Published in final edited form as:

J Asthma. 2010 March ; 47(2): 150–155. doi:10.3109/02770900903483824.

Asthma Diagnosis, Severity, Control and Medication Use In Low Income Minority Preteens

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Abstract

Background—Asthma severity, control, type of medical regimen provided and compliance with it are not well understood in minority patients at the transition stage from childhood to adolescence.

Objective—Identify factors in clinical practice and patient behavior associated with negative outcomes for children at this developmentally significant period.

Methods—Parents of 1292 children with asthma among 6827 pre-teens in 19 middle schools in predominantly African American (94%), low income neighborhoods in Detroit, Michigan were enrolled. Data collected through self administered survey and telephone interviews were useable for 936 parents. Study queries related to demographics, asthma symptoms, and medication use. Mixed effects models with a random intercept for school used to determine severity and control and association of medical regimens to these.

Results—Sixty-seven percent children with probable asthma had received a physician's diagnosis. Being female was associated with being undiagnosed ($p=0.02$); 47% with no diagnosis had persistent asthma and 68% with a diagnosis and asthma medicines were not controlled. Over half with a diagnosis and no medicine were not controlled. Thirty nine percent had controller medicine; 40% were not compliant with controller use; 9% nebulized controller medicine. Compliant use of controller medicine was not associated with asthma control ($p=0.001$).

Conclusions—Lack of an asthma diagnosis was significant in these low income communities. Adolescent girls were at risk for not receiving a diagnosis. Regimens provided children at an important stage in their development were not consistent with therapies recommended for asthma control. Patient compliance with asthma regimens was low. Both clinical and patient education regarding effective asthma management is needed regarding pre teens in low income minority communities.

Clinical Implications—Diagnosis and medical therapy choices for low income, African American pre-adolescents may not account for the actual level of their symptoms. Asthma is likely to be uncontrolled at this significant developmental stage in this population. Girls may be at risk for diagnosis failure.

Keywords

Asthma; Pre-Adolescents; Intervention; Self-Management; Middle School; African-American; Low Income

Introduction

Asthma in low income and minority communities continues to be a significant public health concern.^{1,2, 3} In the 10-13 year old age group, asthma prevalence in these communities is estimated to be as high as 22%.⁴ Asthma-related health care utilization is the highest among the chronic diseases of childhood and adolescence for annual hospitalizations and Emergency Department (ED) visits.⁵ Burden is very high on minority families. Black children are twice as likely as whites to need urgent care,⁶ three times as likely to be hospitalized, and four times as likely to die from asthma.⁵

Some improvements in the picture of clinical intervention for pre teens with asthma have been noted. Carter, Debley, and Redding,⁷ for example, illustrated that although overall prevalence of asthma for middle school students has increased from 3 to 6.2 % in just under a decade, the prevalence of undiagnosed asthma appears to have decreased from 12 to 6.2% likely indicating a change in clinical awareness of the disease. Particular problems associated with asthma management especially for minority students at the important transition period from 10 to 13 years of age are not well understood. Children at this stage develop physically including hormonal changes and growth spurts.⁸ They reach the point where asthma becomes more prevalent in girls.⁹ They become more independent as asthma managers and more interested in socialization into peer groups where effective management may or may not be valued.¹⁰

The study presented here explored asthma severity, control, medical regimens provided by clinicians, and compliance by patients in this developmentally significant age group. The purpose of the study was to identify factors related to clinical practice and patient behavior that comprise targets for change to curb the continuing burden of asthma for African American preadolescents in low income communities.

Methods

Sample

All study procedures were approved by the University of Michigan Institutional Review Board. With permission of the Detroit Public School System, letters were sent to principals of 31 middle schools requesting participation in the study. Nineteen schools agreed to take part. A two step process was used for enrollment. First, a survey questionnaire (asthma identification form) to be completed by parents/guardians was sent home with students that

requested the parents' description of asthma related symptoms as outlined in the National Asthma Education and Program Prevention (NAEPP) guidelines for diagnosis and treatment of asthma.¹¹ A total of 6827 asthma identification forms were distributed over a two year period and 4194 were returned [return rate of 71.4%, adjusted for 10% Detroit Public Schools daily absentee rate]. Second, among families returning a usable form (N=4038), 32% of children met criteria for probable asthma, provided a signed parental consent and were enrolled providing a study population of 1292 students. Probable asthma was determined based on NAEPP guidelines: e.g. the child had a diagnosis of asthma and/or a prescription for asthma medications in the last year, or presence of asthma symptoms during the day time or at night in the past year.

The study population was 94% African American and over 70% of students qualified for the federal reduced/free lunch program according to School System reports (<http://detroit.k12.mi.us/data/>).¹²

Data Collection

Data were collected through the self-administered asthma identification form and from telephone interviews conducted by trained interviewers with study parents. On the initial asthma identification form, parents provided up to three contact phone numbers for the purposes of further data collection. Attempts were made to reach parents at all available phone numbers at least 20 times within a three month window. Of the 1292 enrolled child and parent subject pairs, 936 parent telephone interviews (72%) were completed. The parent interview averaged 45 minutes in length and included questions related to demographics, the child's asthma history, symptoms, medications and health care use.

Measures

Severity—Asthma severity was determined for children without a physician's diagnosis based on responses regarding nighttime and daytime symptoms (cough, cough with exercise, wheeze with a cold, wheeze without a cold, wheeze with exercise, difficulty catching his/her breath, chest tightness, and shortness of breath) experienced in the past 12 months.^{11,13} The question about nighttime symptoms was multiple-choice (“most nights”, “five or more nights a month”, “three to four nights a month”, “one or two nights a month”, “never”). For daytime symptoms, parents were asked to report the number of days when symptoms were present an overall daytime symptom measure was constructed by summing counts. Severity levels were calculated guided by NAEPP definitions and based on nighttime and daytime symptoms. Overall severity was assigned as the more severe of the two.

Control—Asthma control was determined only for children with a diagnosis of asthma, and was based on reports of presence of symptoms in the previous 3 and 12 months as provided in the parent interview. The 5 to 11 year old NAEPP guideline¹¹ was used to determine control. Nighttime symptoms excluded cough with exercise and wheeze with exercise. After summing the individual symptom counts, weekly and monthly averages were calculated. The control level was assigned by taking the worst of the day or night control level based on cut-points corresponding to NAEPP Guidelines. We have reported here analyses based on symptoms from the past three months under the assumption that parents' recall may be better over a shorter time period. Analyses were repeated using symptoms from the past year to account for seasonality and there were no significant differences in the findings between the two time periods.

Medications—Parents were asked to retrieve the child's medicines from wherever they were kept and read to the interviewer the names of all drugs the child was currently taking for asthma, including both prescribed and over-the-counter medications. For each reported

prescription medicine, parents were asked the delivery method (liquid, pill, inhaler, nebulizer) the clinically recommended dose and frequency of administration and when the child had most recently used the medication. After data collection, drugs were classified into five categories: bronchodilator, anti-inflammatory for the lung, anti-inflammatory for the nose, prescription allergy medicine, and over-the-counter medication. The analysis presented here was limited to medications prescribed specifically for asthma; only bronchodilators (reliever) and anti-inflammatories for the lungs (controller) are described.

Data Analysis

Statistical analyses used the SAS[®] System, version 9.1.¹⁴ To account for clustering that may have existed within the 19 schools serving as recruitment sites, mixed effects models with a random intercept for school were used for all analyses. Only univariate associations were examined and all models were univariate. To guard against small numbers in the severe persistent category, severe and moderate persistent asthma were combined into one category in analyses. Percentages reported here used the number of valid responses as the denominator and may not sum to 100 due to rounding.

Results

Table I presents the demographic description of the sample. The students were predominantly African American and male and were of low income, with 47% of the households reporting an annual income under \$15,000. Ninety-seven percent of children had some form of health insurance, primarily Medicaid or Medicaid related e.g. MiChild. Of the 936 children identified through initial assessment as meeting criteria for asthma whose parents provided full information, 67% had received a physician's diagnosis and 33% were undiagnosed. Only 11% of children had ever seen an asthma specialist. Table I also shows the children's characteristics by diagnosis status. Older age was associated with having a diagnosis of asthma ($p = .03$) and being female was associated with being undiagnosed ($p = .02$). Figure I presents the distribution of severity and control in the study population. It shows 47% of children with no diagnosis had persistent asthma and 68% with a diagnosis and asthma medicines were not controlled. Over half (53%) with a diagnosis and no asthma medicine also were not in control.

Severity classification is made prior to treatment for asthma in the clinical setting (NHLBI, 2007).¹³ In this study, of the 313 children without a physician's diagnosis, 92% used no asthma related medications, that is, no prescribed therapies associated with asthma treatment. Of these children 53% reported symptoms of intermittent asthma, 25% mild persistent asthma, 13% moderate persistent asthma, and 10% symptoms of severe persistent asthma. Table II provides characteristics of undiagnosed children by severity. No demographic factor was associated with greater severity of disease in children who did not have a diagnosis.

Control, according to the NAEPP Guidelines,¹¹ is assessed when patients have been treated for asthma. Table III presents the distribution of control in children with a physician's diagnosis who were and were not in possession of asthma medicines. Over three fourths of these preteens had been given asthma prescriptions. Almost half of the preteens with no prescription were well controlled. However, one quarter were not well controlled and another quarter in poor control. Among those with a prescription, a third were in good control, more than a quarter were not well controlled and over a third were in poor control. Children in poor control were more likely to use nebulized medicine.

Table IV shows that almost all children with an asthma prescription had been given reliever medicine. Over a third (38%) had used their relievers on the day of the interview or the

previous day. Approximately half had used a nebulizer to administer the bronchodilator. Another third had not used this type of medicine for more than a month, indicating very intermittent symptoms, only 39% of children with a diagnosis and prescription had medicine aimed at control, although in 68% asthma was not controlled. Further, 9% of controller users reported using a nebulizer to administer this type of medicine. NAEPP Guidelines¹¹ recommend daily administration of controller medicine for patients with persistent disease. However, 40% of all subjects with controller medicine reported that it had last been used more than a week previously indicating poor compliance with the medical regimen.

Table V presents the level of control and most recent use of relievers by compliance to controller medication. It shows that compliance and control had little association with the type of medicine used. More children who were compliant in using their controller medicine had very poorly controlled asthma compared to those who were non compliant ($p=0.04$) or those who used a reliever only ($p<0.001$). Further, significantly more children who were compliant in using controller medicine had recently (day of interview or previous day) used reliever medicine ($p<0.001$).

Figure II shows the number and specific type of medicines used by these pre teens. Children who only used one medicine were much more likely to use Albuterol than another type of drug. A third of the children on controllers used Singulair and a fifth used a combination medicine e.g. Advair.

Discussion

These data paint a very worrisome picture of asthma in middle school children in predominantly African American, low income neighborhoods in Detroit and may have implications for children in vulnerable communities in other parts of the country. Although undiagnosed asthma in a general population of middle school children has been shown to be declining,⁷ in this sample of low income preteens, over a third exhibiting asthma symptoms had received no diagnosis or asthma treatment. Over one fifth of these undiagnosed children exhibited significant, serious disease. Lack of a diagnosis was evident even though almost all these preteens had access to health care through Medicaid or its related state adapted program, e.g. MiChild. These findings suggest that either parents were not seeking asthma care for their children or clinicians were not identifying asthma when children made routine visits for other health problems. Girls were most likely to be overlooked for an asthma diagnosis. Although asthma is more prevalent in boys¹⁵ around the time of puberty prevalence switches to favor girls. It is thought that hormonal shifts at menarche accounts for the increase in asthma onset and severity.^{16,17} Because of the predominance of the disease in boys it may be that clinicians expect to find asthma less often in girls and this became a self fulfilling prophecy for this group of children. For those of both sexes without a diagnosis no significant demographic factor was associated with more severe disease suggesting that it is difficult to predetermine which children will be at most serious risk.

In children with an asthma diagnosis, only lack of insurance was associated with not having prescription medicine for asthma. It may be that although almost all children had third payer provided access to health care and were covered for some form of asthma medications, insurance was insufficient to cover specific asthma treatments preferred by physicians. Perhaps these low income parents did not secure needed medicine for unknown reasons. Perhaps physicians believed the condition was not serious enough to warrant medicine. Children without prescription medicine were more likely to have their asthma in control than those on asthma medicines. This may indicate no need for medicines because no symptoms were present. However, over half of these children did exhibit symptoms and poor control suggesting that they in fact needed asthma medicine but had not received it.

The picture for children with asthma prescriptions suggests that over two thirds were not in control. About 40% of patients on controller medicines failed to use them appropriately, that is, administer them daily as recommended for those with persistent asthma. This could well account for lack of control in this group but does not account for the 60% of patients who were compliant with their controller medicines. The regimens provided to non compliant patients could conceivably have not been effective and this encouraged non compliance. There is also the possibility that in some cases delivery systems given families for administering the medicines were not effective as significant numbers nebulized their medicines.

Controller medicines were much less evident in this sample than the level of the children's symptoms indicate. Far less than half were on controller medicines. As noted it may be that cost of drugs played a role in the prescription choices of physicians, however, under most plans covering the participating families some form of asthma control medicine was included. In general, asthma drugs and devices were available through Medicaid and MiChild for virtually all study participants. Occasionally, a Medicaid health maintenance organization or similar system may have excluded a specific drug on its formulary but in such cases almost always a comparable medicine is available. The data suggest adherence to NAEPP guidelines among the physicians treating the children was at a low level.

Although cost to the patient does not appear to be a dominant factor in explaining regimen choices for this sample of children, physician-family communication may have been a factor. Lack of communication between provider and family could conceivably have led to prescription choices less conducive to control. Patel et al¹⁸ found a third of the physicians they surveyed reported that cost of medication for the family was a barrier to the doctor when deciding on asthma medicine prescriptions. However, over half of the clinicians reported that they actually did not discuss potential out-of-pocket medicine related expenses with their patients. Pediatricians were less likely than other physicians to discuss drug costs. An added potential explanation for the worrisome asthma profile in these pre teens is the delivery devices used. National guidelines¹¹ make clear that routine nebulizer delivery of bronchodilator medicines is generally less effective and more costly than metered dose inhalers with spacers. Many children with asthma prescriptions used nebulizer administered bronchodilator therapy despite metered dose inhalers with spacers being likely a more effective choice.¹⁹ Just under 10% used nebulizers for controller therapy a practice not endorsed in asthma guidelines.

Asthma control especially in minority children appears to continue as a significant public health concern.²⁰ The quality of care rendered patients in this study who were at a significant stage in their physical and social development appears inadequate to achieve control of their disease. Girls were less likely to be diagnosed although their disease could be significant. The number and type of prescription medicines and means of delivery were not associated with control suggesting a mismatch between the level of disease and therapies prescribed. Patient compliance with asthma regimens was low, but this fact only partially explains lack of control. The need for both clinician and patient education regarding effective diagnosis, treatment and control of asthma seems acute in the low income, minority pre teen population included in this study.

Key Messages

- Diagnosis and therapy failure is significant in low income African American pre-adolescents
- Girls can be overlooked for diagnosis

- Ineffective delivery device use is not uncommon.

Acknowledgments

We wish to acknowledge the support of the faculty and staff of the Detroit Public School's Office of Research, Evaluation, and Assessment. We wish to thank Robert B. Mellins, M.D. for his review and comments on this manuscript.

This research presented here was supported by grant 5-R01HL068654 from the Lung Division of the National Heart, Lung, and Blood Institute of the National Institute of Health.

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Number of Children: 476

Figure II.

Frequency and specific types of medications reported

Note: This is the only chart/table where the child is NOT the unit of analysis. In this chart there is one observation per reported medication (953 meds for 476 children).

Table I

Subject characteristics overall and by diagnosis status

	Overall	No Diagnosis	Diagnosis	p-value
Number of Children	936	313 (33%)	623 (67%)	
Asthma Severity				
Intermittent	47%	53%	45%	0.02
Mild Persistent	25%	25%	25%	
Moderate Persistent	17%	13%	19%	
Severe Persistent	11%	10%	11%	
Demographics				
Age, mean (SD)	11.6 (0.6)	11.5 (0.5)	11.6 (0.7)	0.03
Age of onset of symptoms	4.6 (3.7)	6.1(3.9)	3.9 (3.5)	<0.0001
Female	47%	53%	45%	0.02
African-American Race	96%	96%	96%	0.62
Body mass index Z-score [†] , mean (SD)	1.0 (1.4)	0.9 (1.6)	1.1 (1.3)	0.22
Household Income				
<\$15,000	47%	46%	47%	0.87
\$15,000 - \$40,000	39%	39%	39%	
\$40,000+	14%	15%	14%	
Primary Caretaker's Education				
Less than High School	20%	20%	20%	0.84
High School degree	37%	38%	36%	
More than High School	43%	42%	44%	
Has Insurance	97%	98%	97%	0.34
Of Insured Children, Has Medicaid	68%	65%	70%	0.18
Uses Asthma Medication	54%	8%	76%	<0.0001

[†] A z-score is an individual's deviation from the population mean divided by the standard deviation of the population. A z-score of 0 is the US National average.

Table II

Subject characteristics by asthma severity in undiagnosed children

	Intermittent	Mild Persistent	Mod/Sev Persistent	p-value
Number of Children	165 (53%)	78 (25%)	70 (22%)	
Demographics				
Age, mean (SD)	11.5 (0.5)	11.5 (0.6)	11.6 (0.6)	0.13
Female	50%	62%	49%	0.83
African-American Race	98%	96%	94%	0.25
Body mass index Z-score [†] , mean (SD)	0.9 (1.6)	0.8 (1.8)	1.1 (1.5)	0.68
Household Income				
<\$15,000	43%	53%	48%	0.33
\$15,000 - \$40,000	40%	35%	42%	
\$40,000+	18%	12%	11%	
Primary Caretaker's Education				
Less than High School	15%	25%	26%	0.17
High School degree	39%	41%	33%	
More than High School	45%	34%	41%	
Has Insurance	99%	96%	97%	0.36
Of Insured Children, Has Medicaid	64%	65%	70%	0.51

[†] A z-score is an individual's deviation from the population mean divided by the standard deviation of the population. A z-score of 0 is the US National average.

Table III
Subject characteristics by level of control and use of prescription asthma medications

	No Prescription				With Prescription			
	Well Controlled	Not Well Controlled	Very Poorly Controlled	p-value	Well Controlled	Not Well Controlled	Very Poorly Controlled	p-value
Number of Children	70 (48%)	38 (26%)	39 (27%)		152 (32%)	134 (28%)	190 (40%)	
Demographics								
Age, mean (SD)	11.7 (0.6)	11.6 (0.6)	11.7 (0.7)	0.67	11.6 (0.6)	11.6 (0.7)	11.6 (0.7)	0.82
Female	51%	45%	49%	0.68	47%	43%	41%	0.30
African-American Race	94%	95%	92%	0.74	97%	94%	98%	0.51
Body mass index Z-score [†] , mean (SD)	1.1 (1.2)	0.8 (1.7)	1.4 (0.8)	0.58	0.9 (1.4)	0.9 (1.2)	1.2 (1.2)	0.02
Household Income								
<\$15,000	44%	47%	64%	0.06	36%	51%	51%	0.03
\$15,000 - \$40,000	33%	39%	31%		50%	37%	36%	
\$40,000+	23%	13%	6%		14%	12%	13%	
Primary Caretaker's Education								
Less than High School	23%	8%	33%	0.48	18%	19%	20%	0.83
High School degree	39%	37%	46%		38%	32%	35%	
More than High School	39%	55%	21%		44%	49%	45%	
Has Insurance	91%	95%	92%	0.75	98%	97%	98%	0.76
Of Insured Children, Has Medicaid	68%	69%	78%	0.38	62%	66%	78%	0.001
Medication Use								
Type of Asthma Medication Used								
Controller + Reliever					28%	37%	43%	0.004
Controller only					2%	1%	4%	
Reliever only					70%	61%	53%	
Number of Meds, mean (SD)								
Uses an Inhaler					1.8 (0.8)	2.1 (1.0)	2.2 (0.9)	0.0002
Uses a Nebulizer					76%	85%	89%	0.001
Spacer Use, among inhaler users					41%	49%	53%	0.03

	No Prescription				With Prescription				p-value
	Well Controlled	Not Well Controlled	Very Poorly Controlled		Well Controlled	Not Well Controlled	Very Poorly Controlled		
Always/Most of the time					29%	35%	35%		0.64
Sometimes/Hardly ever					21%	21%	18%		
Never					50%	44%	47%		

Table IV

Type and Extent of asthma medication use in children with a diagnosis and a prescription (n=476)

	Relievers	Controllers
Number of Users	463 (97%)	188 (39%)
Form(s) used *		
Oral (Pill or Liquid)	17%	65%
Inhaler	81%	52%
Nebulizer	49%	9%
Most recent use		
Today/Yesterday	38%	60%
Last week	21%	9%
Last Month	10%	8%
More than a month ago	30%	24%

* Categories are not mutually exclusive since some children report more than one medication within the category

Table V

Level of control by compliance to controller medication and most recent reliever use.

	Compliant Controller Users	Non-Compliant Controller Users	Reliever Only Users
Number of Children	112	74	288
Asthma Control			
Well Controlled	21%	30%	37%
Not Well Controlled	24%	32%	28%
Very Poorly Controlled	54%	38%	35%
<i>p-value vs. Compliant Controller Users:</i>		0.04	<0.001
Most recent use of Reliever			
Today/Yesterday	60%	28%	29%
Last week	13%	27%	22%
Last Month	6%	14%	10%
More than a month ago	13%	19%	37%
Unknown/Don't use a Reliever	9%	12%	3%
<i>p-value vs. Compliant Controller Users:</i>		<0.001	<0.001