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Outcomes After Periodic Use of Inhaled Corticosteroids in Children

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Abstract

Background—Many children with persistent asthma use inhaled corticosteroids on a periodic basis. Clinical trials in adults suggest that periodic use of inhaled corticosteroids may be effective for patients with mild persistent asthma. However, scant information exists on the clinical outcomes of children with asthma who are using inhaled corticosteroids on a periodic basis in real-world settings.

Objective—This prospective cohort study compared clinical outcomes during a 12-month follow-up period between children with persistent asthma whose parents believed that they were supposed to use inhaled steroids either (a) periodically or (b) daily year-round at the start of the period. The clinical outcomes studied were (1) asthma-related emergency department (ED) visits or hospitalizations, (2) uncontrolled asthma based on health care and medication use, and (3) outpatient visits for asthma.

Patients and methods—The study population included children with persistent asthma from two health plans whose parents reported that they were using inhaled corticosteroids during a baseline telephone interview. The interviews collected information on whether the children's parents believed they were supposed to use inhaled corticosteroids on a periodic or daily basis, as well as baseline asthma symptom status, sociodemographic, and behavioral variables. We used computerized databases to identify clinical events for each child during the 12 months after their baseline interview. Uncontrolled asthma was defined as any asthma-related ED visit or

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hospitalization, two or more oral steroid prescription fills, or four or more beta-agonists canisters filled during the 12-month period. We compared these outcomes between the periodic versus daily users of inhaled corticosteroids using logistic regression analyses. We conducted both (1) a traditional logistic regression analysis in which we adjusted for selection bias by including covariates such as age, asthma physical status, sociodemographic and behavioral variables, and history of asthma-related health care use during the year before interview and (2) an analysis using propensity scores to more fully adjust for selection bias.

Results—Of a total of 476 children in the study, 55% of parents believed their children were supposed to be using inhaled corticosteroids on a periodic basis and 45% believed their children were supposed to be using them daily year-round based on the baseline parent interview. At baseline, periodic inhaled corticosteroid users had less severe asthma than daily users based on several measures including better asthma physical status scores on the Children’s Health Survey for Asthma (mean 87 ± 16.0 vs. 81 ± 17.4 , $p = < 0.0001$). During the year before the baseline interview, periodic users compared with daily users were less likely to have an ED visit or hospitalization (10% vs. 23%, $p = 0.0001$) and less likely to have had five or more albuterol prescription fills (13% vs. 31%, $p < 0.0001$). During the follow-up year, those who believed inhaled steroids were for periodic use were less likely than those who believed inhaled steroids were for daily use to have an ED visit or hospitalization for asthma (OR 0.36, 95% CI: 0.18–0.73), even after adjusting for baseline asthma status and other covariates. Similarly, those who believed inhaled steroids were for periodic use were less likely to have uncontrolled asthma, OR 0.38 (95% CI: 0.24–0.62). Analyses using propensity score adjustment yielded similar results to the logistic regression analyses.

Conclusion—Children whose parents believed they were supposed to use inhaled corticosteroids on a periodic basis had less severe asthma at baseline than those whose parents believed they were supposed to be using them daily. Periodic users were less likely than daily users to have adverse asthma outcomes during 1-year follow-up. This suggests that clinicians may be applying appropriate selection criteria by choosing patients with less severe asthma for periodic inhaled corticosteroid regimens.

Keywords

asthma; periodic inhaled corticosteroids; children

Introduction

Many children with persistent asthma do not use inhaled corticosteroids on a daily basis, despite national guidelines that recommend they be considered for daily year-round use in most of these patients (1). Not using inhaled corticosteroids on a daily basis may be due in part to families not adhering to clinician recommendations(2), but it also arises from deliberate instructions by clinicians(3, 4). Many pediatricians report that they recommend that most of their patients with mild persistent asthma use inhaled corticosteroids on a seasonal or periodic basis, rather than daily (5). This practice is consistent with the findings of a recent clinical trial in adults with mild persistent asthma that suggested that periodic use of inhaled corticosteroids was as effective as year-round use (6).

Although many children are receiving inhaled corticosteroids on a periodic basis, little evidence exists about the outcomes of this common practice (4, 5). No definitive clinical trials of periodic inhaled corticosteroid use are yet available in children. To guide clinical practice, it is important to determine which children with asthma are receiving periodic steroids and whether they are at increased risk for subsequent adverse asthma outcomes.

The objectives of this prospective study were to compare the characteristics and clinical outcomes of children whose parents believed that they were supposed to be using inhaled corticosteroids on a periodic basis with children whose parents believed that they were supposed to be using them daily as recommended by their asthma care providers. We hypothesized that children with periodic use of inhaled corticosteroids would have less severe asthma at baseline because providers would be more likely to prescribe periodic use of inhaled corticosteroids for patients with milder asthma. We also hypothesized that children with periodic use would subsequently have equal or better asthma outcomes than children with daily year-round use, after adjusting for baseline severity of asthma and other important covariates.

Patients and Methods

Design and Study Settings

This was a prospective cohort study of children with persistent asthma in two health care systems: Neighborhood Health Plan (NHP), a community health center–affiliated managed care organization with Medicaid- and commercially enrolled children, and Harvard Vanguard Medical Associates (HVMA), a multi-specialty provider group in the greater Boston area that serves privately insured patients as well as Medicaid patients. To assign children to periodic or daily steroid use groups, we asked, “Is (your child) supposed to use [inhaled corticosteroids]: (1) Every day, year round (2) Every day, but only during weeks or months when (his/her) asthma is active (3) Not every day, only for relief of asthma symptoms.” Parents who responded that their children were supposed to use inhaled corticosteroids “every day, year round” were classified as daily users and the others were classified as periodic users. We collected data on asthma clinical status and other predictors at baseline via a telephone interview with parents in a previous cross-sectional study (7). For each patient, we collected data on asthma-related clinical outcomes for 12 months after the baseline interview using computerized data from NHP and HVMA. The study was approved by the institutional review board of Harvard Pilgrim Health Care.

Data Collection

To identify children likely to have persistent asthma, we queried computerized data using criteria for persistent asthma defined in the Health Employer Data Information Set (HEDIS) measure of the National Committee on Quality Assurance. We used claims records at NHP and electronic medical records at HVMA to identify children with diagnoses of asthma based on ICD-9 codes (493.0 to 493.9) from any clinical encounter plus any of the following events during the year before baseline: four or more occasions that asthma medication was dispensed, one or more ED visit as the principal diagnosis, one or more hospitalizations for

asthma, or four or more outpatient visits for asthma and at least two asthma medication dispensing events.

We conducted a second stage screening at the beginning of each parent telephone interview to confirm the child had ever been diagnosed with asthma. The structured telephone interview was conducted in English or Spanish and consisted of closed-ended questions. Parents who participated received US\$20. Surveys with identical content in English and Spanish were mailed to families after 12 failed telephone interview attempts over 2 weeks.

Of 1,594 parents we attempted to contact based on computerized data, 449 (24%) were unreachable due to telephone numbers that were wrong, disconnected, or not in service. Thirty-six (2%) were ineligible because they did not speak English or Spanish or had moved out of state, 62 (4%) did not have a child with asthma. Of the 1,047 parents who were eligible for the study, 754 (72%) completed the survey and 640 had used inhaled corticosteroids in the year before the survey. For our study population, we selected the 476 children who had used inhaled corticosteroids in the year before the survey and were enrolled with their insurer for 10 or more of the 12 months after the survey.

Measures

Our main outcome measures were ED visits or hospitalizations from asthma, uncontrolled asthma, and outpatient visits for asthma exacerbations. An ED visit or hospitalization was identified as asthma-related if it had either a principal diagnosis of asthma or a principal diagnosis of a related respiratory illness (i.e., pneumonia or upper respiratory illness) in a child with a history of asthma. We defined uncontrolled asthma as any one of the following: any asthma-related hospitalization, any asthma-related ED visit, two or more oral steroid prescriptions in the outcome period after the telephone interview, or five or more beta-agonist canisters filled in the outcome period. We chose to include two or more oral steroid prescriptions as uncontrolled asthma because guidelines from the National Asthma Education and Prevention Program (NAEPP) classify two or more exacerbations requiring oral corticosteroids per year as uncontrolled asthma. We also defined uncontrolled asthma based on five or more prescription fills for beta-agonists based on the results of a previous study that found that five or more canisters of inhaled beta-agonists was an independent predictor of subsequent emergency hospital care compared to less than five canisters (8). We identified outpatient visits for asthma exacerbations using the ICD9 code for asthma exacerbations.

We evaluated as covariates factors that could potentially influence asthma medication recommendations by the provider, including the child's age, family demographics, parent attitudes, family life, and relationship between the family and provider. To measure asthma severity that could affect asthma physical status and clinical outcomes from asthma, we used the previously validated Child's Health and Asthma Status (CHSA) score (9). Children with high CHSA scores have lower disease severity (9). To further account for asthma severity, we assessed previous history of ED visits, hospitalizations, uncontrolled asthma, and outpatient visits for asthma as potential covariates. Our survey included instruments and questions that we developed that have been previously published as part of this study (7).

These domains included questions on parent expectations for asthma control, parent concerns about medications, competing family priorities, and interactions with providers.

Children were classified as being periodic users if their parents responded that they believed their children were supposed to use inhaled steroids during periods of symptoms or during seasons of worst asthma or had been treated in the past with inhaled corticosteroids. We included children whose parents said that they had used inhaled corticosteroids in the past in the periodic group because these children had similar utilization patterns based on computerized medication-dispensing data as those who used inhaled corticosteroids only when symptomatic. For example, in the year before the survey, children whose parents reported that they had used inhaled corticosteroids in the past had filled, on average, 1.86 corticosteroid inhalers per year compared with 1.87 per year in the “when symptomatic” group. Similarly, in the year following the survey, children whose parents reported that they had used inhaled steroids in the past, filled on average 1.5 corticosteroid inhalers per year compared with 1.6 per year in the “when symptomatic” group.

Statistical Methods

Analyses were conducted in SAS version 9.1 (SAS Institute, Cary, NC, 2007). In bivariate analyses, we evaluated the association of each outcome with pattern of inhaled corticosteroid use and with other independent variables that included age, gender, race/ethnicity, CHSA score, respondent’s highest education attained, household income, insurer, parental employment status, expectation for functioning with asthma, concerns about asthma medications, provider knowledge about the child, and competing family priorities. We also assessed previous history of ED visits, hospitalizations, uncontrolled asthma, and outpatient visits for asthma stratified by pattern of inhaled corticosteroid use.

We modeled the probabilities of having at least one asthma-related ED visit or hospitalization, uncontrolled asthma based on our definition, and at least one outpatient visit for asthma exacerbation with logistic regression. Children whose parents believed they were supposed to be using inhaled corticosteroids daily were the reference group. We controlled for confounding by adjusting for some important covariates that may have affected both the clinical outcomes as well as the treatment assignment. For each outcome, candidate variables significant at $p = 0.20$ in the bivariate analyses were included in the model. In addition, two-way interaction terms chosen via stepwise selection were added to the model to further reduce the bias. Variables significant at $p = 0.20$ were retained in the final multivariate models for interaction terms.

Because traditional logistic regression may not fully control for potential confounders, we used the propensity score subclassification approach. This approach has been increasingly used in recent years in studies of the comparative effectiveness of medication regimens to help control for selection bias. We used logistic regression to generate the propensity score, which is defined as the conditional probability of assignment to the periodic use of inhaled corticosteroids given a vector of observed covariates. The independent variables listed above were entered into stepwise selection to select significant main effects and interaction terms. The final model included the baseline asthma symptom score, age, race, medications concern score, expectation score, and three two-way interaction terms among the asthma

severity, race, and the medications concern score. Five subclasses were constructed based on the quintiles of the estimated propensity score.

Five subclasses constructed from the propensity score are expected to remove over 90% of the bias due to each of the covariates (10); thus the observed covariates should be approximately balanced between the periodic versus daily use groups. Two-way analysis of variance (ANOVA) with interaction and Cochran-Mantel-Haenszel (CMH) general association test were used for continuous and categorical covariates respectively to examine the within-subclass balance of distributions. Our results suggested we had balanced distributions within five subclasses.

Results

Baseline Characteristics

Of the 476 children in the study population, 55% of parents believed that their children were supposed to use inhaled corticosteroids on a periodic basis, while 45% believed that their children were supposed to use them daily. As shown in Table 1, children whose parents believed that they were supposed to be periodic users had better asthma physical status than children whose parents believed that they were supposed to be daily users based on higher mean CHSA scores (87.0 vs. 81.0, $p < 0.0001$). Children whose parents believed that they were supposed to be periodic users tended to be younger than daily users (mean age, 6.8 vs. 7.6, $p = 0.006$) and were less likely to have parents who were working full-time (25% vs. 36%, $p = 0.04$). In contrast, children whose parents believed that they were supposed to be periodic users were similar to daily users in race/ethnicity, parental education, income, and insurance provider. Parents of periodic users had higher concerns about medications than daily users (mean score 10.3 vs. 11.9, $p < 0.0001$).

As shown in Table 2, in the year before the interview, children whose parents believed that they were supposed to be periodic users had less asthma-related health care use. They were less likely than children whose parents believed that they were supposed to be daily users to have filled five or more albuterol prescriptions (15% vs. 35%, $p > 0.0001$), two or more inhaled corticosteroid prescriptions (57% vs. 81%, $p < 0.0001$), and two or more leukotriene prescriptions (22% vs. 32%, $p = 0.03$). Furthermore, children whose parents believed that they were supposed to be periodic users were less likely to have had a hospital-based asthma event (an ED visit or hospitalization) (16% vs. 34%, $p < 0.0001$) or an asthma-related outpatient exacerbation visit (79% vs. 87%, $p = 0.03$). They were also less likely to have uncontrolled asthma (36% vs. 56%, $p < 0.0001$).

Clinical Outcomes During the Follow-up Year

During the 12 months after the baseline interview, children whose parents believed that they were supposed to be periodic users of inhaled corticosteroids had less asthma-related health care use and fewer adverse clinical outcomes than children whose parents believed that they were supposed to be daily users. They were less likely to fill two or more prescriptions for oral steroids (15% vs. 29%, $p = 0.001$ (Table 2) and less likely to five or more prescriptions for albuterol (13% vs. 31%, $p < 0.0001$). Children whose parents believed they were

supposed to be periodic users were less likely to have a hospital-based event related to asthma (10% vs. 23%, $p = 0.0001$). They were significantly less likely to have uncontrolled asthma (28% vs. 51%, $p < 0.0001$).

Results of Logistic Regression Analyses and Propensity Score Adjustment

In multivariate analyses of adverse asthma outcomes during the 12-month follow-up period, we adjusted for baseline asthma status and prior asthma clinical use and selected sociodemographic and behavioral covariates. After adjusting for these covariates, children whose parents believed that they were supposed to be periodic users of inhaled corticosteroids remained at lower risk for adverse asthma outcomes than daily users. Children whose parents believed that they were supposed to be periodic users were less likely than daily users to have an ED visit or hospitalization for asthma based on the logistic regression analysis (OR 0.36; 95% CI 0.18–0.73). The propensity score adjustment results were similar (OR 0.51; 95% CI 0.26–1.01). Periodic users were less likely to have uncontrolled asthma than daily users in the logistic regression analysis (OR 0.38; 95% CI, 0.24–0.62). Propensity score adjustment yielded similar results (OR 0.52; 95% CI 0.32–0.84). Children whose parents believed they were supposed to be using inhaled corticosteroids periodically were slightly less likely than children whose parents believed they were supposed to be daily users to have had outpatient visits for asthma exacerbations, but the difference was not statistically significant in either the logistic regression model (OR 0.92; 95% CI 0.57–1.48) or the analysis with propensity score adjustment.

Discussion

This study found that children whose parents believed that they were instructed to use inhaled corticosteroids on a periodic basis had less severe asthma at baseline and were less likely to have subsequent hospital-based asthma events or uncontrolled asthma than those whose parents who said they were instructed to use inhaled corticosteroids daily. These results suggest that clinicians are selecting children with less severe asthma for periodic inhaled corticosteroid regimens and that such children do not have worse clinical outcomes than those who are assigned to daily regimens.

Our study examines a common clinical practice for which scant information is available. We studied the subsequent clinical outcomes of children whose parents believe they are supposed to use inhaled corticosteroids on a periodic basis. It is important to understand the effects of recommendations to use inhaled corticosteroids periodically because this is a common clinical approach. A recent study found that nearly all providers surveyed felt that inhaled corticosteroids could be effective for some patients with asthma when used seasonally or for short periods of time(5). Nearly one third of providers reported that they prescribed periodic inhaled corticosteroids to more than half of their patients with mild persistent asthma (5). Another study found that one self-reported reason for lack of provider compliance with asthma guidelines was lack of agreement with the guideline component of daily inhaled corticosteroids (11). Periodic inhaled steroid use is becoming more acceptable as the 2007 NHLBI guidelines state that periodic or seasonal treatment is an acceptable

option for some children and should be considered as step down therapy for patients being removed from daily inhaled corticosteroids (1).

Several recent clinical trials in adults with asthma have provided evidence to support periodic inhaled corticosteroids for selected patients with mild persistent asthma, but similar studies are not yet available for children (12–14). Our study was observational rather than randomized, and the periodic users had less severe asthma at baseline than the daily users. Observational studies of treatment effects are prone to selection bias, and in this study it is likely that clinicians assigned patients with less severe asthma to periodic regimens. We attempted to minimize this bias by adjusting for baseline asthma status and many other baseline covariates and by using propensity scores. However, unmeasured selection bias or confounding might explain the fact that periodic users had better outcomes than daily users during the follow-up year. Thus, our study does not demonstrate that periodic use of inhaled corticosteroids is safe or effective for all patients, only that patients who believe they are supposed to be using periodic regimens in a real-life population do not have worse clinical outcomes than those assigned to daily use regimens. Furthermore, the children whose parents believed they were supposed to be daily users did not have higher prescription refills of inhaled corticosteroids. Given that other studies demonstrated protective effects of daily inhaled corticosteroid use (1), it is possible that nonadherence played a role in our findings. A randomized trial to assess outcomes after daily versus periodic inhaled steroid use in children with asthma is needed and is already ongoing with support from National Heart, Lung, Blood Institute (NHLBI) but is not expected to yield results until 2010 (15).

A few other limitations of our study deserve mention. Periodic inhaled corticosteroid use in our population could have occurred either due to clinicians recommending periodic use, due to parents not adhering to clinician recommendations for daily use, or due to parental misunderstanding of recommendations made by the clinicians. We used parent report to classify inhaled corticosteroid use, and it is known that parents tend to over-report use of medications due to social desirability bias. If some patients in the group that reported daily use were actually not using inhaled corticosteroids daily, this could have biased our study towards finding that the daily users had worse outcomes. Furthermore, we did not evaluate the specific patterns of periodic inhaled corticosteroid use with regard to daily dose (low, medium, or high dose) or whether the inhaled corticosteroids were used in combination with long-acting beta agonists. It is also notable that although children who received periodic inhaled corticosteroids were significantly less likely to have uncontrolled asthma compared to daily users (28% vs. 51%), this level of uncontrolled asthma in both groups was suboptimal.

Conclusion

We found that children with persistent asthma using inhaled corticosteroids on a periodic basis had less severe asthma and experienced better subsequent clinical outcomes than those who were supposed to use inhaled corticosteroids on a daily basis. These results may reflect providers using clinical judgment to assign children with less severe asthma to periodic regimens for inhaled corticosteroid use. These findings provide some reassurance that in

actual practice, children assigned to periodic inhaled corticosteroids are not at higher risk than children assigned to daily use.

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Glossary

ANOVA	Analysis of Variance
CHSA	Children's Health Survey for Asthma
CMH	Cochran-Mantel-Haenszel
ED	Emergency Department
HEDIS	Health Employer Data Information Set
HVMA	Harvard Vanguard Medical Associates
NAEPP	National Asthma Education and Prevention Program
NHLBI	National Heart, Lung, Blood Institute
NHP	Neighborhood Health Plan

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Table 1

Comparisons of demographic and other parent-reported baseline factors between children whose parents believed they were supposed to be periodic users and children whose parents believed they were supposed to be daily users of inhaled corticosteroids, $N = 476$.

	Periodic users (n = 250)	Daily users (n = 226)	p^1
Age in years, mean [SD]	6.8 [3.0]	7.6 [3.2]	0.006
Race/ethnicity			0.06
White	46% (114)	44% (99)	
Black	21% (53)	29% (66)	
Latino	19% (47)	19% (43)	
Other	14% (36)	8% (18)	
Parental education			0.42
High school or less	24% (60)	23% (52)	
Some college	25% (61)	32% (71)	
College graduation or more	40% (125)	46% (102)	
Household income			0.83
\$30,000	35% (79)	38% (81)	
\$30,001–\$50,000	15% (34)	15% (31)	
\$50,001 or more	51% (119)	46% (58)	
Parental employment status			0.04
Unemployed	38% (92)	32% (71)	
Part-time	37% (91)	32% (73)	
Full time	25% (63)	36% (81)	
Insurance provider			0.58
Neighborhood Health Plan ²	33% (83)	29% (65)	
Other	66% (167)	72% (161)	
Asthma physical status score ³ , mean [SD]	87.0 [16.0]	81.0 [17.4]	<0.0001
Expectations of functioning with asthma score, mean [SD] ⁴	7.9 [2.2]	9.0 [2.5]	0.0005
Competing family priorities score, mean [SD] ⁵	12.7 [5.5]	12.9 [5.2]	0.78
Medication concerns score, mean [SD] ⁶	10.3 [2.5]	11.9 [2.5]	<0.0001
Provider interactions score, mean [SD] ⁷	3.6 [1.8]	3.3 [1.7]	0.14

¹ χ^2 testing was used to evaluate categorical variables and T-tests and Wilcoxon Rank Sum for continuous variables.

² Neighborhood Health Plan is a predominantly Medicaid-insured population that also includes privately insured patients.

³ Asthma physical status score was assessed by the Child Health Status Asthma (CHSA) measure, with a scale from 0 (worst status) to 100 (best status).

⁴ The expectation score ranged from 4 (low expectations) to 16 (high expectations) and was created by summing the results to the following four questions: “I believe my child can be symptom free most of the time,” “I expect asthma will not affect school/daycare attendance,” “I expect child can fully participate in gym,” and “I expect child will have no ER visits or hospitalization visits from asthma.” For each question, parents responded on a 4-point Likert scale ranging from strongly disagree (1) to strongly agree (4).

⁵ Parents were asked to rate their frequency of worry in the previous 2 months in housing, home or neighborhood safety, job, personal/family relationships, income/making ends meet/keeping up with bills, parents' own health/or other family member's health and to respond on a 5-point Likert scale. The overall competing priorities score ranged 5 (worry "all of the time") to 30 ("worry none of the time").

⁶ The medication concern score was based on four questions with a score of 4 (high concerns) to 16 (low concerns). Parents were asked whether they agreed with the following statements: "Child's asthma does not need medicine every day," "Child will become dependent on medicines if given every day," "Child does not need as much medicine as doctor prescribed," "Sometimes stop giving child medicine to give body rest." For each question, parents responded on a 4-point Likert scale ranging from strongly agree (1) to strongly disagree (4).

⁷ Interactions with the primary provider were assessed based on parent report to two questions: "How would you rate (Asthma Doctor)'s knowledge of your child's medical history?" and "How would you rate (Asthma Doctor)'s knowledge about your child as a person (special abilities, concerns, fears)?" For each question, parents responded on a 6-point Likert scale ranging from excellent (1) to very poor (6). These two questions were summed to form the provider interactions score.

Table 2

Asthma-related health care use by children whose parents believed they were supposed to be periodic users vs. children whose parents believed they were supposed to be daily users of inhaled corticosteroids, N = 476.

	Periodic use (n = 250)	Daily use (n = 226)	<i>p</i>
During the 12 months prior to the baseline interview			
Albuterol prescription fills			<0.0001
5 or more	15% (37)	35% (79)	
Inhaled corticosteroid prescription fills			<0.0001
0–2 canisters	31% (71)	39% (89)	
3–5 canisters	39% (88)	38% (86)	
6 canisters	30% (67)	23% (51)	
Leukotriene prescription fills year			0.03
2 or more	23% (57)	32% (72)	
ED visits or hospitalizations			<0.0001
1 or more	16% (39)	34% (76)	
Asthma control			<0.0001
Uncontrolled	56% (126)	36% (90)	
Outpatient visits for asthma related illness			0.03
1 or more	79% (198)	87% (196)	
During the 12-months after the baseline interview			
Albuterol prescription fills			<0.0001
5 or more	13% (32)	31% (71)	
Inhaled corticosteroid fills			<0.0001
0–2 canisters	74% (185)	66% (166)	
3–5 canisters	20% (49)	26% (66)	
6 canisters	6% (16)	7% (18)	
Leukotriene prescription fills			0.02
2 or more	26% (66)	74% (184)	
ED visits or hospitalizations			0.0001
1 or more	10% (24)	23% (51)	
Asthma control			<0.0001
Uncontrolled	28% (70)	51% (116)	
Outpatient visits for asthma exacerbation			0.29
1 or more	27% (68)	33% (75)	

Table 3

Odds of adverse asthma outcomes among children whose parents believed they were supposed to be periodic users of inhaled corticosteroids, compared with children whose parents believed they were supposed to be daily users.

Outcome	Odds ratio from logistic regression analysis (95% confidence interval)	Odds ratio from propensity score analysis (95% confidence interval)
Hospital-based event (any emergency department visit or hospitalization)	0.36 (0.18, 0.73) ¹	0.51 (0.26, 1.01)
Uncontrolled asthma	0.38 (0.24, 0.62) ²	0.52 (0.32, 0.84)
Outpatient visit for asthma exacerbation	0.92 (0.57, 1.48) ³	0.8 (0.48, 1.32)

¹ Adjusted for age, race/ethnicity, CHSA score, parental education, insurance, expectations score, competing priorities score, provider interactions score, number of outpatient visits for asthma during the 1 year before the interview, uncontrolled asthma in the 1 year before the interview, number of ED visits or hospitalizations in the 1 year before the interview, and the following interactions: CHSA*education, CHSA*number of ED visits or hospitalizations, CHSA score* age.

² Adjusted for age, race/ethnicity, CHSA score, parental education, household income, expectations score, competing priorities score, number of outpatient visits for asthma during the 1 year before the interview, uncontrolled asthma in the 1 year before the interview, number of ED visits or hospitalizations in the 1 year before the interview, and the following interactions: expectations score*race/ethnicity and CHSA score*age.

³ Adjusted for age, race/ethnicity, CHSA score, household income, insurance, expectations score, competing priorities score, number of outpatient visits for asthma during the 1 year before the interview, uncontrolled asthma in the 1 year before the interview, number of ED visits or hospitalizations in the 1 year before the interview, and the following interactions: CHSA score* age and CHSA score*insurance.