note that the proportion of adolescents who had been hospitalized was significantly higher in the inaccurate group than in the poorly-controlled accurate group, yet the latter group reported a greater number of days of hospitalization than the former. This inconsistency may indicate that asthma exacerbation in perceptually accurate adolescents with poorly-controlled asthma requires longer and potentially more complicated treatment while acute asthma episodes experienced by inaccurate adolescents can be resolved by short-term, intensive management regimens during hospitalization. Differences in the nature of asthma acuity between the accurate and inaccurate groups warrant further research.

Use of an asthma specialist was found to be associated with perceptual accuracy especially in those with poorly controlled asthma. Previous studies have suggested that access to an asthma specialist may improve the likelihood of receiving asthma education (Cabana, Chaffin, Jarlsberg, Thyne, & Clark, 2008; Diette et al., 2001). Given our findings, we speculate that asthma education might have improved perceptual accuracy in those who had been seen by asthma specialists. This finding underscores the importance of asthma education in promoting symptom perception in adolescents with asthma.

The Expert Panel considers regular asthma check-ups essential and recommends follow-up every 1- to 6-months depending upon the level of control (NHLBI, 2007). In this study, office visits for routine asthma check-ups in the past 3 months were reported by 45% of our participants. It is difficult to determine whether the rate is considerably lower than what should be expected because our reference period did not span to cover the maximum 6-month interval by the recommendation. However, it is concerning to note that the odds of routine PCP visits among adolescents with poor asthma control and inaccurate perception was not significantly different from adolescents whose asthma was well controlled.

School clinics were used frequently by a large proportion of our participants (33%), especially by those with poorly controlled asthma. This underscores the importance of schools' readiness in handling asthma-related health issues. School clinics should have capacity to address urgent needs of students with asthma by furnishing them with adequate treatment medications and equipment and securing properly trained health professionals within the school setting. Timely and appropriate treatment at the school can potentially eliminate or reduce the overuse of more costly acute health services such as the emergency department and hospitalization.

Given the positive association between missed school days and asthma severity (Moonie, Sterling, Figs, & Castro, 2006), over 46% of school absenteeism among inaccurate adolescents provides compelling evidence that perceptual inaccuracy is a risk factor for high asthma morbidity. Frequent school absenteeism is particularly concerning because of its negative impact on learning and academic performance (Breuner, Smith, & Womack, 2004). Therefore, it is important to pay special attention to those with inaccurate perception to prevent them from missing learning opportunities at school which can potentially disadvantage them for lifetime.

Several limitations warrant caution in interpreting the study findings. First, because of the use of self-reported data, we cannot rule out the possibility of recollection errors in recounting health service utilization for the past 3 months. The employment of multiple recruitment sites and methods made it impossible for the research team to confirm the validity of the self-reported healthcare utilization against medical records. However, we believe that our relatively brief reference period helped to minimize recollection errors especially for the events occurring infrequently such as hospitalization and ED visits. Second, in determining perceptual accuracy, we relied solely on subjective data without objective validation (e.g., bronchial challenge test). As Fritz (2007) demonstrated, however,

the use of subjective awareness of naturally occurring asthma symptoms is considered better and a more realistic method of determining perceptual accuracy than artificial laboratory procedures. Finally, the generalizability of the study results is limited due to the convenient sample of small size. The small number of adolescents within the poorly-controlled accurate group is especially of concern. We cannot rule out low power to detect a difference among the groups as a possible explanation of null results for some variables examined, especially for comparisons with the PCA group. Nonetheless, these groups are empirically driven based on perceptual accuracy and represent clinically relevant subgroups. Replication studies using larger sample sizes are warranted to affirm the generalizability of our findings.

Although our cross-sectional design precludes drawing any causal inference between perceptual accuracy and health service utilization, our findings provide strong evidence that adolescents with inaccurate perception are at risk for heightened asthma morbidity as reflected in their frequent use of acute inpatient health services as well as school absenteeism. Inaccurate symptom perception can hamper effective asthma management not only because it can present a barrier for providers to determine optimum treatment courses but also because it adversely affects adolescents' capacity to respond to symptoms in a timely and appropriate manner. Given the substantial financial cost to families and the undermined functional capacity in individuals (specifically in relation to frequent school absenteeism), perceptual inaccuracy of asthma symptoms in adolescents needs to be assessed diligently and addressed effectively. During office visits, providers can probe adolescent patients for discrepancies between actual symptom reports and their overall perception. Special attention needs to be directed to those who present perceptual inaccuracy and to promote accuracy for optimal care management.

Acknowledgments

This study is supported by a grant from the National Institute of Health R21 NR009837.

References

- American Lung Association. Asthma & children fact sheet. 2007 [Retrieved May/14, 2008]. from http://www.lungusa.org/site/apps/nl/content3.asp?c=dvLUK9O0E&b=2058817&content_id={05C5FA0A-A953-4BB6-BB74-F07C2ECCABA9}&notoc=1
- Apter AJ, Affleck G, Reisine ST, Tennen HA, Barrows E, Wells M, et al. Perception of airway obstruction in asthma: Sequential daily analyses of symptoms, peak expiratory flow rate, and mood. *The Journal of Allergy and Clinical Immunology*. 1997; 99(5):605–612. [PubMed: 9155825]
- Baker RR, Mishoe SC, Zaitoun FH, Arant CB, Lucas J, Rupp NT. Poor perception of airway obstruction in children with asthma. *Journal of Asthma*. 2000; 37(7):613–624. [PubMed: 11059529]
- Banzett RB, Dempsey JA, O'Donnell DE, Wamboldt MZ. Symptom perception and respiratory sensation in asthma. *American Journal of Respiratory and Critical Care Medicine*. 2000; 162(3 Pt 1):1178–1182. [PubMed: 10988151]
- Barnes PJ. Poorly perceived asthma. *Thorax*. 1992; 47(6):408–409. [PubMed: 1496496]
- Bijl-Hofland ID, Cloosterman SGM, Folgering HTM, Akkermans RP, van Schayck CP. Relation of the perception of airway obstruction to the severity of asthma. *Thorax*. 1999; 54(1):15–19. [PubMed: 10343625]
- Boulet LP, Deschesnes F, Turcotte H, Gignac F. Near-fatal asthma: Clinical and physiologic features, perception of bronchoconstriction, and psychologic profile. *J Allergy Clin Immunol*. 1991; 88:838–846. [PubMed: 1744354]
- Breuner C, Smith M, Womack W. Factors related to school absenteeism in adolescents with recurrent headache. *Headache*. 2004; 44(3):217–222. [PubMed: 15012658]
- Cabana MD, Chaffin DC, Jarlsberg LG, Thyne SM, Clark NM. Selective provision of asthma self-management tools to families. *Pediatrics*. 2008; 121(4):e900–e905. [PubMed: 18381518]

- Centers for Disease Control and Prevention. Asthma prevalence, health care use and mortality: United states, 2003–05. 2007 [Retrieved May/15, 2008]. from <http://www.cdc.gov/nchs/products/pubs/pubd/hestats/ashtma03-05/asthma03-05.htm>
- Diette GB, Skinner EA, Markson LE, Algatt-Berstorm P, Nguyen TT, Clark RD, et al. Consistency of care with national guidelines for children with asthma in managed care. *Journal of Pediatrics*. 2001; 138(1):59–64. [PubMed: 11148513]
- Dozier A, Aligne CA, Schlabach MB. What is asthma control? discrepancies between parents' perceptions and official definitions. *Journal of School Health*. 2006; 76(6):215–218. [PubMed: 16918841]
- Feldman JM, McQuaid EL, Klein RB, Kopel SJ, Nassau JH, Mitchell DK, et al. Symptom perception and functional morbidity across a 1-year follow-up in pediatric asthma. *Pediatric Pulmonology*. 2007; 42(4):339–347. [PubMed: 17358038]
- Fritz GK, Adams SK, McQuaid EL, Klein R, Kopel S, Nassau J, et al. Symptom perception in pediatric asthma: Resistive loading and in vivo assessment compared. *Chest*. 2007; 132(3):884–889. [PubMed: 17573500]
- Fritz GK, McQuaid EL, Spirito A, Klein RB. Symptom perception in pediatric asthma: Relationship to functional morbidity and psychological factors. *Journal of the American Academy of Child and Adolescent Psychiatry*. 1996; 35(8):1033–1041. [PubMed: 8755800]
- Horak E, Grässl G, Skladal D, Ulmer H. Lung function and symptom perception in children with asthma and their parents. *Pediatric Pulmonology*. 2003; 35(1):23–28. [PubMed: 12461735]
- Kifle Y, Seng V, Davenport PW. Magnitude estimation of inspiratory resistive loads in children with life-threatening asthma. *American Journal of Respiratory and Critical Care Medicine*. 1997; 156(5):1530–1535. [PubMed: 9372671]
- Lai CK, De Guia TS, Kim YY, Kuo SH, Mukhopadhyay A, Soriano JB, et al. Asthma control in the asia-pacific region: The asthma insights and reality in asia-pacific study. *J Allergy Clin Immunol*. 2003; 111:263–268. [PubMed: 12589343]
- Magadle R, Berar-Yanay N, Weiner P. The risk of hospitalization and near-fatal and fatal asthma in relation to the perception of dyspnea. *Chest*. 2002; 121(2):329–333. [PubMed: 11834639]
- McQuaid EL, Mitchell DK, Waldersq N, Nassau JH, Kopel SJ, Klein RB, et al. Pediatric asthma morbidity: The importance of symptom perception and family response to symptoms. *Journal of Pediatric Psychology*. 2007; 32(2):167–177. [PubMed: 16717140]
- Mittal V, Khanna P, Panjabi C, Shah A. Subjective symptom perceptual accuracy in asthmatic children and their parents in india. *Annals of Allergy, Asthma & Immunology*. 2006; 97(4):484–489.
- Moonie SA, Sterling DA, Figgs L, Castro M. Asthma status and severity affects missed school days. *The Journal of School Health*. 2006; 76(1):18–24. [PubMed: 16457681]
- National Heart, Lung, and Blood Institute. Expert panel report 3: Guidelines for the diagnosis and management of asthma. 2007
- Rhee H, Belyea MJ, Elward KS. Patterns of asthma control perception in adolescents: Associations with psychosocial functioning. *Journal of Asthma*. 2008; 45:600–606. [PubMed: 18773334]
- Strunk RC, Mrazek DA, Fuhrmann GS, LaBrecque JF. Physiologic and psychological characteristics associated with deaths due to asthma in childhood. A case-controlled study. *JAMA : The Journal of the American Medical Association*. 1985; 254(9):1193–1198. [PubMed: 4021061]
- Yoos HL, McMullen A. Symptom monitoring in childhood asthma: How to use a peak flow meter. *Pediatric Annals*. 1999a; 28:31–39. [PubMed: 9926371]
- Yoos HL, McMullen A. Symptom perception and evaluation in childhood asthma. *Nursing Research*. 1999b; 48(1):2–8. [PubMed: 10029396]

Figure 1.
Rate of each type of health care services (at least once) among three groups (N=126).
IG = inaccurate group; WCA = well-controlled accurate group; PCA = poorly-controlled accurate group

Figure 2.

The average number of each type of health care service among three groups (N=126).

IG = inaccurate group; WCA = well-controlled accurate group; PCA = poorly-controlled accurate group

Table 1**Health Care Utilization Questionnaire**

This questionnaire is to find out how much you have visited a hospital, ER, doctor's office, or school clinic because of your asthma in the past 3 months.

- 1 During the past 3 months, have you ever been hospitalized because of asthma?
Yes No
If yes, how many days were you in the hospital? _____
  - 2 During the past 3 months, have you ever been taken to the Emergency Room because of asthma?
Yes No
If yes, how many times? _____
  - 3 During the past 3 months, have you ever been seen by the asthma specialist?
Yes No
If yes, how many times? _____
  - 4 During the past 3 months, have you ever been seen by your primary care providers (physician or nurse practitioner) because of worsening asthma?
Yes No
If yes, how many times? _____
  - 5 During the past 3 months, have you ever been seen by your primary care providers (physician or nurse practitioner) for the routine check-up of your asthma?
Yes No
If yes, how many times? _____
  - 6 During the past 3 months, have you ever visited your school clinic because of your asthma symptoms?
Yes No
If yes, how many times? _____
  - 7 During the past 3 months, have you ever missed days of school because of your asthma?
Yes No
If yes, how many days in total? _____
-

Table 2

Logistic Regression Models for Use of Health Services: Odds Ratios and 95% Confidence Intervals (n=126).

	Hospitalization		ED Visits		Asthma Specialist		Acute PCP Visits	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
IG vs. WCA	8.81 **	1.62 – 47.89	3.44 *	1.03 – 11.55	1.32	0.49 – 3.61	2.88 *	1.16 – 7.19
PCA vs. WCA	5.24	0.36 – 77.09	1.31	0.12 – 14.59	5.64 *	1.24 – 25.73	17.87 **	3.08 – 103.59
Race	0.16	0.02 – 1.30	0.06 *	0.01 – 0.72	0.90	0.25 – 3.20	0.33	0.09 – 1.16
Income	1.61	0.87 – 2.99	1.13	0.65 – 1.95	1.07	0.74 – 1.55	1.28	0.90 – 1.82
Education	0.77	0.54 – 1.12	0.89	0.64 – 1.23	0.84	0.66 – 1.07	0.96	0.77 – 1.21

	PCP for Routine Check-Up		School Clinic Visits		Missed School Days	
	OR	95% CI	OR	95% CI	OR	95% CI
IG vs. WCA	1.05	0.46 – 2.40	3.29 **	1.35 – 7.99	4.28 **	1.62 – 11.31
PCA vs. WCA	2.74	0.61 – 12.25	6.54 *	1.42 – 30.07	3.48	0.66 – 18.46
Race	0.61	0.21 – 1.74	1.30	0.42 – 4.04	0.27	0.07 – 1.04
Income	1.06	0.79 – 1.42	0.90	0.64 – 1.25	1.43	0.96 – 2.13
Education	0.98	0.81 – 1.20	0.98	0.79 – 1.21	0.81	0.64 – 1.03

OR = Odds Ratio; 95% CI = 95% confidence interval;

* p≤0.05;

** p≤0.01

IG = inaccurate group; WCA = well-controlled accurate group; PCA = poorly-controlled accurate group

Table 3
Negative Binomial Regression Models Predicting the Number of Days or Times of Health Service Utilization (n=126).

	Hospitalization			ED Visits			Asthma Specialist			Acute PCP Visits		
	Beta	95% CI		Beta	95% CI		Beta	95% CI		Beta	95% CI	
IG vs. WCA	2.17 *	0.51 – 4.26		1.22 *	0.06 – 2.46		0.23	-0.78 – 1.27		1.21 ***	0.50 – 1.94	
PCA vs. WCA	3.47 **	1.13 – 6.39		1.41	-0.47 – 3.41		1.01	-0.45 – 2.74		1.86 **	0.85 – 2.91	
Race	1.89	-0.28 – 4.66		3.06 *	1.00 – 6.20		-0.56	-1.85 – 0.61		0.84	-0.08 – 1.91	
Income	0.42	-0.32 – 1.31		0.18	-0.39 – 0.74		-0.10	-0.45 – 0.24		0.22	-0.06 – 0.51	
Education	-0.23	-0.74 – 0.22		-0.16	-0.49 – 0.14		-0.12	-0.38 – 0.12		-0.05	-0.22 – 0.13	
Constant	-3.13	-9.08 – 2.54		-3.03	-7.94 – 1.37		1.19	-2.08 – 4.68		-2.05	-4.55 – 0.18	

	PCP For Routine Check Up			School Clinic Visits			Missed School Days		
	Beta	95% CI		Beta	95% CI		Beta	95% CI	
IG vs. WCA	0.41	-0.15 – 0.96		0.32	-0.76 – 1.47		1.99 **	0.97 – 3.10	
PCA vs. WCA	0.83 *	-0.02 – 1.62		0.69	-0.83 – 2.85		1.48	-0.19 – 3.63	
Race	0.61	-0.11 – 1.36		-0.86	-2.09 – 0.34		1.86 *	0.11 – 3.71	
Income	0.13	-0.07 – 0.33		-0.16	-0.62 – 0.3		0.26	-0.15 – 0.72	
Education	-0.04	-0.16 – 0.10		-0.27	-0.58 – 0.04		-0.12	-0.39 – 0.13	
Constant	-0.95	-2.80 – 0.80		4.84	1.14 – 8.74		-1.37	-5.08 – 2.66	

95% CI = 95% confidence interval;

* p≤0.05;

** p≤0.01.

IG = inaccurate group; WCA = well-controlled accurate group; PCA = poorly-controlled accurate group