Socioeconomic Status, Drug Insurance Benefits, and New Prescriptions for Inhaled Corticosteroids in Schoolchildren With Asthma

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Background: Low-income children with asthma are less likely to receive inhaled corticosteroid prescriptions that can prevent asthma morbidity.

Objective: To determine whether the receipt of inhaled corticosteroids in children with asthma is related to household socioeconomic status and type of drug insurance.

Design: Using population-based prescription and health care data from Manitoba, a cohort study of the determinants of receiving new prescriptions for inhaled corticosteroids was conducted in children treated with asthma drugs.

Participants: School-aged children (n=12481) receiving asthma prescriptions from January 1995 to March 1996 but no inhaled corticosteroid prescriptions in the initial 6-month period.

Main Outcome Measures: Household socioeconomic and drug insurance predictors of the probability of receiving a new inhaled corticosteroid prescription from July 1995 to March 1998, following adjustment for disease and health care utilization factors.

Results: In comparison with higher-income children insured through a provincial cost-sharing drug plan, the adjusted likelihood ratio for a new inhaled corticosteroid prescription was 0.88 (95% confidence interval, 0.80-0.97) in low-income children insured through the same drug plan and 0.82 (95% confidence interval, 0.76-0.88) in children receiving prescriptions at no charge through provincial income assistance or First Nations benefits programs (Winnipeg, Manitoba).

Conclusion: Independent of asthma severity, type of drug insurance, or health care utilization patterns, low-income children with asthma are significantly less likely to receive inhaled corticosteroid prescriptions.


Asthma can cause significant disruptions in the daily activities of schoolchildren when they must miss school or spend time in the hospital or emergency department.1,2 Inhaled corticosteroids are prophylaxis drug therapies that reduce the likelihood of asthma hospitalization.3-6 They have become an integral part of asthma treatment guidelines, and their use in children with asthma has risen during the past 10 years.7-10 However, there is evidence that not all children who require inhaled corticosteroids receive them.11,12 Furthermore, low-income children are more likely to have greater asthma severity and higher asthma hospitalization rates.13-17

It has been increasingly documented that low-income children with asthma are less likely to receive inhaled corticosteroid drugs, but the reasons for this are unclear.18-23 Although less frequent prescription drug utilization among low-income children has been attributed to a lack of drug insurance coverage,24 less optimal use of prescription drugs has also been observed in low-income children enrolled in drug insurance programs that provide prescriptions at no charge.18 This study was undertaken to determine whether the receipt of inhaled corticosteroid drugs in children with asthma was related to their socioeconomic environment and drug insurance status. Our hypothesis was that independent of drug insurance type, low-income children with asthma would be less likely to receive prescriptions for inhaled corticosteroids than higher-income children.

RESULTS

From a population of 174,208 children aged 5 to 15 years, 16,862 met the asthma drug treatment criteria during the period from January 1995 to March 1996. Among these children, 12,481 did not receive an inhaled corticosteroid prescription for at least 6
PARTICIPANTS AND METHODS

STUDY DESIGN

A cohort study of children with no inhaled corticosteroid prescriptions in an initial 6-month period was nested within a population of children aged 5 to 15 years who were receiving asthma prescription drugs between January 1995 and March 1996. The rationale for selecting children taking asthma drugs was to identify a group of asthmatic children experiencing current symptoms who would be candidates for inhaled corticosteroid therapy. Children were evaluated for the receipt of a new inhaled corticosteroid prescription during the period from July 1995 to March 1998; factors associated with the probability of receiving an inhaled corticosteroid prescription were examined.

STUDY POPULATION

Data were obtained from 4 population-based electronic databases maintained by the Manitoba Health Services Insurance Plan (MHSIP), which provides health insurance for all Manitobans. The databases included (1) registration files; (2) physician reimbursement claims; (3) hospital discharge abstracts; and (4) records of prescriptions dispensed in retail pharmacies. The study protocol was approved by the Human Research Ethics Board of the University of Manitoba and the Manitoba Health and Confidentiality Committee, Winnipeg.

The MHSIP registration file contains a record for every individual eligible to receive insured health services, and records birth date, sex, and geographic location. Records of physician reimbursement for medical care provided are submitted through a fee-for-service arrangement and contain information on patient diagnosis at the 3-digit level of the International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) system. Discharge abstracts for hospital services include information on up to 16 diagnostic codes from the ICD-9-CM, of which the first diagnosis is responsible for the hospital stay. Prescriptions records are submitted by retail pharmacies for reimbursement by provincial drug insurance plans and for drug utilization review purposes, and contain data on the date of prescription dispensing, drug name and identification number, dosage form, and quantity dispensed. The reliability and validity of the MHSIP databases has been shown to be high. Records linkages among databases were achieved by the use of anonymous personal identifiers to create longitudinal histories of health care utilization. Information on physician specialty was derived from a database characterizing Manitoba physicians.

Children aged 5 to 15 years as of January 1995 were eligible if they received asthma drug prescriptions between January 1995 and March 1996, according to the following criteria: (1) at least 1 prescription for an asthma drug (bronchodilator, inhaled corticosteroid or cromone, oral theophylline, cromone, or oral corticosteroid) in the presence of asthma or bronchitis diagnoses on physician claims or hospital discharge records; or (2) in the absence of these diagnoses, at least 1 prescription for an inhaled corticosteroid or cromone, or a bronchodilator concomitant with ketotifen or a second bronchodilator prescription in the next 2 years. The definition excluded children with a singular use of bronchodilators and no asthma diagnosis. Limiting child age to 5 years and older decreased the likelihood of including children with transient wheezing syndromes. From this population, a cohort of children with no prescriptions for inhaled corticosteroids between January 1995 and June 1995 was selected.

STUDY MEASURES

New Inhaled Corticosteroid Prescription

The main outcome measure was the receipt of a new prescription for an inhaled corticosteroid following 6 months of no use in children receiving asthma drug treatment. Prescriptions included beclomethasone dipropionate, budesonide, fluticasone propionate, flunisolide, and triamcinolone.

Household Insurance and Socioeconomic Status

Three mutually exclusive categories of household drug insurance and socioeconomic status were defined: (1) children insured through the provincial income assistance or federal treaty First Nations prescription programs ("income/FN benefits"); (2) children insured through the Pharmacare program (Winnipeg) and living in the lowest neighborhood income quintile ("low-income"); and (3) children insured through the Pharmacare program and living in the next 4 neighborhood income quintiles ("higher-income"). Income/FN benefits programs provided prescription drugs at no charge. Pharmacare, the provincial drug insurance program, provided prescription drugs on a cost-sharing basis; households paid 100% of their prescription costs until an income-based deductible payment had been reached. Pharmacare children were placed into income quintile neighborhoods according to the 6-digit postal code of their household. Neighborhood income quintiles were created from the Statistics Canada Census 1996 by aggregating household income data within the enumeration area. Quintiles were ranked from months after study entry. Most children (74%) lived in higher-income neighborhoods; income/FN benefits children accounted for 17.4% of the sample, and those living in low-income neighborhoods represented 8.6%. Income/FN benefits and low-income children were significantly more likely to have frequent respiratory tract infections and previous asthma hospitalizations than higher-income children but less likely to have prior health care visit for asthma (Table 1). A new prescription for an inhaled corticosteroid was documented in 40.9% of children.

Unadjusted likelihood ratios indicated that new inhaled corticosteroid prescriptions were significantly more likely to be received by children with more severe asthma, asthma specialist care, previous health care visits or hospitalizations for asthma, and frequent respiratory tract infections (Table 2). Income/FN benefits children (but not low-income children) were significantly less likely than higher-income children to receive a new prescription for an inhaled corticosteroid. Children with continuous physician care were less likely to receive a new inhaled corticosteroid prescription than those without continuous care.

The likelihood ratio of a new inhaled corticosteroid prescription, adjusted for asthma severity and asthma
the 20% of the population residing in the lowest-income neighborhoods to the 20% residing in the highest-income areas. This method has been used by others to describe neighborhood income and is a good approximation for household income.31-33

Asthma Severity

Children were classified by level of asthma severity using a drug treatment measure that assigned severity on the basis of the asthma prescription drug profile and hospitalization history, as recorded in the 1995-1996 health care data.34 Asthma severity levels were defined as follows: mild to moderate asthma (bronchodilators with or without inhaled corticosteroids or cromones), moderate to severe asthma (bronchodilators with inhaled corticosteroids or cromones and/or asthma hospitalization with high bronchodilator use [≥90% of doses]), and severe asthma (bronchodilators with inhaled and oral corticosteroids). To diminish misclassification of severity subsequent to the nonreceipt of prescriptions, children not receiving inhaled corticosteroids could be classified as having moderate to severe asthma if they used high doses of bronchodilators and were hospitalized. The severity measure was found to have good reliability (κ = 0.82) and validity through its association with markers such as hospitalization in an intensive care unit.35

Physician Specialist Use

To adjust for physician practice style,36-38 children were classified according to use or nonuse of an asthma specialist for care from January 1995 to March 1998. An asthma care visit was defined as a physician visit or hospitalization for a diagnosis of asthma or for bronchitis coexisting with a secondary diagnosis of asthma. Asthma specialists were defined as allergists and pulmonologists; all other physicians (ie, family practice physicians or general pediatricians) were defined as nonasthma specialists.

Continuity of Physician Care

Continuous care provided by a physician prior to the receipt of a new inhaled corticosteroid prescription was defined on the basis of a child’s physician visit pattern by whether at least 90% of visits were to 1 nonasthma specialist and/or 1 asthma specialist from January 1995 to March 1998 or the date of the study outcome. Asthma drug treatment has been linked to continuity of physician care,35,36 and this measure has been derived to describe continuity of primary care on the basis of health care administrative data.46

Frequency of Respiratory Tract Infections

Because the propensity to prescribe inhaled corticosteroids is affected by the frequency of asthma exacerbation, commonly caused by respiratory tract infections,8 the frequency of respiratory tract infections was measured from January 1995 to March 1998 or the date of the study outcome. The measure was based on health care visits for upper respiratory tract infections, bronchitis, or an antibiotic prescription within 7 days of a physician visit or hospitalization for asthma. Antibiotic use as a marker for respiratory tract infections has previously been validated.42 A respiratory tract infection visit rate higher than the 90th percentile value was classified as a history of frequent respiratory tract infections.

ANALYSIS

The likelihood ratio of receiving an inhaled corticosteroid prescription from July 1995 to March 1998, or cancellation of MHSIP benefits for households that moved out of province, was determined using Poisson regression. Following assumptions of Poisson distribution, Poisson regression was conducted on grouped data obtained from stratification of children by household insurance, socioeconomic status, and other explanatory variables.43 To adjust for varying follow-up time, the rate of a new inhaled corticosteroid prescription was based on the number of child-days, calculated from July 1995 until the date of the inhaled corticosteroid prescription, cancellation of MHSIP benefits, or March 31, 1998. In addition to the study measures described, the following explanatory variables were evaluated: age at study entry,39 hospitalization for asthma from birth to study outcome,40 and previous health care visits for asthma from birth to study outcome.47 Explanatory variables were retained in the model by comparing the difference in deviance between the nested models with the \( \chi^2 \) statistic for the difference in \( df \) between the 2 models at a 95% confidence interval. Sample size calculations showed that 723 income/FN benefits children and 578 low-income children were required to detect a likelihood ratio of 0.85 for a new inhaled corticosteroid prescription in these children vs higher-income children. Sample size determination assumptions included a power index of 2.96 (Bonferroni corrected \( \alpha = 0.017 \) with a 1-tailed test; \( \beta = 0.2 \)), an incidence rate of 0.45 for inhaled corticosteroid prescriptions, and sample size ratios of 0.11 for low- vs higher-income children and 0.24 for income/FN benefits vs higher-income children.

COMMENT

Ten percent of Manitoba schoolchildren received a prescription for an asthma drug in 1995 and 1996. Asthma practice guidelines advocate the prescribing of inhaled corticosteroids to prevent asthma symptoms and exacerbation.28 We found that 41% of the schoolchildren treated with asthma drugs received a prescription for an inhaled corticosteroid following a 6-month period of no use, similar to the prescribing of new courses of inhaled corticosteroids in other populations of schoolchildren with universal access to drug insurance.49 The extent of
new use of inhaled corticosteroids was not evenly distributed among children but varied by household socioeconomic status and type of drug insurance. In comparison with higher-income children, low-income and income/FN benefits children were 10% to 20% less likely to receive a new prescription for an inhaled corticosteroid.

Less frequent use of inhaled corticosteroids has been reported in low-income children with and without access to drug insurance. Our findings in income/FN benefits children are comparable with the observations that US children receiving prescriptions at no charge from Medicaid are less likely than children with private insurance to receive inhaled corticosteroid prescriptions.18,23 However, few studies adjust for known determinants of inhaled corticosteroid use, such as asthma severity and specialist use22,36-38,50 or duration of health care for asthma and frequency of asthma triggers.9,45-48,51,52 As we observed, these factors were not equally distributed according to household socioeconomic status,13-17,52 and in the multivariate model, new use of inhaled corticosteroids was significantly more likely in their presence.

Income/FN benefits households represent the lowest-income families in Canada.24,53 The observation that a new prescription for an inhaled corticosteroid was less likely in income/FN benefits children receiving prescription drugs at no charge suggests the influence of household socioeconomic factors unrelated to issues of cost. Infrequent use of the health care system by low-income children may result in fewer opportunities for the prescription of inhaled corticosteroids.17,19 Although continuous physician care was not associated with a greater likelihood of receiving inhaled corticosteroids in our study, this may be related to conceptual differences between a health care utilization measure and survey measures that:

### Table 1. Proportion of Children With Characteristics Important to Receipt of Inhaled Corticosteroids by Household Socioeconomic and Drug Insurance Status*

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Income/FN Benefits (n = 2175)</th>
<th>Low Income (n = 1079)</th>
<th>Higher Income (n = 9227)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Severe asthma</td>
<td>2.1</td>
<td>3.2</td>
<td>1.7</td>
</tr>
<tr>
<td>Moderate to severe asthma</td>
<td>16.5</td>
<td>18.6</td>
<td>18.6</td>
</tr>
<tr>
<td>Mild to moderate asthma</td>
<td>81.4</td>
<td>77.3</td>
<td>79.7</td>
</tr>
<tr>
<td>Asthma specialist consultation</td>
<td>6.8</td>
<td>9.4</td>
<td>9.4</td>
</tr>
<tr>
<td>Continuous physician care</td>
<td>47.3</td>
<td>52.8</td>
<td>51.8</td>
</tr>
<tr>
<td>Previous asthma hospitalization†</td>
<td>14.3</td>
<td>12.7</td>
<td>10.3</td>
</tr>
<tr>
<td>Previous visit for asthma‡</td>
<td>56.5</td>
<td>59.2</td>
<td>62.1</td>
</tr>
<tr>
<td>Frequent¶ respiratory tract infections</td>
<td>15.4</td>
<td>10.3</td>
<td>8.6</td>
</tr>
</tbody>
</table>

*FN indicates federal treaty First Nations prescription programs. Data are presented as percentage.
†P <.001, determined using the Mantel-Haenszel trend test.
‡“Frequent” was defined as rates > the 90th percentile.

### Table 2. Likelihood of a New Prescription for an Inhaled Corticosteroid by Socioeconomic and Drug Insurance Status, Asthma Severity, and Other Health Care Utilization Factors, July 1995–March 1998*

<table>
<thead>
<tr>
<th>Explanatory Factor</th>
<th>No. of New ICS Prescriptions</th>
<th>No. of Child-Days</th>
<th>Rate/1000</th>
<th>Likelihood Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Income/FN benefits</td>
<td>835</td>
<td>1967759</td>
<td>0.42</td>
<td>0.89 (0.83-0.96)</td>
</tr>
<tr>
<td>Low income</td>
<td>842</td>
<td>984063</td>
<td>0.44</td>
<td>0.92 (0.83-1.02)</td>
</tr>
<tr>
<td>Higher-income</td>
<td>3845</td>
<td>8066849</td>
<td>0.48</td>
<td>Reference</td>
</tr>
<tr>
<td>Severe asthma</td>
<td>186</td>
<td>122270</td>
<td>1.52</td>
<td>3.68 (3.17-4.26)</td>
</tr>
<tr>
<td>Moderate to severe asthma</td>
<td>1191</td>
<td>1864121</td>
<td>0.64</td>
<td>1.54 (1.45-1.65)</td>
</tr>
<tr>
<td>Mild to moderate asthma</td>
<td>3727</td>
<td>901235</td>
<td>0.41</td>
<td>Reference</td>
</tr>
<tr>
<td>Asthma specialist visit†</td>
<td>538</td>
<td>961697</td>
<td>0.56</td>
<td>1.23 (1.12-1.34)</td>
</tr>
<tr>
<td>No specialist visit</td>
<td>4566</td>
<td>10037019</td>
<td>0.45</td>
<td>Reference</td>
</tr>
<tr>
<td>Continuous physician care§</td>
<td>2102</td>
<td>5994833</td>
<td>0.35</td>
<td>0.58 (0.55-0.62)</td>
</tr>
<tr>
<td>No continuous care</td>
<td>3002</td>
<td>5003883</td>
<td>0.60</td>
<td>Reference</td>
</tr>
<tr>
<td>Prior asthma hospitalization</td>
<td></td>
<td></td>
<td>898</td>
<td>982824</td>
</tr>
<tr>
<td>No hospitalization</td>
<td>4206</td>
<td>10015892</td>
<td>0.42</td>
<td>Reference</td>
</tr>
<tr>
<td>Prior asthma health care‡</td>
<td>3835</td>
<td>6321478</td>
<td>0.57</td>
<td>1.83 (1.72-1.95)</td>
</tr>
<tr>
<td>No prior asthma care</td>
<td>1469</td>
<td>4677238</td>
<td>0.31</td>
<td>Reference</td>
</tr>
<tr>
<td>Frequent¶ respiratory tract infections§</td>
<td>828</td>
<td>785321</td>
<td>1.05</td>
<td>2.52 (2.34-2.71)</td>
</tr>
<tr>
<td>Few respiratory tract infections§</td>
<td>4276</td>
<td>1021395</td>
<td>0.42</td>
<td>Reference</td>
</tr>
<tr>
<td>Age, y</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5–6</td>
<td>1162</td>
<td>2408288</td>
<td>0.48</td>
<td>1.05 (0.98-1.12)</td>
</tr>
<tr>
<td>≥7</td>
<td>3942</td>
<td>8590428</td>
<td>0.46</td>
<td>Reference</td>
</tr>
</tbody>
</table>

*ICS indicates inhaled corticosteroid; FN, federal treaty First Nations prescription programs. Data are presented as odds ratios (95% confidence intervals) unless otherwise indicated.
†Adjusted for factors listed in model A (asthma severity and specialist use).
‡Adjusted for factors listed in model B (asthma severity, specialist use, prior asthma hospitalization, prior asthma health care, and frequent respiratory tract infections).
§From January 1, 1995, to the date of inhaled corticosteroid prescription, end of Manitoba Health Services Insurance Plan coverage, or March 31, 1998.
||From birth to the date of inhaled corticosteroid prescription, end of Manitoba Health Services Insurance Plan coverage, or March 31, 1998.
¶“Frequent” was defined as rates > the 90th percentile.
Low-income children with asthma are less likely to receive prescriptions for inhaled corticosteroids, which may or may not be attributed to cost barriers to the acquisition of these drugs. This study was undertaken to determine whether the receipt of inhaled corticosteroid prescriptions in asthmatic children with access to universal health insurance was related to socioeconomic status in households receiving prescriptions at no charge or on a cost-sharing basis. In comparison with higher-income children, the likelihood of receiving new inhaled corticosteroid prescriptions was reduced in low-income children insured through a similar cost-sharing drug plan and further reduced in low-income children receiving prescriptions at no charge. This study contributes information on the effects of prescription cost sharing, as well as the influence of socioeconomic factors outside of prescription cost issues on the use of inhaled corticosteroids in low-income children with asthma.

categorize the source of medical care as physician office vs emergency department. Whereas no differences in the prescribing rate of inhaled corticosteroids have been reported between children receiving Medicaid and non-Medicaid children, inhaled corticosteroids are less likely to be dispensed to those receiving Medicaid. New receipt of an inhaled corticosteroid prescription in our study may represent incidental use or the delayed refill of an existing prescription. Either way, nonreceipt of inhaled corticosteroid prescriptions may be related to parental disbelief in the effectiveness of asthma medication in preventing symptoms, which has been associated with recurrent emergency department use by low-income children. Consideration of patient belief systems should be an essential component of asthma education provided by health care professionals.

Parental inability to pay for prescriptions remains a reason for a lower use of inhaled corticosteroids among low-income children insured through Phar- macare. This drug insurance program is administered through an income-based deductible payment. The payment is 2% of the annual income for households with incomes less than $15000 and 3% for households with higher incomes; once the deductible level is reached, families receive their prescriptions at no charge. Despite access to drug insurance, deductible levels in some low-income families may require considerable out-of-pocket payment for expensive drugs. If asthma morbidity is to be improved, drug insurance programs need to adjust levels of cost sharing by lowering annual deductibles or providing 100% reimbursement for children living in low-income households.

By reporting the new receipt of prescriptions, which was unaffected by previous prescribing practices, our objective was to represent physician intent to prescribe inhaled corticosteroids. A recent study found that the prescribing of inhaled corticosteroids by physicians in a health maintenance organization did not vary by drug insurance status of the child. The prescription database contains prescriptions dispensed, not written, and we were unable to determine whether the nonreceipt of inhaled corticosteroid prescriptions was the outcome of physician nonprescribing or the nonfilling of prescriptions. As others have reported, we found that children seeing asthma specialists were more likely to receive inhaled corticosteroid prescriptions. In comparison with general practice physicians, the outcome of receiving care from asthma specialists is fewer emergency department visits and hospitalizations. These observations identify the need to educate family physicians and pediatricians on optimal asthma drug management, an intervention that has improved outcomes in patients with asthma.

In conclusion, we found that independent of many influential factors, the new receipt of inhaled corticosteroid prescriptions was less likely in low-income children living in 2 types of households: those receiving prescriptions at no charge and those receiving prescriptions on a cost-sharing basis. These findings are an important contribution to the knowledge regarding the effects of socioeconomic status on the use of asthma prophylaxis drugs in a population with universal access to health care and drug insurance. The potential outcomes of lower inhaled corticosteroid use are the increased hospitalization of low-income children, its associated diminished quality of life, and higher health care costs. In describing the role of cost and noncost dimensions of socioeconomic status, our study has identified opportunities for intervention by drug insurance programs as well as health care professionals.

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REFERENCES
