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Components of recommended asthma care and the use of long-term control medication among urban children with asthma

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Abstract

Background—Previous research has documented an underuse of long-term control medications among children with asthma, in non-adherence with national guidelines on asthma care.

Objectives—To determine if factors related to access and quality of asthma care are associated with underuse of long-term control medication among children with asthma.

Research Design—A parent-report cross-sectional survey conducted in 26 randomly selected New York City public elementary schools

Subjects—5,250 children, of whom 912 had asthma

Results—Twenty-nine percent of children with asthma reported using a long-term control medication. Among children with persistent asthma, defined as having one or more sleep disturbances due to asthma per week, 59.0% reported using a long-term control medication. After adjusting for demographic factors, children who had an asthma plan, had visited a doctor in the previous 6 months for non-urgent asthma care, or were enrolled in an asthma education program were more likely to use long-term control medication (Odds Ratios:6.00, 4.11, 2.88, respectively). Children of Spanish-speaking parents, African-American children, and children with no health insurance were the least likely to use long-term control medication (Odds Ratios: 0.51, 0.49, 0.20, respectively). Children who reported recommended components of asthma care were the most likely to use their medication with appropriate frequency.

Conclusions—Children who reported markers of high quality, personalized medical care, were more likely to use long-term control medication. These findings illustrate that components of the medical care received, and not only the demographic characteristics of the patient, are key factors in understanding the underuse of long-term control medication in urban children with asthma.

Introduction

Although the recommended treatment for asthma is well established, health outcomes among children with asthma have been less than optimal.¹ Current recommendations focus on a combination of medications to address airway inflammation and constriction and avoidance of environmental triggers.² Yet, a number of studies have documented poor adherence to these guidelines, resulting in the persistence of poor health outcomes and disparities in markers of morbidity, especially among those of low socioeconomic status.^{3–6} In previous work, the authors have found that almost half of a representative sample of urban children with asthma had an urgent visit to the emergency department in the past 12 months.⁷ Latinos were five

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times as likely and African-Americans two times as likely as Whites to report urgent visits to the emergency department.⁷ Deficiencies and disparities in quality of life and activity limitation among children with asthma have been documented in other studies.⁸⁻⁹

The clinical guidelines set forth by the National Heart Lung and Blood Institute (NHLBI) aim to improve asthma care in the United States by creating a standard of asthma treatment that is based upon the best available medical knowledge.² A key component of these guidelines is the recommendation that all children with persistent asthma use long-term control medication. Additionally, the guidelines recommend that these children and/or their parents should receive counseling on the proper way to take these medications, including the importance of using them in the absence of active symptoms.² However, underuse of long-term control medications, especially among minority children, continues to be a major impediment to successful asthma management.¹⁰⁻¹⁴ A recent survey conducted by Halterman et al found that 37% of children under the age of 18 with persistent asthma did not report receiving long-term control medication.¹³ Research has shown that there is a problem of under-prescription of medication by physicians⁶ as well as underuse of the medication by children, once it has been prescribed.^{15,16}

A number of studies have focused on characteristics of the child and their family as explanations for medication non-adherence among patients.¹⁷⁻²² For example, previous research examining racial/ethnic disparities in the use of long-term control medications has often discussed the role of cultural beliefs, parental perceptions of asthma, and lack of health literacy as potential explanations for why Latinos and African-Americans are less likely than Whites to use and refill their medications.^{17,21,22} Yet, there have been few studies to examine whether appropriate use of long-term control medication may be associated with other characteristics of quality asthma care that minority children are less likely to receive.

A recent study of children under 18 found that minority children were less likely to report using a controller medication and less likely to have an asthma management plan from their physician, although the study did not determine if failing to have an asthma plan contributed to the lack of medication use.¹⁴ Another study of children under 18 found that failing to have an asthma plan was associated with having persistent symptoms and not reporting use of long-term control medication.¹³ However, there are other factors related to health care access and quality, besides having an asthma plan, that could impact a child's use of long-term control medication. Additionally, these factors could also influence whether children use the medication appropriately, i.e. regularly even when not having symptoms.

In the present study, we hypothesized that children who report markers of quality asthma care will be more likely to use long-term control medication, independent of their socioeconomic status. The objective of this study was to assess the factors associated with long-term control medications in an ethnically and economically diverse sample of urban children. An additional objective was to determine if communication barriers and education affect appropriate use of medication.

Methods

Data were collected as part of a cross-sectional study of asthma prevalence during the 2002-2003 school year.²³ The project was reviewed and approved by the Mount Sinai Institutional Review Board, the Mount Sinai Health Insurance Portability and Accountability Act Office and the New York City Department of Education's Division of Assessment and Accountability.

Methodology for this study has been reported in previous publications.^{23,24} Briefly, New York City ZIP Codes were ranked and grouped according to their childhood asthma hospitalization

rate. To obtain a representative sample of New York City school children, the ZIP Codes within the three groups with the highest, median, and lowest asthma hospitalization rates were eligible for inclusion in the study. One public elementary school per eligible ZIP Code was randomly selected with probability proportional to size. A total of 26 schools were selected, 8 within each strata and two additional schools in the area of low asthma hospitalization to compensate for the lower expected prevalence. To control for seasonality of asthma symptoms, which could affect reported medication use, schools from each of the three groups were assessed concurrently during overlapping 2-week periods, and so equal numbers of schools were assessed during the fall, winter, and spring seasons.

Within each school, questionnaires were distributed in two randomly selected classrooms per grade level, kindergarten through 5th grade, and up to two self-contained special education classrooms where available. As described in a previous publication²⁴, an interactive presentation was given in each classroom, and children were instructed to bring the questionnaire home to their parent/guardian and return the completed form within two weeks. Both children and teachers were given nominal incentives, such as school supplies, to encourage participation.

The parental questionnaire was adapted from a previous study of childhood asthma and was available in English, Spanish, or Chinese.²⁵ To ensure clarity and cultural appropriateness, the questionnaire was pilot-tested among groups of native speakers, prior to the study. The questionnaire contained standardized items on demographics, household environment, asthma diagnosis and symptoms, medication use and healthcare utilization. Ever having asthma was defined as a positive response to the following question, "Have you or your child ever been told by a doctor or nurse that he/she has asthma?". Children who also reported wheezing in the previous 12 months were identified as having current asthma.

Because the NHLBI guidelines recommend long-term control medication for all children with persistent asthma², we sought to examine a subset of children who would fall into this category based on their reported symptoms. The NHLBI classification scheme uses a combination of day and nighttime symptoms, medication use, and lung function tests in order to categorize asthma severity in a clinical setting.² In this study, we used sleep disturbances due to asthma as the marker for asthma severity. In order to be consistent with the NHLBI classification scheme, children with a physician's diagnosis of asthma who also reported one or more sleep disturbances due to asthma per week were designated "persistent", requiring treatment with long-term controller medication.

Use of medications, was ascertained by including a table of commonly prescribed medications on the questionnaire and allowing respondents to indicate which medications their children used during the past 2 weeks, as well as frequency of use. There was also an area where parents could include medications not listed. For the purpose of this study, long-term control medications included medications that fell into one of the following categories: long-term beta agonists, inhaled corticosteroids, cromolyn, and leukotriene modifiers. The table also listed commonly prescribed short-term beta-agonists and allergy medications. The response options for frequency of use were: 1) when having symptoms only, 2) when having an attack only, or 3) regularly-even when not having symptoms.

To assess factors related to access to medical care, the questionnaire included items on insurance status, access to medical advice on evenings or weekends, and whether the child had a single, usual source of asthma care. Classifications for a single, usual source of medical care for asthma included emergency departments, private physician's offices, community clinics/hospital outpatient clinics, as well as not having a single, usual source of care. If more than one location was indicated on the questionnaire, the respondent was classified as not having a

single source of usual care and combined with the children who reported not having a usual source of care. The rationale for collapsing these two categories is to be able to examine consistency of care, and thus children with a single source of usual care are compared to children who visit different places for their asthma care.

Markers of quality care were derived from the NHLBI guidelines. The following are all included in the NHLBI guidelines as recommended components of quality asthma care: self-management education for the patient and/or family, either through the child's physician or other healthcare provider or program, such as community-based or school-based initiatives, follow-up visits for routine asthma-care at intervals no greater than 6 months, and creating an asthma management plan with a healthcare provider, that contains a component that addresses appropriate medication use.²

Data were weighted to represent the number of children attending public elementary schools within their respective ZIP Codes. All data analyses were conducted using the Surveymeans, Surveyfreq, and Surveylogistic procedures in SAS v9.1 (SAS Institute, Cary, NC, 2003). These methods account for the clustering by school and stratification by neighborhood asthma hospitalization rate in the sampling design.

Weighted percentages of demographic characteristics of the overall sample and of the subset of children with asthma were calculated, as were the weighted prevalence of asthma and the weighted percentage of children with asthma who reported current or persistent symptoms. Long-term medication use in all children with ever asthma, current asthma and persistent asthma was calculated and compared. To determine the socioeconomic and access to care factors that were associated with long-term medication use, both unadjusted and adjusted odds ratios and corresponding 95% confidence intervals (CI) were computed using logistic regression procedures in SAS. Missing data were excluded from these calculations, and a complete case analysis was performed. The multivariate model was constructed using variables selected a priori based on literature review and plausible mechanistic theories.

Frequency of medication use was also examined in order to determine if children who reported use of a long-term control medication used it appropriately, (regularly, even when not having symptoms). A stratified analysis of weighted frequency of use, by access to care factors, was conducted to determine if using medication regularly was more common among children who reported communication and/or educational activities such as having an asthma management plan that included when to take medications regularly and either the child or parent being enrolled in an educational asthma program. Statistical comparisons between groups were made by conducting chi-square tests corrected for the study design in SAS.

Results

As reported in our previous publications^{23,24}, 5250 out of 7310 children returned a completed questionnaire, yielding an absence-adjusted response rate²⁶ of 76.9%. The demographic profile of the study sample has been shown previously to be highly comparable to New York City Department of Education's enrollment data for the participating schools, the 5-12 year old population of the ZIP Codes from where the schools were selected, and the overall public elementary school population of New York City.²⁴

Demographic characteristics of the study participants

The demographic characteristics of the study participants are presented in Table 1. The sample was ethnically diverse, with 39.2% of the children being Latino, 22.3% African-American, 15.2% White, 12.3% Asian, and 6.8% some other race/ethnicity, including multi-racial/ethnic children. Almost two-thirds of the children lived in a household with an annual income less

than \$40,000. Only 5% lived in a household with an annual income of \$75,000 or more. The majority of children lived in a household where a parent/guardian had at least a high school education or equivalency. Approximately 17% of children had their questionnaire completed in a language other than English.

Demographic characteristics of children with asthma

The prevalence of ever having asthma was found to be 20.1% (17.2, 23.0 95% CI), representing 912 children. Children with asthma were more likely to be male or Puerto-Rican, and less likely to be White or Asian (Table 1). Five hundred forty (60.5%) children with asthma reported wheezing in the previous 12 months and were classified as having current asthma. Having reported one or more sleep disturbances due to asthma per week, 16.5% (N=123) of the children with asthma were categorized as persistent. Children with current and persistent asthma had similar demographic profiles to children with asthma overall, although African-Americans made up a larger percentage of persistent asthmatics than all asthmatics (African-Americans: 40.3%). Asians and children classified as Other made up a smaller percentage of children with persistent asthma when compared to children with asthma overall (Asians: 2.66%, Other: 2.80%).

Prevalence of long-term control medication use

Among all children with asthma, 29.1% (25.8, 32.3 95% CI) reported use of a long-term control medication in the previous 2 weeks, while 38.4% (33.5, 43.3 95% CI) of children with current asthma reported medication use. As stated previously, NHLBI guidelines recommend that all children with persistent asthma use a long-term control medication to treat their asthma.² Among the subset of children with persistent asthma in our sample, only 59.0% (49.4, 68.7 95% CI) reported use of a long-term control medication. This data is illustrated in figure 1. Of the 236 children with asthma who reported using a long-term control medication, 33.4% (24.8, 42.0 95% CI) had one or more sleep disturbances due to asthma per week, indicating that despite being on a long-term control medication, their symptoms were not under control.

Factors associated with use of long-term control medication

Unadjusted and adjusted odds ratios for long-term controller use by demographic and access to care factors are listed in Table 2. In unadjusted analyses, access and quality of care factors were strongly associated with using long-term control medications. The greatest positive association was observed among children whose parents had reported developing an asthma management plan with their health care provider. They were six times as likely as children who did not have a management plan to use long-term control medication (OR: 6.00 3.07, 11.7 95% CI). Enrollment in an asthma education program and visiting a physician in the previous 6 months for non-urgent care were also strongly associated with use of a long-term control medication. Access to medical advice on evenings or weekends was not associated with use of long-term control medication in unadjusted analysis (data not shown) and was not included in the final adjusted model.

In the adjusted analysis, access to care factors were more strongly associated with long-term control medication use than demographic factors. Similar to the unadjusted findings, children in an asthma program, children who visited a physician in the last 6 months for non-urgent, routine asthma care, and children who reported working out an asthma management plan with their healthcare provider were all more likely to use long-term controller medication. Having health insurance was also associated with using long-term control medication. Children with no health insurance had very low odds of long-term medication use compared to children with private insurance (OR: 0.20 0.04, 1.09 95% CI). After adjusting for the above components of medical care, children who reported not having a single source of asthma care or reported more

than one usual source of care had the highest odds of using a long-term control medication when compared to children who used the emergency department.

Completing the questionnaire in Spanish, which could indicate issues of communication with non-Spanish speaking healthcare providers, also showed an independent association with medication use, independent from the child's ethnicity. There were too few children with asthma with a questionnaire completed in Chinese to provide a stable odds ratio estimate, but the unadjusted estimate suggests that they too are less likely to use long-term control medication than children from English-speaking families.

The adjusted analysis revealed some disparities in medication use based on demographic factors. The odds ratio comparing medication use among African-Americans to Whites changes from 1.07 in the unadjusted analysis to 0.49 in the adjusted analysis, indicating that African Americans are less likely than Whites to use long-term controller medication, after differences in access to care are taken into account. In both unadjusted and adjusted analyses (not shown here), we found no association between parental educational attainment and medication use. In both instances, the overall p-value was 1.0.

Communication/education factors and regular use of long-term control medication

Slightly more than half, 56.7%, of children with asthma who used a long-term controller medication reported using it regularly, even when not having symptoms. Among children with persistent asthma, the percentage who used their long-term controller medication regularly was 56.3%. Respondents who indicated enrollment in an asthma education program (n=60) were more likely to use medication regularly than those who were not enrolled (n=194) (66.4% vs 53.2%, $p<0.0001$). The difference was even greater when comparing children who had worked out an asthma plan that included taking medications regularly, as 70.8% (n=177) of those children reported taking their medication regularly, compared to only 25.4% (n=77) of the children who either did not have any plan or whose plan did not include those specific instructions ($p<0.0001$).

Discussion

This study documented an underuse of long-term control medication among urban children with asthma, in non-adherence with the recommendations put forth by the NHLBI asthma care guidelines. Additionally, markers of health care access and quality of care were found to be highly associated with use of long-term control medications, independent of demographic characteristics. These findings illustrate that components of the medical care received, and not only the demographic characteristics of the patient, are key factors in understanding the underuse of long-term control medication in urban children with asthma.

Our finding that more than 40% of children with persistent asthma did not report using a long-term control medication is consistent with previous population-based studies, both using self-report data^{13,14} and prescription data¹², that document underuse of long-term medication among children. One-third of all children with asthma in this sample who indicated use of a long-term control medication reported experiencing frequent, nighttime symptoms. This suggests that, despite using a long-term control medication, their asthma remains poorly controlled. Some of these children may require more aggressive medication regimens or additional counseling on the importance of reducing the presence of environmental allergens and triggers.¹⁴ Both of these actions should be addressed as part of a comprehensive asthma management plan, which the majority of children reported having. Thus, it is possible that some of these plans may be incomplete and/or not updated frequently to address a child's changing symptomology, potentially contributing to the finding that some children using long-term control medications do not have well-controlled asthma.

This study also found that markers of access and quality care were highly associated with long-term control medication use. Previous work in children under 18 found similar results regarding the association between having an asthma management plan and using long-term control medication.¹³ However, our study also controlled for other medical care factors, such as type of health insurance, a recent non-urgent physician visit and usual source of care, which we found also contributed to long-term control medication use. Additionally, our study was able to compare long-term control medication use in children of different socioeconomic backgrounds, building upon previous work which focused on traditionally underserved populations, such as Medicaid recipients.^{10,27}

Children from Spanish-speaking households were less likely to use long-term control medication than children from English-speaking households. Consistent with previous research,^{14,28,29} this finding indicates communication-related and/or cultural barriers to appropriate medication use and treatment that are independent of income, insurance status and source of care. Our finding that children with multiple sources of care are more likely to use a long-term control medication than children who reported having a single, source of usual care may be explained by their increased contacts with different members of the health field. This may give patients greater opportunity to be prescribed and/or counseled on long-term control medication.

Our study also found that African-Americans were less likely to report long-term medication use, after adjusting for factors related to access and quality of care. Previous work has suggested that disparities in medication use between African-Americans and Whites may be due to lower expectations of health outcomes among minority parents coupled with a greater concern about using medication everyday, even in the absence of symptoms.²² Our study did not inquire about complementary or alternative medical treatments, which previous research has found are more common among minority families. Research suggests that African-Americans are more likely to use alternative treatments in place of traditional medication,³⁰⁻³² which may explain some of the disparity between African-Americans and Whites observed in our study.

In addition to characterizing the factors associated with using long-term control medication, this study examined whether children were taking the medication appropriately. The finding that almost half of the children with a long-term control medication use it only when having symptoms illustrates a lack of understanding among parents about how the medication works to prevent symptoms before they start. It may also indicate a lack of communication between physician and patient/family. This is supported by the finding that the parents who reported having an asthma plan which specifically included a component on taking medications regularly were the parents most likely to report that their child took the medication regularly.

After adjusting for access and quality of care factors, our study did not find associations between long-term control medication use and either parental education level or household income. In contrast, previous work has found that low-income children and children with parents with lower levels of education are less likely to use long-term control medication for their asthma.^{12-14,27} These studies did not control for some of the access and quality of care factors that were included in the present analysis, which could explain the difference in our findings. Although the income data suggest that children from middle-income families are more likely to use long-term control medication than children from lower or upper income families, the confidence intervals are very wide, preventing us from making substantive conclusions about the relationship between income and medication use.

This study used self-report of medication use, as opposed to obtaining prescription data from a pharmacy or medical record. It is possible that parents receive, but do not fill prescriptions for long-term control medications for their children with asthma. Previous studies of

discordance between parent and physician report of medication prescription found that when a physician reported a prescription for long-term control medication, more than one-third of parents failed to report its use.¹⁵ While it may cause an underestimate of the number of children who receive long-term control medication prescriptions, self-report data represents use of the medication, which is an important marker on the pathway to optimal asthma management.

This study is limited by its cross-sectional design, which prevents drawing conclusions on causality. Selection bias may also be a limitation because parents who responded to the survey may have been different from those who chose not to participate. However, this limitation may have been minimized by our high response rate and the finding that study sample was demographically very similar to the selected schools' enrolled population, the population of the ZIP Codes surrounding the schools, as well as the overall New York City public school population.²⁴ Thus, it is less likely that our findings are explained by selection bias. The use of complete-case analysis in our multivariable regression model is another potential limitation, as the exclusion of missing data caused the sample size of this analysis to be reduced. Even with these potential limitations, these study results are generalizable to the overall New York City pediatric population, as well as to children living in other US urban environments, which share similar demographic profiles, insurance coverage, and asthma prevalence.

In conclusion, these findings stress the importance of continued education of physicians and patients on the established standard of care for childhood asthma, including using long-term control medication in the context of a comprehensive asthma management plan. Our study shows that long-term control medications continue to be underutilized in the treatment of childhood asthma. This study's results support providing a context of asthma management that includes working on an asthma plan, scheduling non-urgent asthma check-ups, and providing self-management education in order for children to use their medication and use it with appropriate frequency.

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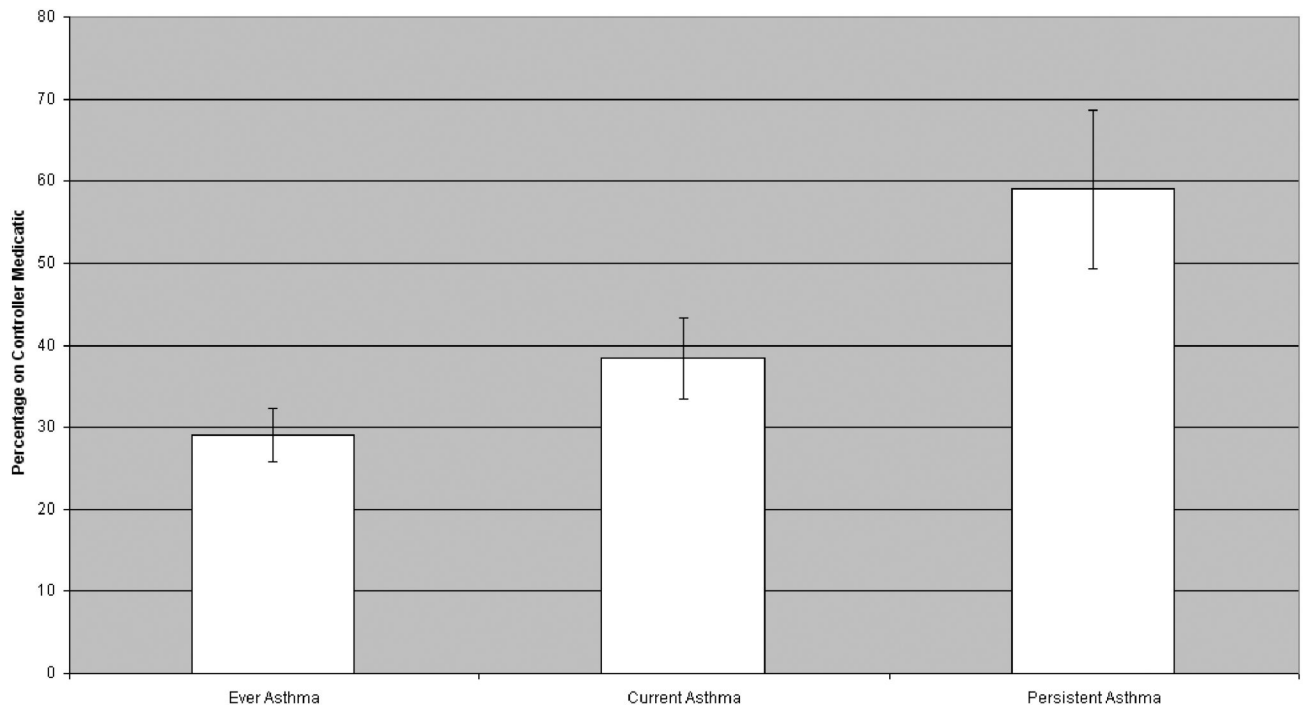


Figure 1. Percentage of children who reported use of a long-term control medication by asthma status. Ever asthma defined as having received an asthma diagnosis from a physician or other healthcare provider. Current asthma defined as having an asthma diagnosis and reporting wheezing symptoms in the previous 12 months. Persistent asthma defined as having an asthma diagnosis and reporting one or more sleep disturbances due to asthma per week.

Table 1

Demographics of total sample and sub population of asthmatics, defined as having a physician's diagnosis of asthma

	Overall Study Sample (N=5,250)	Ever Asthmatics (N=912)
Gender		
% Male	46.8	54.4
Mean Age, years	8.1	8.2
Ethnicity		
Latino	39.2	47.0
Dominican	6.9	8.3
Mexican	8.0	4.1
Puerto Rican	12.1	23.2
Other Latino	11.8	11.4
African-American	22.3	28.6
White	15.2	8.2
Asian	12.3	5.7
Other	6.8	6.9
House hold Income		
<\$20,000	41.1	46.4
\$20,001-\$39,999	25.2	26.7
\$40,000-\$74,999	13.1	10.2
\$75,000 or more	5.3	3.4
Parental Education		
Less than High School	19.5	22.5
High School/GED	28.6	31.4
Some College/trade School	23.5	22.9
College graduate/Professional Degree	21.8	17.9
Language		
English	82.7	83.3
Spanish	15.3	15.8
Chinese	2.0	0.9

Table 2
Unadjusted and adjusted odds ratios and corresponding 95% confidence intervals of long-term control medication use for ever asthmatics*

	Unadjusted Odds (95% Confidence Interval)	unadjusted analysis p-value	Adjusted Odds (95% Confidence Interval)	adjusted analysis p-value
Ethnicity		0.04		0.002
Dominican	0.62 (0.36, 1.07)		0.73 (0.26, 2.06)	
Mexican	1.11 (0.56, 2.21)		1.14 (0.42, 3.14)	
Puerto Rican	0.93 (0.64, 1.37)		1.00 (0.57, 1.78)	
Other Latino	1.07 (0.65, 1.74)		1.39 (0.56, 3.49)	
African-American	1.07 (0.74, 1.54)		0.49 (0.27, 0.89)	
Asian	0.64 (0.38, 1.09)		0.60 (0.30, 1.22)	
Other	0.98 (0.60, 1.60)		1.25 (0.64, 2.44)	
White	1.0		1.0	
Income		0.2		0.1
<\$20,000	1.43 (0.70, 2.92)		1.02 (0.34, 3.06)	
\$20,001-\$39,999	1.49 (0.76, 2.93)		1.42 (0.59, 3.43)	
\$40,000-\$74,999	1.74 (0.93, 3.26)		1.71 (0.75, 3.90)	
\$75,000 or more	1.0		1.0	
Language		0.001		<0.0001
Spanish	0.97 (0.67, 1.41)		0.51 (0.27, 0.98)	
Chinese	0.51 (0.35, 0.73)		Unstable Estimate	
English	1.0		1.0	
Insurance		0.3		0.2
None	0.62 (0.28, 1.37)		0.20 (0.04, 1.07)	
Medicaid	0.97 (0.60, 1.59)		0.94 (0.55, 1.62)	
Child Health Plus	1.10 (0.61, 2.00)		0.75 (0.27, 2.05)	
Private	1.0		1.0	
Usual Source of Care		0.03		<0.0001
Clinic/Hospital Outpatient	1.11 (0.61, 2.05)		1.18 (0.57, 2.46)	
Doctor's Office	1.36 (0.81, 2.31)		1.08 (0.60, 1.95)	
No One Place	1.37 (0.83, 2.26)		2.07 (1.13, 3.82)	
Emergency Department	1.0		1.0	

	Unadjusted Odds (95% Confidence Interval)	unadjusted analysis p-value	Adjusted Odds (95% Confidence Interval)	adjusted analysis p-value
Asthma education program	2.88 (152, 5.12)	0.0003	2.12 (1.19, 3.78)	0.01
Doctor's Visit in the Past 6 Months	4.11 (220, 7.67)	<0.0001	3.17 (1.80, 5.58)	<0.0001
Asthma Plan	6.00 (3.07, 11.7)	<0.0001	4.20 (1.95, 9.05)	0.0002
Evening symptoms once or more a week	4.78 (3.01, 7.59)	<0.0001	4.36 (2.93, 6.47)	<0.0001

* Final adjusted model based on 605 respondents with complete data for all variables.