
Asthma patients' perception of their ability to influence disease control and management

Laurent Laforest, MD, PhD*; Abdelkader El Hasnaoui, MD, PhD†; Céline Pribil, PhD‡; Cécile Ritleng, MSc*; Marie-Sophie Schwalm, MSc‡; and Eric Van Ganse, MD, PhD*

Background: Patients' perception of their ability to influence their asthma symptoms has not been sufficiently addressed.

Objective: To study the relationship between patients' perceived ability to self-care, as approached by internal locus of control (LOC) orientation, and concomitant level of asthma control.

Methods: A cross-sectional study was conducted from May 19, 2004, through July 7, 2005. Asthma patients receiving inhaled corticosteroids and supervised in primary care were identified. Asthma control was measured with the Asthma Control Test. Patients reported their LOC orientation on a 100-mm visual analog scale (0%, "I have absolutely no influence on asthma change," to 100%, "this change only depends on me"). Asthma therapy was obtained from a prescription database. The risk of an internal LOC of less than 50% was studied.

Results: Among the 163 patients with documented LOC (mean age, 52 years; 58% female), 72 (44.2%) had an internal LOC of less than 50%. Asthma control was inadequate for 65 of the 157 patients with available data on the global score of the Asthma Control Test (41.4%). Patients with inadequately controlled asthma had a higher risk of a LOC of less than 50% (odds ratio, 2.68; 95% confidence interval, 1.23–5.81). A 3-fold increased risk also appeared for patients older than 65 years compared with those younger than 45 years. Conversely, no association was identified with sex, asthma severity markers, or therapy.

Conclusions: Asthma control was related to internal LOC orientation (ie, perceived ability to self-care). Improved self-care efficiency is a target for adequate disease management.

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INTRODUCTION

Patients' beliefs and perception of their disease and treatments play a role in the management of chronic diseases, markedly asthma.^{1–3} Locus of control (LOC) refers to the extent to which individuals believe that they can control events that directly affect them. Individuals with a high internal LOC believe that events result primarily from their own behavior and actions. Such people tend to presume that their efforts to control their disease will be successful. They are more active in seeking information and knowledge concerning their situation than are people with a lower internal LOC. Conversely, those with a lower internal LOC orientation believe that fate or chance primarily determines events.⁴

As a rule, an association has been observed between a low internal LOC or poor control over life and the presence of chronic disease.^{5,6} In turn, in chronic diseases, an association has been identified between a higher internal LOC orientation and better outcomes, as shown by the decreased risk of myocardial infarction exhibited by patients with a high internal LOC.⁷ Clearly, a better understanding of how patients

perceive their ability to self-care would be informative for optimal disease management.

The overall level of asthma control remains suboptimal despite effective controller therapy. A better understanding of patients' psychological factors may be a pivotal issue to improve the quality of care. Surprisingly, LOC has so far been rarely examined in asthma patients, more specifically the association between patients' LOC orientation and their level of asthma control. It would be of interest to verify whether patients with inadequately controlled asthma have a lower internal LOC. Besides, it is unclear to what extent LOC orientation in asthma varies with patient characteristics or factors related to disease management.

The Picadilly study was conducted among patients receiving inhaled corticosteroids (ICSs), alone or with other controllers, with the objective of investigating their behaviors toward ICS therapy. Patients reported in questionnaires how they perceived their personal influence on their asthma. Our main objective was to determine whether a lower internal LOC orientation was associated with a poorer level of asthma control. Other factors influencing LOC orientation were also investigated.

METHODS

Study Design and Population

A cross-sectional study was conducted from May 19, 2004, through July 7, 2005. Asthma patients 15 years or older, receiving inhaled anti-inflammatory therapy during the past 6 months, and supervised by general practitioner (GP) mem-

Affiliations: *CHU Lyon, Unité de Pharmacopidémie, Service de Neurologie, Hôpital Pierre Wertheimer, Bron, France; †Epidemiology Department, GSK laboratory, Marly-le-Roi, France; ‡Cegedim Strategic Data France, Boulogne, France.

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bers of the Cegedim France network were eligible for inclusion. Patients were excluded if they had an associated diagnosis of chronic obstructive pulmonary disease or language or understanding problems. When they visited their GP, the GP explained the study to the patients who met the inclusion criteria. Those who agreed to participate were invited to complete a questionnaire at the inclusion visit and during the subsequent visits. The protocol was approved by the National Data Privacy Committee.

Collection of Data

Patients completed self-report questionnaires at the inclusion visit. Asthma control was measured with the Asthma Control Test.⁸ Five questions covered the following dimensions: limitations in activities, nocturnal awakenings, episodes of breathlessness, use of rescue medication, and patients' evaluation of their own control. A global score of 20 or more indicates correct asthma control. Asthma severity was estimated by the reported use by patients of oral or injected corticosteroids during the past 3 months.

Asthma therapy was extracted from the Longitudinal Patient Database (prescription database). Rescue medications consisted of short-acting β -agonists (SABAs) and anticholinergic drugs. Controller medications included ICSs, long-acting β -agonists (LABAs), LABA-ICS fixed combinations, oral β -agonists, oral xanthine, and leukotriene receptor antagonists. Controller regimen categories were classified as follows: ICSs alone, ICSs and LABAs (as separate medications), LABA-ICS combinations alone, or LABA-ICS combinations with other controllers or other regimens. The average daily dose of prescribed ICSs was computed during the 6 months before the survey. On the basis of the Global Initiative for Asthma criteria, these doses were considered as low, medium, or high (≤ 500 , >500 – $1,000$, $>1,000$ $\mu\text{g}/\text{d}$ of beclomethasone equipotent, respectively).⁹ Patients reported their LOC on a 100-mm visual analog scale (Fig 1), with 0% indicating "I have absolutely no influence on asthma change" and 100% indicating "asthma change only depends on me."

Statistical Analyses

First, distribution of LOC orientation was studied. Second, correlates of a lower internal orientation of LOC (less than the median value) were identified. LOC was studied in relation to patient characteristics, control of asthma, and asthma therapy. The χ^2 test was used for univariate analyses. A

multivariate logistic regression was conducted. The risk of having a lower LOC orientation was studied. The model systematically included age, sex, asthma control, and asthma severity. Other factors would be included in the model when they showed a significant univariate association with LOC orientation ($P < .15$).

Third, change in LOC orientation over time was investigated because longitudinal data after inclusion were available for some patients. Indeed, these patients completed the same questionnaires at subsequent visits to the GP. For this analysis, the first 2 LOC measures were considered: the LOC measured at inclusion (LOC1) and the next immediate LOC (LOC2). Quantitative changes in LOC orientation were compared with concomitant change of asthma control status. Between the 2 visits, 3 possibilities of change of control status were possible: none ("unchanged" control), worsening ("controlled to inadequately controlled"), and improvement ("inadequately controlled to controlled"). The Kruskal-Wallis test was used to compare changes in LOC according to changes in control. All the analyses were conducted using SAS statistical software, version 9.1 (SAS Institute Inc, Cary, North Carolina).

RESULTS

Of the 204 patients who completed questionnaires, analyses were restricted to the 163 who used the visual analog scale to indicate their LOC. Median LOC value was 50% (25th–75th percentiles, 35%–67%). These 163 patients did not differ from the remaining 41 as to sex, asthma control, and severity markers, but they were younger ($P = .004$).

Patient Characteristics

The mean (SD) age of the 163 patients was 51.6 (19.) years, with 95 females (58.3%) and 24 smokers (14.7%). On the basis of the Asthma Control Test score, 65 (41.4%) of patients had inadequately controlled asthma. During the past 3 months, 1 patient underwent hospital admission, 3 visited emergency departments, and 9 missed at least 1 day of work or school because of asthma.

During the 6 months before the survey, most patients received the LABA-ICS combination alone or with another controller. Fewer patients received ICS monotherapy, ICSs and LABAs as 2 separate drugs, and other controller regimens (Table 1). During that period, 35 (21.5%), 68 (41.7%), and 60 (36.8%) of patients received low, medium, and high daily equipotent doses of beclomethasone, respectively.

More than half the patients were prescribed SABAs, and 10 had anticholinergic drugs combined or not with SABAs (6.1%). Twenty patients (12.5%) reported the use of oral or injected corticosteroids during the past 3 months. Interruptions of ICS therapy were commonly reported by patients, and nearly 1 in 4 believed that continuous use of respiratory drugs was unhealthy (Table 1).

Locus of Control

A wide variation of LOC orientation was observed among patients, with a skewed distribution (Fig 2). A significant

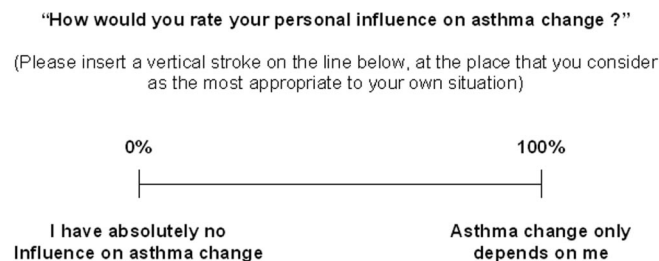


Figure 1. Asthma locus of control.

Table 1. Characteristics of the Study Population

Characteristics	No. (%) of patients (N = 163)
Female	95 (58.28)
Age group, y	
15–45	63 (38.65)
46–65	50 (30.67)
>65	50 (30.67)
Current smoking	24 (14.72)
Asthma severity	
No OCS course	139 (87.42)
At least 1 OCS course (past 3 months)	20 (12.58)
Average daily doses of ICSs ^a (past 6 months)	
≤500 µg/d	35 (21.47)
>500–1,000 µg/d	68 (41.72)
>1,000 µg/d	60 (36.81)
Global asthma control	
Correct control (ACT score ≥20)	92 (58.60)
Inadequate control (ACT score <20)	65 (41.40)
Controller regimens (past 6 months)	
ICS alone	19 (11.66)
ICS and LABA (2 separate drugs)	19 (11.66)
ICS-LABA combination alone	66 (40.49)
ICS-LABA combination with other controllers	41 (25.15)
Other regimens	18 (11.04)
Short-acting β-agonists	
Yes	85 (52.15)
No	78 (47.85)
Patients' behaviors and beliefs toward controller therapy	
Belief that continuous use of respiratory drugs is unhealthy	
Yes	40 (25.16)
No	119 (74.84)
Self-reported behavior during the past 3 months:	
Unintentional interruption of ICS use	
Never or scarcely	111 (70.70)
Sometimes, often, or very often	46 (29.30)
Intentional interruption of ICS use when feeling better	
Never or scarcely	102 (64.15)
Sometimes, often, or very often	57 (35.85)
Intentional interruption of ICS use when feeling worse	
Never or scarcely	150 (94.34)
Sometimes, often, or very often	9 (5.66)
Less frequent use of ICSs when feeling better	
Never or scarcely	107 (66.88)
Sometimes, often, or very often	53 (33.13)
More frequent use of ICSs in case of premonitory signs of asthma attack	
Never or scarcely	125 (78.62)
Sometimes, often, or very often	34 (21.38)
Intentional change of the dosing of ICSs	
Yes	31 (19.25)
No	130 (80.75)

Abbreviations: ACT, Asthma Control Test; ICS, inhaled corticosteroid; LABA, long-acting β-agonist; OCS, oral corticosteroid.

^a Beclomethasone equivalent doses.

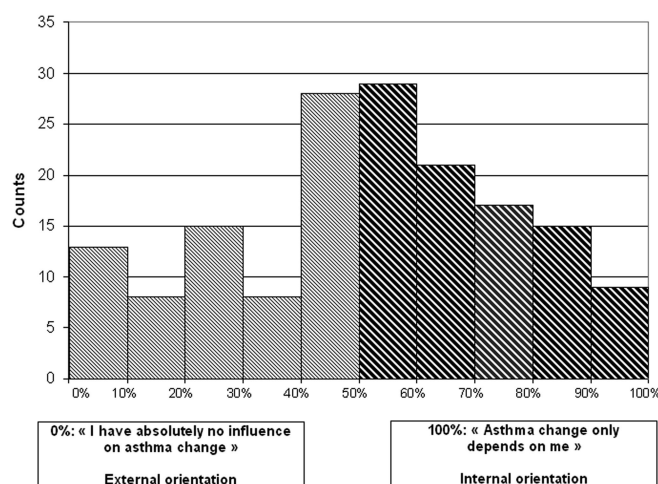


Figure 2. Distribution of locus of control (n = 163).

proportion of them had a LOC measure below 50% (72, 44.2%).

Correlates of LOC Less Than 50%

Univariate analyses of patient characteristics. No significant variation of LOC was observed according to sex or age. However, patients older than 65 years were more likely than their younger counterparts to exhibit a lower internal LOC orientation (Table 2). Patients with a LOC less than 50% were significantly more numerous among patients with uncontrolled asthma ($P = .009$). In contrast, no association emerged with the type of controller regimen, the daily dose of prescribed ICSs (Table 2).

Univariate analyses of patients' declared behaviors toward ICSs. No association was observed between LOC orientation and self-declared behaviors toward ICSs. A higher proportion of patients with a lower internal orientation of LOC believed that continuous use of respiratory medication was unhealthy but not significantly so (Table 3).

Multivariate analyses. In the multivariate model, patients with inadequately controlled asthma exhibited a significantly increased risk of lower internal orientation of LOC compared with patients with controlled asthma. Risk of lower LOC also significantly increased with age (Table 4). No significant association was identified with other variables.

Change in LOC Over Time

Fifty-one patients (31.3%) had at least 1 additional LOC measure performed during follow-up. The mean (SD) duration between baseline LOC value and first following LOC measure (LOC2) was 86.5 (61.4) days (range, 5–260 days). These 51 patients did not differ from others as to age ($P = .65$), sex ($P = .55$), level of control ($P = .80$), and baseline LOC (LOC1) value ($P = .99$). Further additional LOC measures after LOC2 were not analyzed because they were documented for only 22 patients. Mean (SD) quantitative LOC change between baseline value and the first next measure was

Table 2. Proportions of Patients With Locus of Control (LOC) of Less Than 50% According to Patient Characteristics

Characteristics	Total No. of patients	No. (%) of patients with LOC <50%	P value ^a
Overall	163	72 (44.2)	
Female	95	41 (43.1)	.76
Age group, y			.08
15–45	63	22 (34.9)	
46–65	50	22 (44.0)	
>65	50	28 (56.0)	
Current smoking	24	9 (37.50)	.48
Asthma severity			.29
No OCS course (past 3 months)	139	59 (42.5)	
At least 1 OCS course (past 3 months)	20	11 (55.0)	
Global asthma control			.009
Correct control (ACT score ≥ 20)	92	33 (35.9)	
Inadequate control (ACT score <20)	65	37 (56.9)	
Average daily doses of prescribed ICS (past 6 months) ^b			
≤ 500 $\mu\text{g}/\text{d}$	35	14 (40.0)	.63
>500–1,000 $\mu\text{g}/\text{d}$	68	33 (48.5)	
>1,000 $\mu\text{g}/\text{d}$	60	25 (41.7)	
Controller regimens (past 6 months)			.80
ICS alone	19	8 (42.1)	
ICS and LABA (2 separate drugs)	19	6 (31.6)	
ICS-LABA combination alone	66	30 (45.5)	
ICS-LABA combination with other controllers	41	20 (48.8)	
Other regimens	18	8 (44.4)	
Short-acting β -agonists			.28
Yes	85	41 (48.2)	
No	78	31 (39.7)	

Abbreviations: ACT, Asthma Control Test; ICS, inhaled corticosteroid; LABA, long-acting β -agonist; OCS, oral corticosteroid.

^a χ^2 test or Fisher exact test.

^b Beclomethasone equivalent doses.

–1.1% (28.7%) for the 51 patients. This change was not statistically significant (matched Wilcoxon test, $P = .67$). Variation of LOC was not influenced by the variation of time elapsed between inclusion and the date of LOC2 measure (Spearman test, $P = .20$).

Among the 47 patients who had also a documented concomitant control measure, a significant association was still retrieved between dichotomized LOC2 and concomitant asthma control level ($P = .001$). Individual changes in LOC between inclusion (LOC1) and subsequent measure (LOC2) are depicted in Figure 3. Three groups of patients were considered according to their concomitant changes of control status during this period (improvement, no change, worsening of control). The change in LOC between the 2 measures (LOC2 – LOC1) varied according to concomitant changes of control ($P = .03$). The average change of LOC was low in case of unchanged control between LOC1 and LOC2 measure (–2.1%). In contrast, mean LOC noticeably decreased for the 5 patients whose control, which was initially correct, became inadequate (–29%). Similarly, mean LOC increased for 8 patients whose control improved (inadequate to correct, +17%) (Fig 3).

DISCUSSION

This is 1 of the few investigations of LOC in asthma. Likewise, changes in LOC orientation over time are seldom documented. LOC orientation markedly varied among asthma patients, and those with a lower internal LOC orientation were more likely to be older and to have uncontrolled asthma. LOC seems also to fluctuate with time, in parallel to change of asthma control status. In contrast, no association was observed with other personal characteristics, asthma-related factors, or management-related factors.

The lower internal orientation observed among patients with inadequately controlled asthma (Table 4) was confirmed when considering subsequent measures of LOC orientation and control ($P = .001$), which supports the robustness of this finding. Our result is in line with the conclusions of the study by Halimi et al.¹⁰ In addition, although our findings require confirmation on a higher number of patients, change in LOC over time seems related to that of asthma control level (Fig 3).

Patients with a higher internal LOC may have a more positive approach to their asthma and may want to fully participate in their disease management. Consequently, they

Table 3. Proportions of Patients With Locus of Control (LOC) of Less Than 50% According to Patients' Declared Behaviors Toward ICS Therapy

Behavior	Total No. of patients	No. (%) of patients with LOC <50%	P value ^a
Overall	163	72 (44.2)	
Belief that continuous use of respiratory drugs is unhealthy			.06
Yes	40	23 (57.5)	
No	119	48 (40.3)	
Self-reported behaviors toward therapy during the past 3 months			
Unintentional interruption of ICS use			.98
Never or scarcely	111	48 (43.2)	
Sometimes, often, or very often	46	20 (43.4)	
Intentional interruption of ICS use when feeling better			.36
Never or scarcely	102	47 (46.1)	
Sometimes, often, or very often	57	22 (38.6)	
Intentional interruption when feeling worse			>.99
Never or scarcely	150	65 (43.3)	
Sometimes, often, or very often	9	4 (44.4)	
Less frequent use of ICSs when feeling better			.46
Never or scarcely	107	49 (45.8)	
Sometimes, often, or very often	53	21 (39.6)	
More frequent use of ICSs in case of premonitory signs of asthma attack			.43
Never or scarcely	125	53 (42.4)	
Sometimes, often, or very often	34	17 (50.0)	
Intentional change of the dosing of ICSs			.28
Yes	31	11 (35.5)	
No	130	60 (46.2)	

Abbreviation: ICS, inhaled corticosteroid.

^a χ^2 test or Fisher exact test.

Table 4. Logistic Model: Risk of Lower Internal Orientation (Locus of Control <50%)^a

Characteristics	OR (95% CI)
Age group, y	
15–45	Reference
46–65	1.68 (0.74–3.80)
>65	3.45 (1.45–8.21)
Male	1.47 (0.72–3.00)
Use of oral corticosteroid courses (past 3 months)	0.87 (0.29–2.61)
Inadequate asthma control	2.68 (1.23–5.81)
Belief that continuous use of respiratory drugs is unhealthy	1.91 (0.85–4.27)

Abbreviations: CI, confidence interval; OR, odds ratio.

^a n = 151.

may use their controllers regularly, provided that they had been sensitized to this issue. Unlike purely information-based trainings,¹¹ training that actively involves patients in the management of their disease may result in a reduction of asthma symptoms.^{12–13} However, reverse causation remains possible. Because less symptomatic patients may have better psychological status, they may consider their own influence

on asthma as more important than would symptomatic patients.

Patients older than 65 years were more likely to have a lower internal LOC. The relationship with age might result from older patients' resignation behavior, after experiencing several years of asthma symptoms. No effect of age was observed on "perceived ability to deal with asthma" in the study by Katz et al,¹⁴ but patients were all younger than 50 years. Further studies are desirable to investigate the influence of age on LOC.

No significant association was observed in our data with patients' self-reported behaviors toward ICSs (Table 3). Nonetheless, interpretation requires caution because a higher internal LOC may result in a better adherence only if patients are adequately informed and convinced of the need to use ICSs regularly. Our results suggest that misperception about asthma therapy is common in the study population, which could affect patients' motivation to use controllers regularly, independently of LOC orientation (Table 3). Investigation of the relationship between adherence to therapy and LOC orientation has yielded conflicting results. Halimi et al¹⁰ found better adherence to therapy among high internal LOC patients, whereas other studies did not.^{15,16}

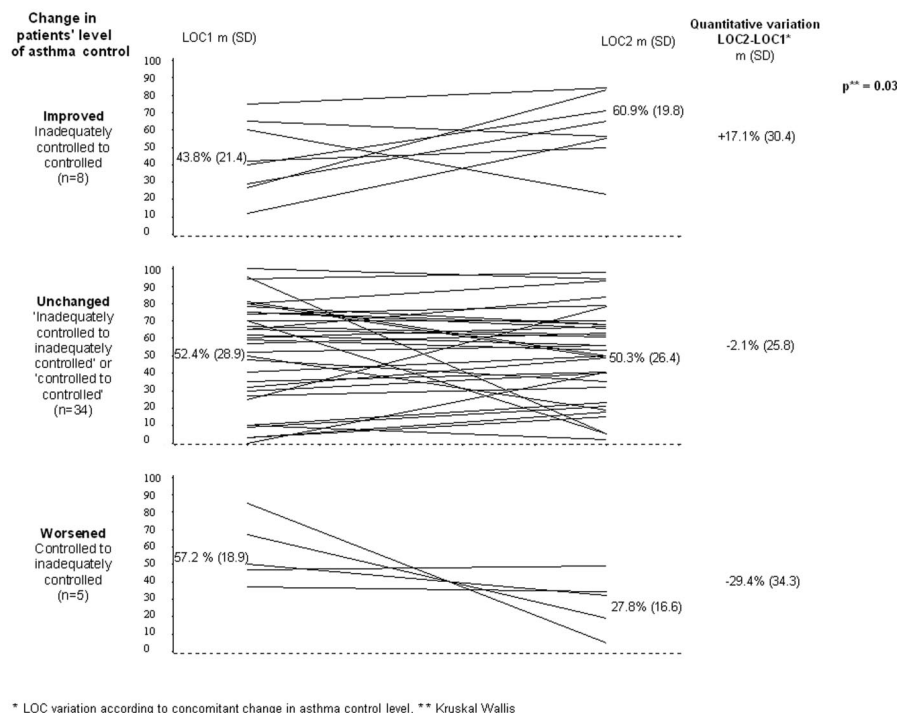


Figure 3. Change in locus of control (LOC) status between inclusion (LOC1) and first subsequent measure (LOC2) according to concomitant change in asthma control.

Although statistically nonsignificant, the nearly 2-fold increased risk of lower LOC internal orientation observed among patients who believed continuous use of respiratory drugs to be unhealthy would suggest that an inadequate understanding of therapy may negatively influence LOC orientation. The perception of treatment usefulness was significantly found to be associated with a greater perception of control of asthma.¹⁴ We did not identify any significant effect on LOC of other factors, such as asthma severity or the intensity of ICS therapy.

This study had some limitations. LOC was not measured with a validated instrument.^{4,17,14} Because of the skewed distribution, LOC was coded as a dichotomous variable for multivariate analyses. However, when complementary univariate analyses were conducted with LOC as the quantitative variable, the main findings with asthma control persisted ($P = .01$, data not shown). Besides, when the LOC distribution was divided into tertiles, a clear dose pattern effect appeared ($P = .004$, data not shown). This indicates that our findings were not dependent on the coding of LOC variable, which is supportive of their robustness.

This study was conducted on a limited sample of patients. Our findings should be verified on a higher number of patients, notably concomitant changes of LOC and asthma control over time. Patients' educational level could not be investigated. Unfortunately, sociodemographic status was not documented in our study. Not only is asthma common among patients belonging to low socioeconomic environment,^{18,19}

but also the association between a low socioeconomic status and a poor control has been observed.²⁰ It would also be interesting to note whether socioeconomic status also influences patients' LOC.

Our sample of patients, all treated with ICSs, was not representative of the general population of asthma patients. The time elapsed between the LOC1 measure and LOC2 substantially varied among patients. However, such variation may not affect our findings because no association was observed between this duration and LOC quantitative variation ($P = .20$).

These results have clinical and research implications. The role of LOC in asthma control needs a better understanding. It is unclear whether there is a causal relationship between these outcomes. If so, reinforcing patients' confidence in efficiency of self-care (eg, modifying LOC toward internal orientation) may contribute to improve asthma control. Conversely, both outcomes might be 2 independent concepts. These hypotheses require investigation.

More generally, the potential interrelations in asthma among LOC orientation, asthma control, patients' beliefs and behaviors toward controllers, and management-related factors (including asthma-related medical resource utilization) should be better investigated.^{21,22} Also, a better knowledge of the changes of LOC over time and with age is also needed.

Our data suggest that asthma patients commonly believe that their efficacy on asthma control is limited, more specifically when their asthma is inadequately controlled (Table 4),

which is of concern. Better education of patients is desirable to improve the quality of asthma care. In practice, such education should not overlook asthma patients' psychological factors, notably, LOC orientation. GPs and other caregivers may help patients understand that they can markedly improve the control of their disease with more adequate behaviors with regard to controller therapy. In particular, it would be of interest to verify whether potential improvements of patients' asthma control resulting from educational programs are associated with a concurrent shift of LOC toward internal orientation and improved patients' ability to self-manage, as suggested by some studies.^{23,24,25}

In conclusion, LOC orientation varied markedly among patients, and it could vary in time in parallel with control. Lower internal LOC was associated with a poorer level of asthma control and with older age. Further studies are needed to understand fully the potential role of LOC orientation in asthma management and outcomes.

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REFERENCES

1. Laforest L, Van Ganse E, Devouassoux G, et al. Patient-reported adverse events under asthma therapy: a community pharmacy-based survey. *Clin Pharmacol Ther.* 2007;82:167–172.
2. Foster JM, Aucott L, van der Werf RH, et al. Higher patient perceived side effects related to higher daily doses of inhaled corticosteroids in the community: a cross-sectional analysis. *Respir Med.* 2006;100:1318–1336.
3. Laforest L, Van Ganse E, Devouassoux G, et al. Asthmatic patients' poor awareness of inadequate disease control: a pharmacy-based survey. *Ann Allergy Asthma Immunol.* 2007;98:146–152.
4. Rotter JB. Generalized expectancies for internal versus external control of reinforcement. *Psychol Monogr.* 1966;80:1–28.
5. Stelmach W, Kaczmarczyk-Chalas K, Bielecki W, et al. The association between income, education, control over life and health in a large urban population of Poland. *Int J Occup Med Environ Health.* 2004;17:299–310.
6. Kiviruusu O, Huurre T, Aro H. Psychosocial resources and depression among chronically ill young adults: are males more vulnerable? *Soc Sci Med.* 2007;65:173–186.
7. Sturmer T, Hasselbach P, Amelang M. Personality, lifestyle, and risk of cardiovascular disease and cancer: follow-up of population based cohort. *BMJ.* 2006;332:1359.
8. Nathan RA, Sorkness CA, Kosinski M, et al. Development of the asthma control test: a survey for assessing asthma control. *J Allergy Clin Immunol.* 2004;113:59–65.
9. Global Initiative for Asthma. *Global Strategy for Asthma Management and Prevention NHLBI/WHO WORKSHOP report (updated 2006).* Bethesda, MD: National Institute of Health; 2006.
10. Halimi L, Vachier I, Varrin M, et al. Interference of psychological factors in difficult-to-control asthma. *Respir Med.* 2007;101:154–161.
11. Gibson PG, Powell H, Coughlan J, et al. Limited (information only) patient education programs for adults with asthma. *Cochrane Database Syst Rev.* 2002;CD001005.
12. Gibson PG, Powell H, Coughlan J, et al. Self-management education and regular practitioner review for adults with asthma. *Cochrane Database Syst Rev.* 2003;CD001117.
13. Chambers CV, Markson L, Diamond JJ, et al. Health beliefs and compliance with inhaled corticosteroids by asthmatic patients in primary care practices. *Respir Med.* 1999;93:88–94.
14. Katz PP, Yelin EH, Eisner MD, et al. Perceived control of asthma and quality of life among adults with asthma. *Ann Allergy Asthma Immunol.* 2002;89:251–258.
15. Apter AJ, Reisine ST, Affleck G, et al. Adherence with twice-daily dosing of inhaled steroids: socioeconomic and health-belief differences. *Am J Respir Crit Care Med.* 1998;157:1810–1817.
16. Schmitt GM, Lohaus A, Salewski C. Control beliefs and patient compliance: an empirical study exemplified by adolescents with diabetes mellitus, bronchial asthma and alopecia. areata [in German]. *Psychother Psychosom Med Psychol.* 1989;39:33–40.
17. Meyers R, Donham GW, Luden K. The psychometric properties of the Health Locus of Control Scale with medical and surgical patients. *J Clin Psychol.* 1982;38:783–787.
18. Clement LT, Jones CA, Cole J. Health disparities in the United States: childhood asthma. *Am J Med Sci.* 2008;335:260–265.2.
19. Riachy M, Bou Khalil P, Khayat G, et al. Impact of low socioeconomic status on the demography and co-morbidities of asthma. *Rev Mal Respir.* 2008;25:275–281.
20. Peters AT, Klemens JC, Haselkorn T, et al; TENOR Study Group. Insurance status and asthma-related health care utilization in patients with severe asthma. *Ann Allergy Asthma Immunol.* 2008;100:301–307.
21. Calfee CS, Katz PP, Yelin EH, et al. The influence of perceived control of asthma on health outcomes. *Chest.* 2006;130:1312–1318.
22. Schafer T, Riehle A, Wichmann HE, et al. Alternative medicine and allergies: life satisfaction, health locus of control and quality of life. *J Psychosom Res.* 2003;55:543–546.
23. McPherson AC, Glazebrook C, Forster D, et al. A randomized, controlled trial of an interactive educational computer package for children with asthma. *Pediatrics.* 2006;117:1046–1054.
24. Armour C, Bosnic-Anticevich S, Brilliant M, et al. Pharmacy Asthma Care Program (PACP) improves outcomes for patients in the community. *Thorax.* 2007;62:496–502.
25. Saini B, Krass I, Armour C. Development, implementation, and evaluation of a community pharmacy-based asthma care model. *Ann Pharmacother.* 2004;38:1954–1960.

Requests for reprints should be addressed to:

Eric Van Ganse, MD, PhD

Unité de Neuro-épidémiologie et de Pharmacologie

Hôpital Neurologique Pierre Wertheimer

59 boulevard Pinel

69677 BRON cedex, France

Email: eric.van-ganse@chu-lyon.fr