



Factors associated with adherence to asthma treatment with inhaled corticosteroids: a cross-sectional exploratory study

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**Title: Factors associated with adherence to asthma treatment with inhaled corticosteroids:
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Abstract

Background: Understanding factors at the patient, provider or organizational level associated with inhaled corticosteroids (ICS) adherence is important when planning adherence-enhancing interventions.

Objective: To explore factors associated with adherence to ICS among patients with asthma aged 12 to 45 years.

Methods: A cross-sectional study was conducted among patients with asthma reporting ICS prescription during the baseline interview of an intervention study. Three methods were used to measure ICS adherence: a 4-item self-report questionnaire, a single question (SQ) measuring past 7-day exposure to ICS and a medication possession ratio (MPR, i.e., the sum of ICS days of supply/365). We assessed 46 potential factors of ICS adherence derived from the Predisposing, Reinforcing and Enabling Constructs in Educational Diagnosis and Evaluation (PRECEDE) model. Their association with ICS adherence was measured using multivariate logistic regressions.

Results: Among the 319 participants included, 16.0%, 43.0% and 9.1% were adherent according to the 4-item questionnaire, SQ and MPR, respectively. Ten factors were associated with good ICS adherence. Among them, a low family income level, a high number of asthma drugs used, a good knowledge of asthma pathophysiology and the perception that following the ICS prescription was easy were associated with adherence through one of the measures. Two factors emerged through more than one measure: perceiving asthma severity as moderate to very severe and perceiving a high risk of death if ICS are not taken as prescribed.

Conclusion: ICS adherence was poor in those individuals with asthma. Future adherence-enhancing interventions could target the identified modifiable risk factors.

Trial registration: ClinicalTrials.gov Identifier NCT02093013

Key words: asthma, medication adherence, adherence determinants, inhaled corticosteroids

INTRODUCTION

In 2013, the World Health Organization estimated that approximately 300 million people worldwide suffered from asthma [1]. The 2014 prevalence of asthma in Canada for persons aged 12 years and older was 8.1% [2]. Asthma is responsible for 250,000 deaths each year worldwide, representing between 150 and 300 deaths for Canada alone [3].

According to the “Global Initiative for Asthma” (GINA), the treatment of asthma aims to control symptoms and maintain adequate respiratory function [4]. The treatment has two main components: non-pharmacological treatment aiming to prevent exacerbations by avoiding triggers and pharmacological treatment [1, 4]. The latter comprises quick-relief medications to treat asthma symptoms during an asthma worsening event and long-term maintenance treatment drugs that must be taken regularly to prevent exacerbations [5]. Preventive drugs act on several clinical pathways, such as allergy and inflammation. Inhaled corticosteroids (ICS) are the main asthma preventive drugs. Long-acting beta-2 agonists (LABA) are also used as add-on treatment when a low dose of ICS is insufficient to control the disease [6].

Despite these effective treatments [7], asthma control is still poor in many patients [8, 9]. Non-adherence to preventive drugs is frequently cited when explaining uncontrolled asthma [4, 5, 10] and can lead to severe asthma exacerbations [11]. Some studies have assessed the factors associated with adherence to asthma treatment [12-15], many of which are modifiable factors that could be addressed as an essential step to the development of adherence-enhancing intervention. In the province of Quebec, Canada, studies have shown that the use of asthma medication is not appropriate [16, 17] even though policies such as the general drug insurance program, which provides all citizens with drug insurance, might facilitate adherence. However,

to our knowledge, very few studies focused on factors associated with adherence to asthma medications in this population [16, 18] or used a comprehensive assessment model. This study aims to investigate factors associated with adherence to ICS used alone or in combination with LABA using the Green and Kreuter Predisposing, Reinforcing and Enabling Constructs in Educational Diagnosis and Evaluation (PRECEDE) model [19], one of the most popular health promotion models that we adapted to the context of asthma.

METHODS

Study design

We conducted a cross-sectional study using data collected as part of the baseline assessment of an intervention study that aimed at measuring the effectiveness of an integrated care program on asthma control among people aged 12 to 45 years with asthma [20].

Study population

From the 349 patients with asthma included in the intervention study, we selected the 319 who stated that they had been prescribed an ICS, either alone or in combination with a LABA in the same inhaler.

The participants came from several regions of Quebec and were recruited by 42 community pharmacists. Individuals for whom the pharmacists had dispensed at least one anti-asthma drug in the previous six months were screened and randomly contacted by phone. They were recruited if they reported an asthma diagnosis, were aged 12 or more years but less than 46 years, and reported using a short-acting beta-2-agonist (SABA) >3 times a week (except before exercise) or a corticosteroid (inhaled or oral). Moreover, we excluded those who had other respiratory diseases, took part in another study, or were pregnant. A detailed flowchart of study participants

is presented in Figure 1. As a reward, all participants received a peak flow meter with instructions and an uncompleted asthma action plan after completing the baseline questionnaire. A complete description of the intervention study population is provided elsewhere [20].

Data collection

All data were collected from telephone interviews and pharmacy dispensing records before the beginning of the intervention. Trained blinded research assistants, using a structured pre-tested computer-assisted questionnaire, performed all interviews. They asked for information on sociodemographic characteristics, asthma drug use, adherence to drug treatment and factors potentially associated with adherence to asthma drug treatment. These factors were assessed with questions designed specifically for this study. The questionnaire (in French) can be provided on request minus the copyright instruments.

The pharmacists that participated in the recruitment of participants provided pharmacy records data for the 12-month period preceding the interview. Moreover, interviewers asked participants if they had visited other pharmacies during this period and contacted those pharmacies to capture all drug dispensing data. A complete description of the data collection is provided in the intervention study [20].

Variables

Dependent variable: ICS Adherence

Because there is no clear gold standard for measuring ICS adherence in real life settings, it was measured using three different methods: a 4-item self-report questionnaire [21, 22], a single question and the Medication Possession Ratio (MPR) [23, 24]. We used the French Canadian version of a 4-item self-reported adherence measure originally developed to measure adherence

to antihypertensive drug treatment [22]. We asked participants to refer to the 12 months before the interview. A participant was considered to adhere to his/her ICS treatment if he/she answered “NO” to all four items of the questionnaire. Using this cut-off, the French version sensitivity in detecting uncontrolled hypertension was 0.44 while specificity was 0.79 [21, 22]. The second measure consisted of a single question (SQ) developed by our team: “How many days did you use your ICS during the last week?” Those who answered “7” were considered to be adherent. Finally, using pharmacy data gathered in the 12-month period before the interview (ICS filled by patients, dates of ICS fills and number of days’ supply), we computed a MPR for each participant (the MPR is the sum of ICS days of supply/365) [23, 25]. When the MPR was $> 75\%$, the participant was deemed adherent. The threshold used to dichotomize adherent and non-adherent varies greatly in the literature. It was set to 75% according to results of Williams et al. [11] that demonstrated that adherence was significantly associated with a reduction in asthma exacerbations, after adjustment for asthma severity, in those with a MPR greater than 75% [hazard ratio, 0.61; 95% confidence interval (CI) 0.41– 0.90].

Independent variables

Forty-six factors potentially associated with ICS adherence were identified using the PRECEDE phase of the Green and Kreuter PRECEDE-PROCEED model [19]. According to the model, three categories of factors may impact adherence to asthma medications (Figure 2): predisposing, enabling and reinforcing factors. We also included other behavioral factors that could be linked to ICS adherence. All these potential factors were identified through a literature review and consultations with clinicians.

A complete description of these factors is provided elsewhere [16].

Data analysis

Descriptive statistics were used to depict patient characteristics. To explore the association between potential factors and adherence to ICS, we built a regression model using a stepwise procedure for each adherence measure. Systematic entry, backward elimination strategies and different variable categories were employed to produce a parsimonious model [26]. First, we estimated crude odds ratios (OR) and 95% confidence intervals (95% CI). Next, variables with a p-value ≤ 0.2 and/or variables with crude OR ≥ 1.50 or ≤ 0.5 were selected for the final logistic regression models as described by Maldonado et al. [27]. We computed adjusted odds ratios (aOR) and 95% CI using multivariate logistic regression models. An inspection of the multicollinearity of selected variables was made according to criteria set by Belsley et al. [28]. A sample size calculation was performed for the intervention study [20] and was not computed again as the present analysis was exploratory rather than predictive or explanatory. We performed all statistical analyses with SAS computer software, version 9.3.

Ethical considerations

The background intervention study [20] was approved by the ethics board of the *Centre hospitalier universitaire de Québec*.

RESULTS***Participant characteristics***

The characteristics of the 319 study participants are presented in Table 1. Among them, 59.6% were women, and the mean age was 30.6 (Standard deviation [SD]: 10.7). Only 22.6% had a high family income level. Over half of the patients (53.3%) perceived their asthma severity as

moderate to severe, and 33.5% perceived a high death risk if they did not take their ICS as prescribed. The average duration of ICS treatment was 14.6 years (SD: 9.5).

Of the 319 participants, 51 (16.0%), 137 (43.0%) and 29 (9.1%) were deemed adherent to the ICS treatment when adherence was measured with the 4-item questionnaire, the single question and the MPR, respectively,

Factors associated with adherence to inhaled corticosteroids

Tables 2, 3 and 4 show the factors associated with ICS adherence according to the adherence measure. In total, ten factors were associated with ICS adherence. Perceiving asthma as moderate to severe was positively associated with ICS adherence in two regression models: the 4-item questionnaire and the SQ. Perceiving a high risk of death if ICS are not taken as prescribed was positively associated with adherence in two regression models: the SQ and the MPR. The remaining factors were associated with ICS adherence in only one regression model. On the one hand, little knowledge about asthma pathophysiology, perceiving that it is difficult or very difficult to follow prescriptions, not being vaccinated against influenza and being a female were negatively associated with ICS adherence. On the other hand, no written information given by any healthcare professionals during the preceding year, being short on ICS due to lack of money, low to average family income and a high number of asthma drugs used were positively associated with ICS adherence.

DISCUSSION

Among our study participants, 16.0%, 43.0% and 9.1% adhered to their ICS treatment according to the 4-item questionnaire, the SQ and the MPR, respectively. This study shows that adherence

to ICS treatment is low among people with asthma, regardless of how adherence is measured. According to a systematic review [29] in which adherence to ICS was measured in 9 studies [11, 30-37], ICS adherence varied between 22% and 63%. More specifically, 6 studies used Continuous Multiple-interval measures of medication Availability (CMA) [11, 31, 32, 34, 36, 37], a measure similar to MPR, and one used a MPR with a threshold of 75% [33]. Average CMA varied from 22% to 46%, whereas 23% of the patients had a MPR>75%. Although it is difficult to compare the average CMA with our MPR that was dichotomized, the proportion of individuals in our study who were deemed adherent with the MPR (9.1%) is much lower than the 23% reported by Hwang et al. but similar to the 14.3% adherent subjects found by Murphy et al. when dichotomizing their CMA at a threshold of 80% [34].

The adherence to ICS obtained with our three measures might have been lower than what has been observed in other studies because only those interested in the intervention study participated. It is therefore likely that those whose asthma remained inadequately controlled and hoped for a better control of their disease were over-represented. The inclusion criteria of the intervention study, i.e., including participants who used a bronchodilator more than three times a week, might also have favored the inclusion of uncontrolled patients. Indeed, the use of a bronchodilator more than three times a week suggests that the asthma is inadequately controlled, leading to the possibility of lack of control due to ICS non-adherence. Considering that the prevalence of nonadherence to ICS is generally higher among patients whose asthma is inadequately controlled [32], this could explain our results.

Moreover, existing literature reports great variation in the level of adherence depending on the measure used. Jentzsch et al. [38] found a proportion of beclomethasone adherence of 96.4% in

children with asthma after one year of treatment when self-reported by the child or a parent through a diary, 65.7% when measured using a method similar to the MPR, 42.8% when the canister weight loss (and consumption) was evaluated and 34.9% when an electronic monitoring device was used to record the date and time of each inhaler actuation. These results are consistent with our finding that self-reported measures of ICS adherence provide higher adherence estimates than methods using pharmacy data. The substantial difference in adherence values observed in our study could mean that these methods measure adherence to ICS treatment differently. The difference could also depend on their respective limitations. The MPR method is not subject to social desirability bias, unlike the 4-item questionnaire and the single question. It is an objective measure that has shown good predictive validity [22, 23, 39]. However, the information could be biased because prescription refills do not necessarily mean that patient takes medications as recommended, and some refills done at pharmacies not participating in this study might have been missed. Moreover, people could have been prescribed an ICS only for a period of time (e.g. seasonally) while we used a fixed denominator of 365 days to measure the MPR. The single question was not validated and only assessed if the person was exposed to ICS every day for the last week, not accounting for all aspects of medication adherence (i.e. the right dose, timing and frequency). The substantial difference in adherence values could also depend on the different recall periods used (12-month and 7-day). None of these methods may be used as a “gold standard” for measuring adherence because of the difference in adherence aspect targeted by each method and their limitations. Methods must be chosen depending on research objectives and the population studied [40].

We explored factors associated with ICS adherence using three adherence measures. Ten different factors were associated with adherence, with two factors being common to more than one measure used: the perception of asthma as moderate to severe and the perception of high risk of death when ICS are not taken as prescribed. These two factors, also reported to be associated with ICS adherence in other studies [41, 42], should be regarded as key factors in improving adherence to ICS. One should note that both factors are related to risk perception. Risk perception is determined by knowledge of the disease, confidence in the ability to perform certain tasks, past experience, and anticipated consequences [43]. It could be that patients who were sufficiently warned were more aware of the consequences that can result from non-adherence to medication than other less informed patients. It could also be the result of prior experiences (hospitalizations, severe exacerbations, etc.). Future intervention studies might focus on these factors and use techniques such as risk communication and self-monitoring of ICS intake.

Factors associated with adherence to ICS in the present study are similar to some previously reported results, which also varied depending on the measure used [41, 44].

When using the MPR, we found that men, participants with lower family income and those who used ≥ 3 asthma medications were more likely to be adherent to ICS. Some authors identified males as being associated with adherence to ICS [44] or females as associated with non-adherence [32, 41, 44]. However, sex was not associated with adherence according to Corsico et al. [45] and Chatkin et al. [46]. The association between sex and adherence to ICS remains a controversial issue in existing literature. Interestingly, in our univariate analyses, the significance

of the association between sex and adherence to ICS was higher (p-value=0.022) than in multivariate analysis, where it was borderline for statistical significance (p-value=0.048).

Regarding income, our results did not corroborate those found in the literature. Janson et al. [14] and Wells et al. [47] identified a low level of income as negatively associated with adherence to ICS in a United States population. This discrepancy with our results could be explained by differences in the population studied, the healthcare system and the reimbursement rules in place. Indeed, access to medicines might be easier for low-income individuals residing in Quebec than for low-income individuals in the United States. In the province of Quebec, all citizens are covered with drug insurance, which is not the case in the United States. Moreover, out-of-pocket expenses vary depending on income, with low-income individuals having only a small amount of money to pay each month before reaching a maximum, after which all drugs claimed become free. These policies might improve ICS adherence.

We observed an association between ICS adherence and the use of ≥ 3 asthma medications. There are conflicting results in the literature regarding such association between the number of drugs and medication adherence. Patients using a large number of asthma medications probably have more severe asthma, making them more dependent on their medication to perform their daily activities. Gregoire et al. [48] conducted a study similar to ours on predictors of nonadherence to antihypertensive medications in an adult population and observed that patients who used four or more tablets a day were more likely to be adherent than others who used less. Participants who did not receive written information from any healthcare professionals during the preceding year were more likely to be adherent to ICS when the 4-item questionnaire was used for evaluating ICS adherence. The direction of this last association was unexpected. We

hypothesized that it could be due to an increased awareness of adverse events leading to a greater fear of experiencing these events in those receiving written information about ICS. Boulet et al. [49] showed that the most common fears of patients regarding ICS were their effect on body image, bone density and their reduced effectiveness over time. In addition, a study done in the United States based on medical record reviews showed that 27.2% of patients reported at least one local adverse event in the course of one year. However, 47.3% reported having moderate to severe local adverse events [50]. A patient decision aid for inhaled corticosteroid use, such as the one developed by Gagne et al. [51], could help patients communicate their fear to their healthcare professionals and facilitate practitioner-patient communication and engagement of the patient in its treatment.

Three other factors were identified with the SQ method. First, participants who reported being short on ICS due to a lack of money were more likely to be adherent. This factor needs to be explored by another study. One of our hypotheses is that adherent people are more likely to be short on drug because they actually use the medication regularly, which is not the case for non-adherent individuals. Second, participants who were not vaccinated against influenza were less likely to be adherent. Receiving a flu shot every year can be viewed as a preventive health-related behavior similar to taking ICS for people with asthma. Third, those who perceived difficulties in following their ICS prescription instructions over the next year were less likely to be adherent. This finding is consistent with other studies in which the ease of following the prescriptions is one factor associated with adherence to ICS [41, 42, 44]. Reducing medication-taking barriers, individualizing asthma treatment regimens, and providing cues, materials and professional support could all be strategies used to optimize ICS adherence. Finally, it is

important to note that some factors, such as age, were not found to be associated with ICS adherence in our study.

Strengths and limitations of the study

One of the strengths of this study is the use of a theoretical model, which has identified several potential factors that may affect adherence to ICS. In addition, the use of three different adherence measures, as suggested in the literature [52], allowed for a comprehensive identification of factors associated with adherence to ICS. Another strength is the exclusion of patients on ICS for respiratory diseases other than asthma. Finally, a thorough statistical modeling process was used to explore factors associated with adherence, leading to the identification of a final parsimonious model that best explains adherence for each method.

The findings of this study must be interpreted with caution due to some limitations. First, we used an exploratory cross-sectional design and multiple statistical analyses. We might have found associations that are spurious or factors that are not causal in their relationship with ICS adherence. Second, virtually all Quebec pharmacy owners (i.e. 1597 pharmacists owning 1625 pharmacies) received an invitation to participate in the intervention study. However, only those interested and probably more motivated actually participated (n=42). Thus, it is possible that the characteristics of the patients treated in these pharmacies are different than those of patients managed in other non-participating pharmacies, especially those that can be influenced by a healthcare professional. Moreover, it is possible that patients who agreed to participate were different from those who refused or that some eligible subjects were not invited. However, we compared participant characteristics to those of patients included in a population-based study performed in the province of Quebec [53] and found that they were very similar. As we included

participants based on self-reported diagnosis of asthma and self-reported ICS prescription, we cannot exclude the possibility of misclassification. Finally, the sample size was small, which limited statistical power.

CONCLUSIONS

This study revealed that adherence to inhaled controller medications was poor in a population targeted for an intervention study. It also identified several modifiable factors associated with adherence to ICS such as perception of asthma severity, perception of death risk when ICS are not taken as prescribed, knowledge of asthma pathophysiology, and the perception that following the ICS prescription was easy. These factors underline the necessity, for healthcare professionals, to regularly inform patients on the severity of their condition and to support them in asthma self-management. Knowledge on these factors can also assist the development of future adherence-enhancing interventions targeting ICS adherence to improve asthma control.

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DECLARATION OF INTEREST

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

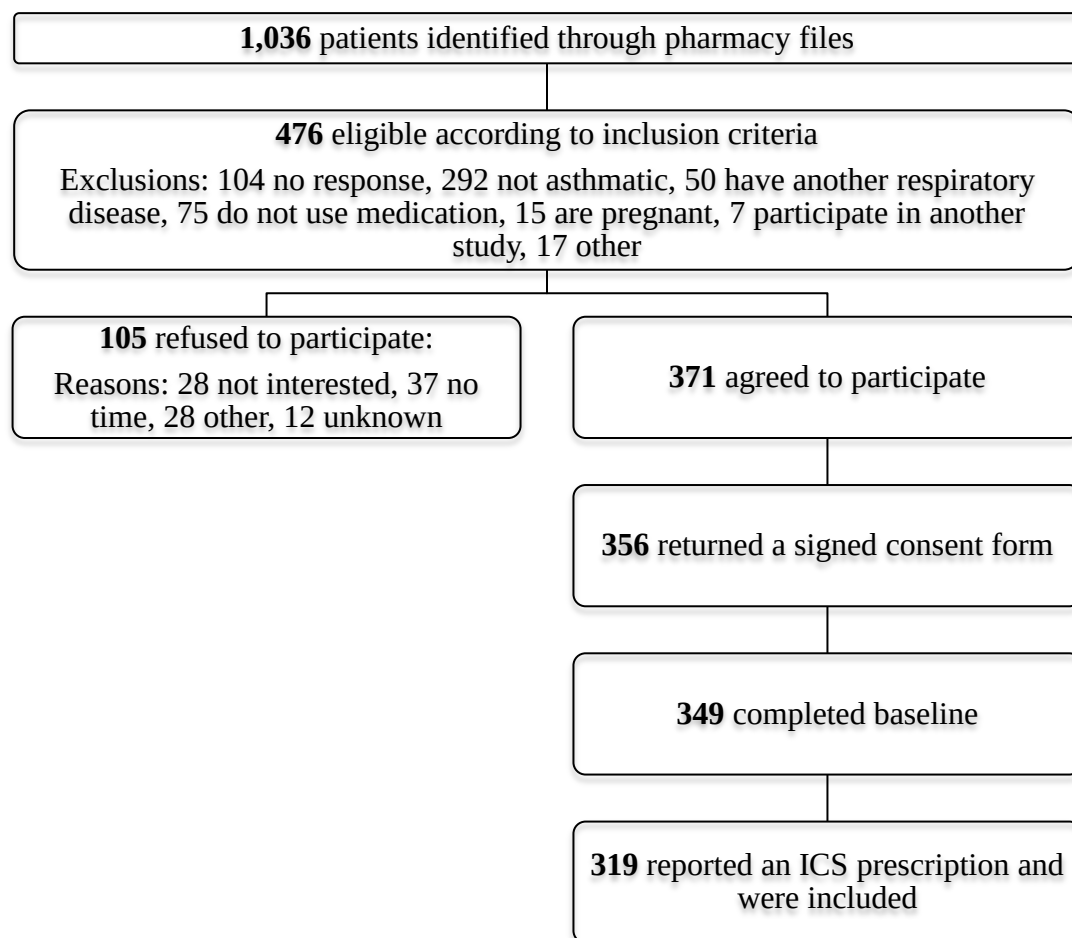


Figure 1. Flow of participants through the study.

Figure 2: PRECEDE model of medication adherence adapted to the asthma context

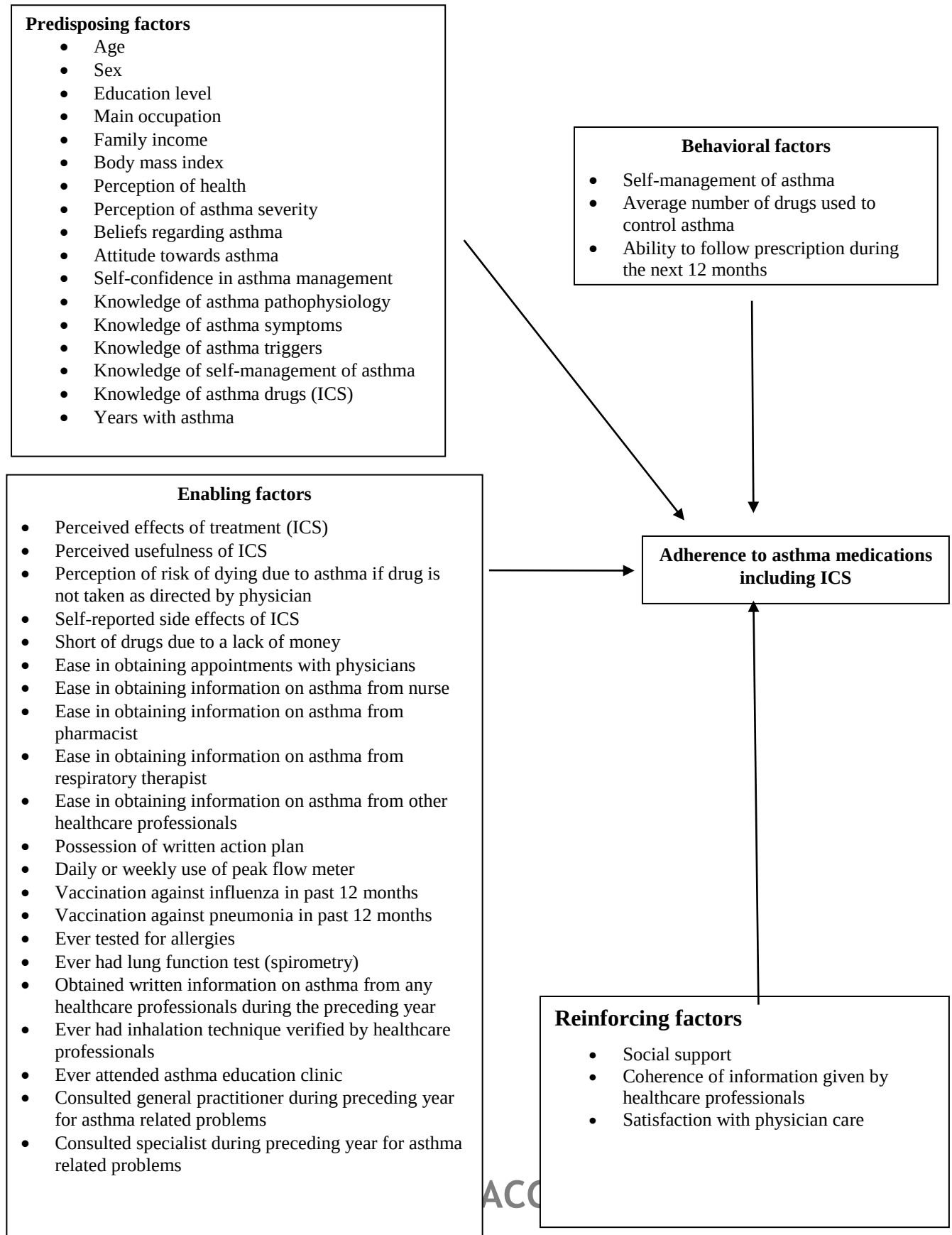


Table 1: Characteristics of the 319 participants

Characteristics	(n)	%
Predisposing factors		
Age (years)		
12 - 17	59	18.5
18 - 39	172	53.9
40 - 45	88	27.6
Sex		
Female	190	59.6
Male	129	40.4
Education level ^a		
None, elementary or high school not completed	153	48.0
High school completed college or university	166	52.0
Main occupation ^a		
Student or worker	272	85.3
Other ^b	47	14.7
Family income ^{a,c}		
Low	41	12.8
Intermediate	189	59.3
High	72	22.6
Unknown	17	5.3
Body mass index, kg/m ² (age) or percentile (age)		
≤24.9 (18 to 45 years) or	166	52.0
25.0–29.9 (18 to 45 years) or 85th ≤ BMI >95th percentile (12 to 17 years)	90	28.2
≥30 (18 to 45 years) or ≥95th percentile (12 to 17 years)	63	19.8
Perception of health		
Excellent/very good/ good	233	73.0
Fair/poor	86	27.0

Table 1: Characteristics of the 319 participants

Characteristics	(n)	%
Perception of asthma severity		
Very mild/mild	147	46.1
Moderate/severe	170	53.3
Unknown	2	0.6
Predisposing factors		
Beliefs regarding asthma		
Positive	221	69.3
Negative	98	30.7
Attitude towards asthma		
Positive	117	36.7
Negative	201	63.0
Unknown	1	0.3
Self-confidence in asthma management		
High	228	71.5
Low/fair	91	28.5
Knowledge of asthma pathophysiology		
Good	228	71.5
Poor	91	28.5
Knowledge of asthma symptoms		
Good	253	79.3
Poor	66	20.7
Knowledge of asthma triggers		
Good	173	54.2
Poor	145	45.5
Unknown	1	0.3
Knowledge of self-management of asthma		
Good	66	20.7

Table 1: Characteristics of the 319 participants

Characteristics	(n)	%
Poor	252	79.0
Unknown	1	0.3
Knowledge of asthma drugs (ICS)		
Very good/good	34	10.7
Fair/poor	285	89.3
Years with asthma		
< 5	43	13.5
≥ 5	276	86.5
Enabling factors		
Perceived effects of treatment (ICS)		
From mild to good	295	92.5
Low effect / No effect	22	6.9
Unknown	2	0.6
Perceived usefulness of ICS		
Very useful	258	80.9
Moderately useful/ not very useful/not useful	61	19.1
Perception of risk of dying due to asthma if drug is not taken as directed by physician		
From high to very high	107	33.5
Moderate or no perception	198	62.1
Unknown	14	4.4.
Self-reported side effects of medications (ICS)		
Yes	27	8.5
No	290	90.9
Unknown	2	0.6
Short of drugs due to a lack of money		
No	274	85.9

Table 1: Characteristics of the 319 participants

Characteristics	(n)	%
Yes	45	14.1
Ease in obtaining appointments with physician		
Easy	180	56.4
Not easy	128	40.2
Have not seen the professional during the preceding year	11	3.4
Ease in obtaining information on asthma from nurse		
Easy	20	6.3
Not easy	288	90.3
Have not seen the professional during the preceding year	11	3.4
Ease in obtaining information on asthma from pharmacist		
Easy	74	23.2
Not easy	229	66.8
Unknown	5	1.6
Have not seen the professional during the preceding year	11	3.4
Ease in obtaining information on asthma from respiratory therapist		
Easy	29	9.1
Not easy	279	87.5
Have not seen the professional during the preceding year	11	3.4
Ease in obtaining information on asthma from other health professionals		
Easy	17	5.4
Not easy	291	91.2
Have not seen other health professionals during the preceding year	11	3.4
Possession of written action plan		
Yes	113	35.4
No	181	56.7

Table 1: Characteristics of the 319 participants

Characteristics	(n)	%
Unknown	14	4.4
Have not seen any professional during the preceding year	11	3.5
Daily or weekly use of peak flow meter		
Yes	27	8.5
No	291	91.2
Unknown	1	0.3
Vaccination against influenza in past 12 months		
Yes	102	32.0
No	216	67.7
Unknown	1	4.7
Vaccination against pneumonia in past 12 months		
Yes	15	4.7
No	301	94.4
Unknown	3	0.9
Ever tested for allergies		
Yes	211	66.2
No	106	33.2
Unknown	2	0.6
Ever had lung function test (spirometry)		
Yes	221	69.3
No	83	26
Unknown	15	0.3
Obtained written information on asthma from any healthcare professionals during the preceding year		
Yes	68	21.3
No	174	54.5
Unknown	2	0.6

Table 1: Characteristics of the 319 participants

Characteristics	(n)	%
No consultation due to asthma in the last 12 months	75	23.6
Ever had inhalation technique verified by healthcare professionals		
Yes	112	35.1
No	203	63.6
Unknown	4	1.3
Ever attended asthma education clinic		
Yes	40	12.5
No	275	86.2
Unknown	4	1.2
Consulted general practitioner during preceding year for asthma related problems		
Yes	150	47.0
No	156	49.0
Unknown	13	4.0
Consulted specialist during preceding year for asthma related problems		
Yes	29	0.2
No	277	86.8
Unknown	13	4.0
Behavioral factors		
Self-management of asthma		
Good	228	71.5
Poor	91	28.5
Average number of drugs used to control asthma		
1 – 2	272	85.3
≥ 3	47	14.7

Table 1: Characteristics of the 319 participants

Characteristics	(n)	%
Ability to follow prescription during the next 12 months		
Easy/Very easy	285	89.3
Difficult/Very difficult	34	10.7
Reinforcing factors		
Social support		
Good	220	69.0
Low	93	29.2
Unknown	6	1.8
Coherence of information given by healthcare professionals		
Good	251	78.7
Low	37	11.6
Unknown	31	9.7
Satisfaction about relation with healthcare professionals		
Satisfied	265	83.1
Unsatisfied	37	11.6
Unknown	17	5.3

^a Based on questions used in the 1998 provincial health survey « *Enquête de Santé Québec sur les habitudes de vie et la santé des québécois* » [1]

^b Other included sick leave, retirement, unemployment and social assistance.

^c Family income is classified in low (very poor, poor), intermediate (lower middle / upper middle) and high (superior) based on the categories used in the 1998 provincial health survey « *Enquête de Santé Québec sur les habitudes de vie et la santé des québécois* ». [1]

- Low income for family with 1 or 2 persons if below \$15,000/year, for family with 3 to 4 persons if below \$20,000/year, or for family with 5 or more persons if below \$40,000/year;

- Intermediate income for family with 1 or 2 persons if from \$15,000 to below \$60,000/year, for family with 3 to 4 persons if from \$20,000 to below \$80,000/year, or for family with 5 or more persons if from \$40,000 to below \$80,000/year;
- High income for family with 1 or 2 persons if from \$60,000 to below \$100,000/year, for family with 3 to 4 persons if from \$80,000/year to \$100,000 or more/year, or for family with 5 or more persons if from \$80,000 to \$100,000 or more /year.

Table 2: Variables associated with adherence to inhaled corticosteroids, measured using the 4-item questionnaire (N=317*)

Variables		Adherent		Non-		OR	95% CI	P- value
		patients		adherent				
		N=51		patients				
				N=266				
		N	%	N	%			
Perception of asthma severity								
Very mild/mild		18	35.3	129	48.9	1.00	-	-
Moderate/severe		33	64.7	135	51.1	3.07	1.30-7.26	0.010
Unknown		-	-	2	-	-	-	-
Knowledge of asthma pathophysiology								
Good		41	80.4	187	70.3	1.00	-	-
Low		10	19.6	79	29.7	0.32	0.12-0.87	0.026
Obtained written information on asthma from any healthcare professionals during the last year								
Yes		9	20.9	57	28.6	1.00	-	-
No		34	79.1	142	71.4	2.95	1.03-8.44	0.043
NA		8	-	67	-			

OR, Odds Ratio adjusted; CI, confidence interval; NA, not applicable because those 75 participants reported having had no consultation with any healthcare professionals (general practitioners, specialist physicians or other health professionals) in the last 12 months; 4-item questionnaire; * Two missing values among the answers to the 4-item questionnaire.

Table 3: Variables associated with adherence to inhaled corticosteroids, measured using the SQ method (N=319)

Variables	Adherent patients N=137		Non-adherent patients N=182		OR	95% CI	P-value
	N	%	N	%			
Perception of asthma severity							
Very mild/mild	48	35.6	99	54.4	1.00		
Moderate/severe	87	64.4	83	45.6	1.77	1.06-2.94	0.029
Unknown	2	-	-	-			
Ability to follow medication prescription during the next 12 months							
Very easy/easy	132	96.3	153	84.1	1.00		
Difficult/very difficult	5	3.7	29	15.9	0.14	0.04-0.43	<0.001
Perception of risk of dying due to asthma if drug is not taken as directed by physician							
High risk	58	45.0	49	27.8	1.00		
Moderate risk or none	71	55.0	127	72.2	0.52	0.31-0.88	0.014
Unknown	8	-	6	-			
Short of drugs due to a lack of money							
No	105	76.6	169	92.9	1.00		
Yes	32	23.4	13	7.1	5.62	2.47-12.77	<0.0001
Vaccination against influenza in past 12 months							
Yes	52	38.0	50	27.6	1.00		
No	85	62.0	131	72.4	0.57	0.33-0.97	0.039

Unknown	1	-
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OR, Odds Ratio adjusted ; CI, confidence interval; ICS, Inhaled corticosteroids; SQ, Single question

Table 4: Variables associated with adherence to inhaled corticosteroids, measured as a Medication Possession Ratio $\geq 75\%$ (N=319)

Variables	Adherent patients N=29		Non- adherent patients N=290		OR	95% CI	P-value
	N	%	N	%			
Sex							
Male	15	51.7	114	39.3	1.00	-	-
Female	14	48.3	176	60.7	0.42	0.18-0.99	0.048
Family income							
High	3	10.7	69	25.2	1.00	-	-
Average	17	60.7	172	62.8	2.59	0.69-9.72	0.157
Low	8	28.6	33	12.0	6.36	1.43-28.22	0.015
Unknown	1	-	16	-			
Average number of drugs used to control asthma							
1 – 2	18	62.1	254	87.6	1.00	-	-
≥ 3	11	37.9	36	12.4	4.23	1.71-10.49	0.001
Perception of risk of dying due to asthma if drug is not taken as directed by physician							
High risk	17	58.6	90	32.6	1.00	-	-
Moderate risk or none	12	41.4	186	67.4	0.42	0.18-0.98	0.045

1. Institut de la statistique du Québec, *Enquête sociale et de santé 1998*. 2001.

2. Institut de la statistique du Québec, *Enquête sociale et de santé 1998*. 2001.