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Original article

The use of the Asthma Control Test in general practice and its correlation with asthma control according to the GINA guidelines

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Abstract

Background:

The GINA guidelines have redefined the primary goal of asthma treatment as achieving optimum control.

Objectives:

To document the level of asthma control in Switzerland, the correlations between the international guidelines by GINA and the ACT's rating of asthma control, current treatment in adolescent and adult Swiss asthma patients and factors associated with asthma control.

Methods:

General practitioners and specialists (pulmonologists, allergologists and paediatricians) were invited to participate in the cross-sectional survey. Asthma control was assessed in 1093 asthma patients using both the ACT and the GINA classification for asthma control.

Results:

According to the GINA guidelines controlled asthma was found in 290 (27%) patients, when measured with the ACT 124 (11.5%) patients showed sufficient asthma control. Of the test results 65% were in accordance with each other, whereas in 85% of the non-matching results the ACT underestimated control according to GINA classification. An ACT cut-off score of ≤ 17 best identified uncontrolled asthma according to GINA guidelines. A total of 956 (87.7%) patients received controller medication and 849 (77.9%) patients received reliever medication. The following parameters were consistently identified to be significantly associated with insufficient asthma control in both GINA and ACT measurements: presence of exacerbation, use of reliever medication, switch of therapy and smoking.

Study limitation:

For this study only the ACT version for adults was used.

Conclusion:

Asthma control remains insufficient in the majority of patients, despite prescription of regular controller medication. This survey confirms the validated ACT to be useful and important in everyday practice as an objective measure for asthma control according to GINA guidelines in order to monitor control and adjust treatment.

Introduction

Asthma is characterized by chronic inflammation of the airways and associated with airway hyper responsiveness that leads to recurrent episodes of symptoms and exacerbations (such as wheezing, breathlessness, chest tightness, and

coughing, particularly at night or in the early morning) and reversible airflow obstruction. Asthma affects an estimated 300 million people worldwide¹ and about 5–8% of the Swiss population and is therefore one of the most common respiratory diseases².

After being revised in 2006 the asthma management guidelines issued by the Global Initiative for Asthma (GINA), widely known as 'the GINA guidelines', have redefined the primary goal of asthma treatment as achieving optimum control³. This happened due to the fact that classification of asthma by level of control was proven to be more relevant and useful in daily practice than the classification of asthma by severity (as the former involves both the severity of the underlying disease and its responsiveness to treatment, which makes it a varying feature of an individual patient's asthma)³.

However, several studies show that large numbers of patients do not achieve sufficient control of asthma^{4–6} and both patients and physicians were shown to overestimate the level of asthma control^{4,6,7}. It is therefore of great importance to find validated measures that identify patients with poorly controlled asthma in order to improve asthma control and quality of life by adjusting treatment^{5,8,9}. Such validated instruments should be simple and patient-based, with or without lung function testing and easy to handle. Hence, they are not only useful for clinicians in research but especially in primary care settings^{8,10}. These measures are recommended by the GINA guidelines⁸ and have been included in recent Swiss research projects in children⁵ and adults⁴. The survey showed that the percentage of well controlled asthma patients, measured by the 7-item Asthma Control Questionnaire (ACQ), can almost be quadrupled by appropriate treatment⁴.

The Asthma Control Test (ACT) is a validated tool for patient-based and objective assessment of asthma control in order to achieve the primary goals of asthma management¹⁰. To our knowledge, there are limited data correlating asthma control using both GINA and ACT. The objective of the present survey was therefore to document the level of asthma control, the correlations between the international guidelines by GINA and the ACT's rating of asthma control and current treatment in adolescent and adult Swiss asthma patients, as well as factors associated with asthma control.

Patients and methods

Both primary care physicians and specialists (pulmonologists, allergologists and paediatricians) were invited to participate in the cross-sectional survey on asthma control in Switzerland. They were asked to collect data of adolescent and adult asthmatic patients seen at least once between July 2007 and December 2008. The diagnoses of asthma

relied on the recruiting physicians. The data were collected within a single visit to the physician's office. There was no follow-up visit. Patients were informed about the anonymous data collection, and written informed consent was obtained from the participants, or in adolescents from their parents or legal guardians, by the recruiting physician.

The physicians were provided with the ACT brochure, the pocket guide for asthma management and prevention by GINA and the datasheet, which included the following items: age, gender, weight, height, race, smoking habits, spirometry results, therapeutic classes of medication used for the current treatment of asthma (controller medication, reliever medication), switch of therapy due to measured asthma control, asthma control measured by the Asthma Control Test (ACT), level of asthma control defined by GINA guidelines (controlled, partly controlled and uncontrolled), including six characteristics: daytime symptoms, limitations of activities, nocturnal symptom/awakening, need for reliever/rescue treatment, lung function (PEF or FEV₁) and the presence of at least one exacerbation during the last month. Adherence to asthma medication was assessed by asking the following questions: 'Has your patient ever forgotten to take his asthma medication in the last three months?' and 'If yes, how often?' As the survey was performed in the German, French and Italian speaking part of Switzerland the ACT brochure, the pocket guide by GINA and the datasheets were provided in all three languages and handed out according to the region. Institutional review board (IRB) approval was obtained for this survey.

The Asthma Control Test (ACT) contains five questions covering the last four weeks since the current visit and asks about limitations of activities, shortness of breath, nocturnal symptoms/awakening, use of reliever/rescue medication as well as personal rating of own asthma control. Each question was answered using a five-point Likert scale (1 equals maximum impairment and 5 equals no impairment at all). The ACT score was calculated as the sum of the responses to the 5 questions. In order to distinguish between different levels of asthma control the following scale was used: score 25 = completely controlled asthma, score 20–24 = moderately controlled asthma, score <20 = not controlled or poorly controlled asthma.

Continuous variables were reported as mean $\pm$ standard deviation. Proportion variables were reported as number *n* and relative frequencies (%). Multinomial logistic models were performed to evaluate a predictive influence of the following factors on either the Asthma Control Test (ACT) or guideline questions (GINA): FEV₁/FVC, BMI, exacerbation, categories of therapy (controller medication, reliever medication, no treatment), switch of therapy and smokers. A *p*-value <0.05 was considered significant. All analyses were done using R version 2.7.1 (R Development Core Team, 2005).

Results

Patient characteristics

Between July 2007 and December 2008 227 primary care physicians, general practitioners and specialists included 1093 asthma patients in the survey, of which 17 had to be excluded from the survey due to missing data regarding the ACT questionnaire. The datasheet was completed in German, in French and in Italian. In this sample the mean age of the patients was 48 years (± 18.6 years) with a range of 10 to 96 years. Seventeen patients (1.6%) were younger than 12 years, 551 (50.5%) were male and 322 (29.9%) were smokers (Table 1).

Asthma control

Asthma control assessed by the GINA guidelines revealed 290 (27%) patients to have controlled asthma, 420 (39%) patients to have partly controlled asthma and 366 (34%) to have uncontrolled asthma. Asthma control measured by the ACT showed completely controlled asthma (score = 25) in 124 (11.5%), moderately controlled asthma (score = 20–24) in 482 (44.8%) and uncontrolled asthma (score <20) in 470 (43.7%) patients (Table 2). 103 (13.8%) out of 747 non-smokers and no more than 20 (6.4%) out of 314 smokers had ‘completely controlled’ asthma.

Table 1. Overall patient characteristics.

	Mean/n	SD/%
Age (years)	48.1	± 18.6
BMI (kg/m ²)	25.44	± 5.11
Gender		
Female	540	(49.5)
Male	551	(50.5)
Smoker	322	(29.9)
Exacerbation	587	(56.7)
Treatment		
Controller medication	957	(87.8)
Reliever medication	848	(77.8)
No medication at all	38	(3.5)

Data are presented as mean $\pm$ standard deviation or *n* (%). BMI = body mass index.

Comparing GINA and ACT, 703 (65.3%) test results were in accordance with each other and 373 (34.7%) were not in accordance. In 319 (85.5%) patients asthma control according to GINA was underestimated by the ACT and in 54 (5%) it was overestimated. There were 327 (89.3%) patients with uncontrolled asthma and 107 (36.9%) patients with controlled asthma, as rated by GINA, who were correctly classified by ACT. The Spearman correlation coefficient measuring the linear correlation between the variables of ACT and GINA was 0.75.

In regularized discriminant analysis the original ACT scores were quantified in a new manner based on the rating of asthma control by the GINA guidelines. These measurements resulted in new cut-off values for the ACT scores: score 24–25 for completely controlled asthma, score 18–23 for moderately controlled asthma and score ≤ 17 for uncontrolled asthma.

We then calculated new cut-off values for smokers and non-smokers: For smokers we calculated a cut-off value ≤ 17 to distinguish patients with uncontrolled asthma from those with moderately or completely controlled asthma. We could not set a cut-off value that could reliably distinguish ‘completely controlled’ and ‘moderately controlled’ asthma. For non-smokers a cut-off value of ≤ 17 distinguished between uncontrolled/poorly controlled and moderately controlled whereas a cut-off ≤ 22 distinguished between moderately and completely controlled asthma.

Medication

Overall, 1050 (96.3%) patients were having treatment for asthma. Of these, 957 (87.8%) patients were having controller medication such as inhaled steroids as medication for asthma (Table 1): a fixed combination, containing ICS and a long-acting β_2 -agonist, was being received by 749 (78.5%) patients. ICS monotherapy was received by 122 (12.8%) patients and 104 (10.9%) were receiving long-acting β_2 -agonist monotherapy. Leukotriene receptor antagonists were being received by 166 (17.4%) patients. ‘Other medication’ such as tiotropium, oral steroids, anti-histamines, anti-IgEs or theophylline were used in 57 (5.9%) patients; 848 (77.8%) patients were reported to

Table 2. Asthma control measured by the total score of the ACT in comparison to asthma control measured by the GINA classification.

		ACT							
		Total		Completely controlled		Somewhat controlled		Not controlled/poorly controlled	
		<i>n</i>	(%)	<i>n</i>	(%)	<i>n</i>	(%)	<i>n</i>	(%)
GINA	Total	1076	(100)	124	(11.5)	482	(44.8)	470	(43.7)
	Controlled	290	(27)	107	(36.9)	176	(60.7)	7	(2.4)
	Partly controlled	420	(39)	15	(3.6)	269	(64)	136	(32.4)
	Uncontrolled	366	(34)	2	(0.5)	37	(10.1)	327	(89.4)

GINA = Global Initiative for Asthma; ACT = Asthma Control Test.

Table 3. Medication and asthma control according to GINA guidelines.

	Total		Controller medication		Reliever medication		No therapy	
	<i>n</i>	(%)	<i>n</i>	(%)	<i>n</i>	(%)	<i>n</i>	(%)
Total	1090	(100)	957	(87.8)	848	(77.8)	38	(3.5)
Controlled	292	(26.8)	269	(92.1)	204	(69.8)	6	(2.1)
Partly controlled	426	(39.1)	375	(88.0)	321	(75.4)	15	(3.5)
Uncontrolled	372	(34.1)	313	(84.1)	323	(86.8)	17	(4.6)

Table 4. Change in therapy and asthma control (by GINA) for the surveyed patient population.

	Total change of therapy		Change in dose of medication		Change in medication		Add-on therapy		Medication stop	
	<i>n</i>	(%)	<i>n</i>	(%)	<i>n</i>	(%)	<i>n</i>	(%)	<i>n</i>	(%)
Total	509	(100)	264	(51.9)	91	(17.9)	210	(41.1)	20	(3)
Controlled	24	(4.7)	16	(6.1)	1	(1.1)	4	(1.9)	4	(20.0)
Partly controlled	185	(36.3)	98	(37.1)	34	(37.4)	64	(30.5)	7	(35.0)
Uncontrolled	300	(58.9)	150	(56.8)	56	(61.5)	142	(67.6)	9	(45.0)

receive reliever medication such as short acting β_2 -agonist and 38 (3.5%) patients were reported to use no medication at all.

Of 292 patients assessed by GINA guidelines as having 'controlled' asthma, 269 (92.1%) received controller medication and of 372 patients classified as having 'uncontrolled/poorly controlled' asthma 313 (84.1%) received controller medication. On the other hand 204 (69.8%) patients with 'controlled' asthma and 323 (86.8%) patients with 'uncontrolled' asthma received reliever medication (Table 3).

After asthma control was assessed at the practitioner's office 509 (46.8%) patients received a change of their current asthma treatment. Of those 509 patients 58.9% had 'uncontrolled' asthma, 36.3% had 'partly controlled' asthma and 4.7% had 'completely controlled' asthma. Change in dose of medication was performed in 264 (51.9%), change in medication in 91 (17.9%), add-on therapy in 210 (41.1%) and medication stop in 20 (3.9%) of all patients receiving treatment change (Table 4).

Factors associated with asthma control

In the multinomial logistic analysis the following parameters were associated with GINA-classified 'partly controlled' asthma: presence of exacerbations, switch of therapy and smoking. While presence of exacerbations, use of reliever medication, switch of therapy, adding medication and smoking increased the probability of being classified as having 'uncontrolled' asthma.

Use of reliever medication and adding medication was strongly associated with 'uncontrolled' asthma, patients with presence of exacerbations had significantly higher

probability for both 'partly controlled' and 'uncontrolled' asthma. For smokers and patients with switch of therapy, the probability for 'uncontrolled' asthma was 47 times higher when switch of therapy was performed as shown in Table 5. The use of controller medication and medication stop was associated with significantly lower probability of uncontrolled asthma measured by GINA (Table 5).

Presence of exacerbation, use of reliever medication, switch of therapy and smoking were associated with 'moderately controlled' and 'not controlled' asthma measured by the ACT. Only adding medication was associated with 'not controlled' asthma, so when medication was added the probability of 'completely controlled' asthma was 11 times lower. Uncontrolled asthma measured by the ACT was negatively associated with only medication stop (Table 5).

Discussion

This cross-sectional survey carried out in Switzerland confirms good asthma control continues to remain rare, when measured with both the ACT and the GINA classification, despite that almost 90% of the surveyed patients being reported to be using controller medication. However, the validated ACT proves to be useful in everyday practice as an objective measure for asthma control according to GINA guidelines. We also found the ACT to be a good screener for insufficient asthma control when using a newly established cut-off point of ≤ 17 . Moreover we could confirm that smoking is an independent predictor of poor asthma control in asthmatics seen by general practitioners in Switzerland.

This survey reports on a representative patient population recruited through both primary and specialist care

Table 5. Multinomial logistic model for factors associated with asthma control with each parameter separately, measured by the ACT and the GINA guidelines among different subgroups.

ACT	Somewhat controlled asthma	Not controlled or poorly controlled asthma
<i>Individual factors</i>		
BMI	1.02 (0.98, 1.07)	1.03 (0.99, 1.07)
Exacerbation yes	2.14 (1.35, 3.38)**	8.34 (5.21, 13.4)***
FEV ₁ /FVC	1.01 (0.95, 1.07)	0.99 (0.92, 1.06)
Controller medication	0.99 (0.53, 1.84)	0.79 (0.43, 1.47)
Reliever medication	1.48 (1.21, 2.8)**	3.49 (2.24, 5.43)***
No medication	0.92 (0.34, 2.54)	0.89 (0.32, 2.47)
Smoker	1.76 (1.05, 2.97)*	3.08 (1.84, 5.15)***
<i>Treatment decision during doctor's visit</i>		
Switch of therapy	2.58 (1.6, 5.1)***	21.6 (12.1, 38.5)***
Change in dose of medication	0.6 (0.19, 1.84)	0.51 (0.17, 1.52)
Change in medication	2.55 (0.32, 20.4)	3.29 (0.43, 25.4)
Add-on	7.3 (0.93, 57.2)	11.4 (1.48, 87.5)*
Medication stop	0.41 (0.08, 2.11)	0.17 (0.03, 0.87)*
GINA	Partly controlled asthma	Uncontrolled asthma
<i>Individual factors</i>		
BMI	0.99 (0.97, 1.01)	1.0 (0.99, 1.02)
Exacerbation yes	2.42 (1.75, 3.35)***	8.97 (6.22, 12.9)***
FEV ₁ /FVC	0.98 (0.94, 1.03)	0.97 (0.92, 1.03)
Controller medication	0.62 (0.37, 1.03)	0.45 (0.27, 0.75)**
Reliever medication	1.31 (0.94, 1.83)	2.84 (1.92, 4.2)***
No medication	1.97 (0.77, 5.06)	2.28 (0.89, 5.86)
Smoker	2.67 (1.84, 3.86)***	2.74 (1.88, 4.0)***
<i>Treatment decision during doctor's visit</i>		
Switch of therapy	8.57 (5.41, 13.6)***	47 (28.8, 76.8)***
Change in dose of medication	0.56 (0.23, 1.38)	0.5 (0.21, 1.21)
Change in medication	5.18 (0.68, 39.6)	5.28 (0.7, 39.9)
Add-on	2.62 (0.86, 8.0)	4.47 (1.49, 13.38)**
Medication stop	0.2 (0.05, 0.73)*	0.15 (0.04, 0.55)**

GINA = Global Initiative for Asthma; ACT = Asthma Control Test; BMI = body mass index; FEV₁ = forced expiratory volume in one second; FVC = forced vital capacity; Add-on = step up in medication performed. Data are expressed as odds ratio with their 95% confidence intervals.

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

in Switzerland. Earlier, we reported that 57% of patients were evaluated by their GP as having insufficient or poor asthma control⁴. About five years later, it seems that the proportion of patients with insufficient asthma control is significantly smaller. In 1999 the AIRE study reported well controlled asthma in only 5% of their 2800 patients and therefore found a great number of patients with poor asthma control¹¹. Almost 12 years later, our findings of 34% uncontrolled asthma patients reflect the results of several recent studies, which categorized more than 30^{12–14} of their patients as having uncontrolled asthma according to GINA guidelines. So the proportion of asthmatics with poor asthma control remains highly prevalent and is confirmed when assessing asthma control with the ACT in a standardized manner. For this study we asked practitioners to recruit individuals with asthma aged 10 years and older and used the ACT version for adults. This version of the questionnaire has been validated in individuals of 12 years and older. However the analyzed study sample consisted of only 11 individuals that were younger than 12 years representing only 1.1% of the total study population. The distribution of these individuals among asthma control status according to GINA was equal and excluding them

from the analysis would most likely not have changed the results significantly.

Still when using a questionnaire to determine the level of asthma control, an even larger population must be classified as having insufficient asthma control. In our survey, 470 out of 1093 subjects (44%) who had completed the ACT questionnaire had an ACT score ≤ 19 , the cut-off point for uncontrolled asthma. These findings were remarkably similar to those found by Thomas *et al.*¹⁴, who included a large number of European and US asthma patients. Other studies using the ACT to assess control found yet higher numbers of uncontrolled asthma, with results ranging from 55% in a web-based study in the US¹⁵ to 56% in a most recent Asian study¹⁶ and up to 57% in European patients recruited over the internet¹⁷.

Correlation between the ACT and GINA classification of asthma control was modest. Sixty-five percent of the test results were in accordance with each other, whereas in 85% of the non-matching results, the ACT underestimated control according to GINA classification. Several reasons may explain these discrepancies. Though similar symptoms are being evaluated in both ratings, the ACT

uses specific questions listing explicit symptoms to evaluate asthma control (for example: "...how much of the time did your asthma keep you from getting as much done at work, school or at home?"¹⁰), while GINA plainly itemises less-specific symptoms without forming any questions (namely, "limitations of activities"³). Forming those questions in a conversation with a patient is up to the individual physician, which could lead to different interpretations of the questions by each patient depending on the phrasing used by the physician. Also variability in grading the item contents may cause some discrepancies and is prone to observer bias. Currently there is no gold standard for measuring asthma control, but the ACT is a validated measure whereas GINA classification is a working definition for which validity data is still missing⁸.

The two measures do not refer to the same time frame, which could give yet another explanation for the less than perfect correlation. Besides measuring frequencies of symptoms, the GINA classification uses no defined time horizon whatsoever, hence it can be used to assess short- or long-term asthma control. In general for instruments measuring asthma control a short recall period (2–4 weeks) is recommended because detailed patient recall of asthma symptoms decreases over time¹⁸. Therefore, the ACT fits these criteria more precisely, since it was developed for assessing short-term asthma control with all 5 questions in the questionnaire referring to events of the preceding four weeks. Studies using similar methods to the ones we used to evaluate the correlation of the ACT and the GINA classification are rare. Still Lai *et al.*¹⁶ recently found significant but lower (0.442) correlation between the ACT scores and a GINA-derived control index, whereas Thomas *et al.* found moderate agreement between the ACT and GINA derived asthma control status¹⁴ and found the ACT to be useful in predicting GINA-defined partly controlled/uncontrolled asthma.

When considering asthma control according to GINA criteria as reference standard, we could establish ACT cut-off points in our survey population of ≤ 17 for uncontrolled, 18–23 for partly controlled and ≥ 24 for controlled asthma respectively. These differ from some of those found in other recent studies^{10,19–21}. In general, a lower cut-off score leads to lower sensitivity and higher specificity. Taking these findings into consideration, a cut-off point of ≤ 17 is a good screener for uncontrolled asthma in patients treated by practitioners in Switzerland. While in other studies the receiver operating characteristic curve was used, we used regularized discriminant analysis to establish cut-off values. Either way, screening uncontrolled asthma is important, because control of asthma can be achieved in the majority of uncontrolled patients²² and achievement of asthma control is associated with improvement in quality of life²³.

In our survey, we found that asthma patients on controller medication, such as inhaled corticosteroids, were

more likely to have controlled asthma, and patients suffering from insufficient asthma control were more often using reliever medication but less ICS. These findings can be explained by the fact that asthma is characterized by chronic inflammation and inhaled glucocorticosteroids are presently the most effective anti-inflammatory drugs in asthma⁸. Almost 90% of asthma patients in this survey were treated with some sort of controller medication; unfortunately, 10.9% of these used long-acting β_2 -agonists as monotherapy, which is not according to GINA guidelines and might lead to ineffective treatment. However the proportion of patients receiving controller medication has increased since Leuppi and colleagues⁴ performed their survey in Swiss asthma patients in 2004/2005, in which they reported only 70% of all asthma patients to use controller medication. Moreover, they found 7.8% asthmatic patients who did not receive any asthma treatment at all, while we only found 3.5% in the current survey. A reason for this yet small amount of well controlled asthmatics may also lie in noncompliance with treatment, since controlled asthma is reported to be positively associated with compliance to therapy^{8,24,25}. It has been estimated that up to 50% of adult or paediatric patients with chronic obstructive lung disease in Europe are unable to use their inhaler devices correctly which most likely affect treatment compliance, efficacy and the patients' asthma management plan²⁶. Furthermore, several studies show that patients overestimate their asthma control^{14,6,20}. So patients' overestimation of asthma control, and therefore possible unawareness of symptoms of the underlying asthma severity, may lead to poor compliance with treatment. This indicates that if physicians educate their patients thoroughly about asthma management and develop a good patient–clinician partnership, the ACT may not only be useful in a primary care setting but also help patients to self-monitor their asthma control in order to accomplish effective treatment hence good asthma control and a better quality of life.

The GINA guidelines recommend to 'step up treatment' if uncontrolled asthma is found and to 'consider stepping up treatment' if partly controlled asthma is measured⁸. In the current survey primary care physicians seem to follow these recommendations. In almost 80% of the patients with uncontrolled asthma according to GINA, and in 42% of the patients with partly controlled asthma, therapy was changed. Mainly add-on therapy or changes in dose of medication were performed. Because no follow-up visit was made, long-term improvement of asthma control in those patients remains unknown. Bateman *et al.*²² and de Marco *et al.*²⁴ report guideline-defined asthma control can be achieved in the majority of patients by adjusting treatment to the level of control.

Our survey has found several factors, such as presence of exacerbation, use of reliever medication, switch of therapy and add-on therapy, to be associated with uncontrolled

asthma according to both GINA classification and ACT rating. Little comparable data was found; nevertheless our findings seem logical. Presence of exacerbation and use of reliever medication are associated with severe asthma and poor asthma control, switch of therapy and adding medication are part of the GINA treatment guidelines when uncontrolled asthma is found.

Thirty percent of all asthma patients observed in this survey were smokers. This is consistent with the findings of the recent Swiss asthma study carried out by Leuppi *et al.* (30%)⁴. In agreement with several previous reports^{27–30}, we found significantly more uncontrolled asthma in smokers than in non-smokers. This indicates that smoking may lead to poor asthma control. Several reasons for this circumstance have been discussed in earlier studies, e.g. the difficult differentiability of asthma in smokers from smoking-associated COPD³¹. In this survey, we tried to minimize that factor by recruiting patients with physician-diagnosed asthma. There is also evidence that smoking impairs the effectiveness of treatment with ICS^{32,33}.

Reasons for this might be that cigarette smoke increases airway inflammations³⁴ and moreover induces neutrophil inflammatory reactions^{35,36}, which are less sensitive to corticosteroids than eosinophil inflammatory reactions, typically found in asthma patients. But smokers do not only have their symptoms more inadequately controlled, they also show greater utilization of health care resources²⁹. Therefore, it is important for physicians to recommend smoking cessation to asthma patients, as it has been reported that quitting smoking improves asthma symptoms³⁷ and leads to significantly better asthma control³⁸.

Numerous studies also identified high body mass index (BMI) to be associated with asthma^{39,40} and moreover with poorly controlled asthma^{28,30}. Though, in our survey, higher BMI tended to be associated with uncontrolled asthma, these associations may be explained by mechanical factors such as decreased functional residual capacity (FRC) in obese patients⁴¹, or obesity-mediated systemic inflammation through increase in proinflammatory adipokines (cytokine) and leptin (adipose derived hormone)^{42,43}.

Our findings suggest that physicians should still adhere to GINA guidelines when assessing asthma control as these guidelines are updated regularly and are considered standard of care in most countries. Correlation between ACT and GINA control classes were only moderate and in those misclassified the ACT is often underestimating asthma control status according to GINA.

The ACT is a short questionnaire that is easy to administer and allows neutral and somewhat more unbiased assessment of asthma control status. It can be administered at home and the scores recorded in a diary can provide useful information about the asthma status going further than the last 4 weeks. It is possible that patients can be

assisted by technical personnel when they are unable to read and fill in the questionnaire and this should be done prior to performing spirometry. With this approach physicians will already have information about current asthma status and lung function when they are speaking to patients and thus will allow more time to discuss other often neglected points such as smoking cessation and re-instruction of inhalation technique.

Conclusions

Even though proportions of individuals with uncontrolled asthma in Switzerland are decreasing, asthma control remains insufficient in a large number of patients, despite prescription of regular controller medication. In Swiss asthma patients treated in an outpatient setting the ACT questionnaire shows high correlation with asthma control status according to GINA guidelines and therefore the ACT can be considered a useful and objective tool in everyday practice of primary care physicians in order to monitor control and adjust treatment.

Transparency

Declaration of funding

This survey was supported by GSK (Switzerland).

Declaration of financial/other relationships

D.M. and J.D.L. have disclosed that they have received a fee for speaking at a conference and for consulting from GSK (Switzerland). E.N. and P.N.C. have disclosed that they have no relevant financial relationships. A.S., M.N. and M.A. have disclosed that they are employed by GSK (Switzerland).

CMRO peer reviewers on this manuscript have disclosed that they have no relevant financial relationships.

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