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## Factors influencing asthma course and the degree of control in the patients assessed with own questionnaire and Asthma Control Test (ACT)

Wpływ wybranych czynników na przebieg i kontrolę astmy u chorych poddanych badaniu za pomocą ankiety własnej i Testu Kontroli Astmy (ACT)

Financial support by Dept. of Internal Medicine, Pneumology and Allergology, Warsaw Medical University.

### Abstract

**Introduction:** Asthma treatment requires control and monitoring. According to Global Initiative For Asthma (GINA) asthma severity is described by degree of control. The aim of the present study was to compare self-patients' opinions about asthma control with Asthma Control Test (ACT) scores. Furthermore factors associated with asthma control were analyzed in the examined group of patients. Age, BMI, the length and the degree of asthma treatment, concomitant diseases, physical activity, exposition to the tobacco smoke, needs for education and self-control were assessed.

**Material and methods:** The study was based on a 36-point questionnaire that evaluated last two years of asthma duration, the reference data were obtained by objective evaluation with ACT.

Fifty three patients, 37 women and 16 men, median age 54 years (24–80 years), from outpatients clinic were enrolled into the study. According to ACT score the patients (pts) were divided into 3 groups: 25 points — well controlled asthma (group 1), 20–24 points — partially controlled asthma (group 2) and less than 20 points — lack of asthma control (group 3).

Kruskal-Wallis test and Chi-square test were used to compare the characteristics of subjects in different ACT groups. Pearson's test was used for assessment of correlation between different parameters.

**Results:** Twenty seven of 53 pts (51%) were treated with low dose of inhaled steroids and long acting beta-agonists (third degree of treatment according to GINA). During last two years the treatment was intensified in 37 pts (70%) due to exacerbation, and 19 of them (36%) were hospitalized in the course of exacerbation. Although 36 out of 53 pts (68%) claimed their asthma was fully controlled, ACT showed full control only in 5/53 (9%) of cases, partial control in 18/53 (34%), lack of control — in 30/53 (57%).

Older age ( $p < 0.05$ ) and longer duration of the disease ( $p < 0.01$ ) were the factors significantly influencing lack of asthma control. A tendency towards worse asthma control was combined also with overweight and greater number of concomitant diseases (mainly coronary artery disease, diabetes and gastro-esophageal reflux). The presence of influenza vaccinations in medical history was associated with better asthma control ( $p = 0.05$ ).

**Conclusions:** A discrepancy between subjective assessment of asthma control and ACT score was observed in the examined group of patients. The frequency of asthma exacerbations (according to questionnaire) was describing the degree of asthma control more precisely than self-assessment.

Older age and longer disease duration were combined with significantly worse asthma control. Better asthma control was combined with the presence of influenza vaccinations in medical history.

**Key words:** asthma, Asthma Control Test, treatment, self-assessment

**Pneumonol. Alergol. Pol. 2012; 80, 3: 198–208**

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Manuscript received on: 23.10.2009 r.

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ISSN 0867–7077

## Introduction

The first Global Strategy for Asthma Management and Prevention (GINA) was published in 1995. During the following 14 years the document was modified and updated many times [1]. The version of the GINA report from 2010 is currently used [2]. The main aim of the treatment of asthma is to gain full control of the disease. To achieve this (i.e. the best and most prolonged control of the disease), besides proper selection of medication and regular medical supervision, it is essential to provide patients with proper education and encouragement for self-assessment. The GINA experts' report from 2006 for the first time proposed classification of the disease that divided it into controlled, partly controlled, and uncontrolled asthma. The assessment of the level of asthma control included symptoms, activity, night waking, lung function expressed as FEV<sub>1</sub> (forced expiratory volume in one second) or PEF (peak expiratory flow), number of exacerbations, and the need for reliever use. Among many tests assessing asthma control, the Asthma Control Test (ACT) was proposed as a simple tool helping with quick assessment of the level of asthma control in the last 4 weeks [3].

The aim of the present study was to investigate, with the help of our own questionnaire, how patients with asthma assess the degree of their disease control and if their individual assessment is in agreement with the commonly accepted Asthma Control Test (ACT) score.

Additional factors, which could have an influence on asthma control levels in the studied group, were also analysed.

## Materials and methods

Among the patients attending the Outpatient Clinic of the Public Central Teaching Hospital in Warsaw between October 2007 and March 2008, asthma patients were identified and asked to complete a questionnaire (attachment 1) developed especially for the study purposes. The questionnaire consisted of 36 questions regarding, among other things: treatment so far, social and individual conditions, lifestyle, comorbidities, asthma-related exacerbations, and hospitalisations. Patients were asked to complete the questionnaire once, before an elective visit at a doctor's office. The collected information covered data from the preceding two years.

After our questionnaire had been completed, the ACT score was also obtained. On the basis of the ACT score three groups were distinguished.

Group 1 consisted of patients who achieved a score of 25 (controlled asthma), group 2 of patients with a score of 20–24 (partly controlled asthma), and group 3 of patients with a score of less than 20 (uncontrolled asthma).

The diagnosis of asthma was verified on the basis of patients' medical documentation available in the Outpatient Clinic. Fifty-three patients were enrolled into the study: 37 women and 16 men, aged 24–80 years (median 54 years).

The relations between ACT score and patients' age, length of asthma duration, level of asthma control according to GINA, comorbidities, body mass index (BMI), physical activity, cigarette smoking, influenza vaccination, possession of a PEF meter, and the patients' interest in the disease were investigated.

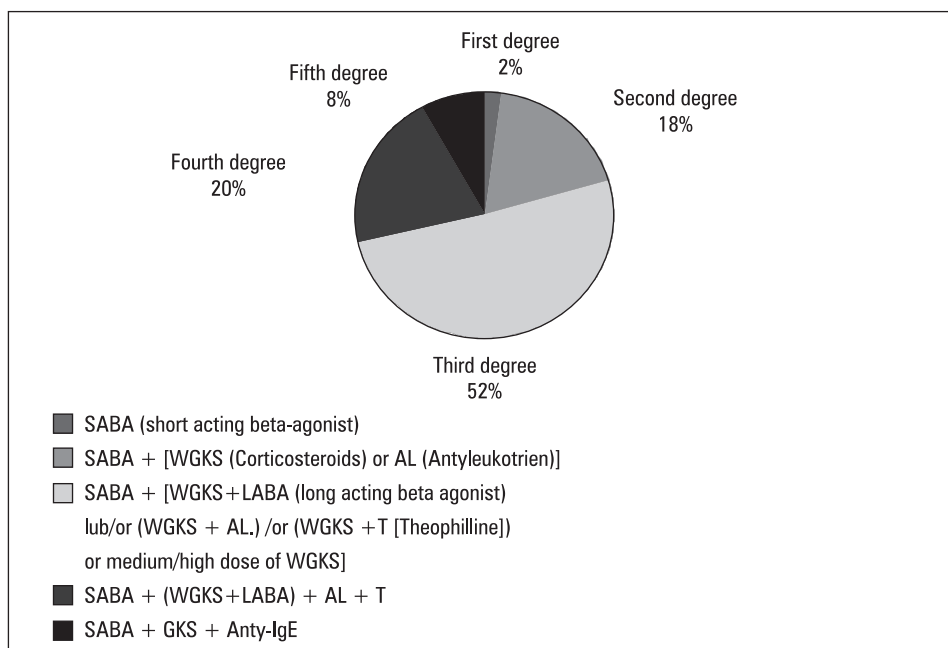
Analyses of the differences in the distribution of each of the parameters were performed with help of the Kruskal-Wallis test and Pearson's chi-square test. The Mann-Whitney-Wilcoxon test was used for identification of the group with significantly different characteristics.  $P < 0.05$  was considered statistically significant.

## Results

### The characteristics of the study population on the basis of our own questionnaire

In 6 patients asthma was diagnosed before they were 16 years old, in 19 when they were 16–30 years old, and in rest of them the diagnosis was established when they were above 30 years of age. The median time from diagnosis to enrolment into the study was 16 years. The majority (42, 80%) of patients had the diagnosis made and treatment commenced directly after the first episode of an asthmatic attack. Twelve patients (23%) reported positive family history for asthma (at least one of the parents suffered from asthma). Twenty-five (47%) participants answered positively to the question about the presence of allergy, confirmed with skin prick tests, and in the majority of cases it was an allergy to inhalant allergens. The main allergens were pollen and house dust mites. In four persons a pollen allergy coexisted with an alimentary one. More than half of the patients reported frequent respiratory tract infections in childhood. In fifteen patients nasal polyps were diagnosed, and nine reported aspirin hypersensitivity. However, the coexistence of aspirin hypersensitivity and nasal polyps was confirmed in only two cases.

Treatment for asthma in relation to GINA recommendations is presented in fig 1. Our question-



**Figure 1.** Treatment stages according to Global Initiative for Asthma

naire revealed that 27 (51%) patients were treated with low doses of inhaled corticosteroids and long-acting beta2-agonist (consistent with GINA's third stage of treatment).

The most frequently reported comorbidities were circulatory system disorders. Hypertension was present in 13 patients (25%) and ischaemic heart disease in 5 patients (9%). Additionally, 4 patients were treated for gastro-oesophageal reflux disease (GERD), 3 for diabetes mellitus type 2, and 3 for thyroid disease.

Looking at the symptoms, poor exercise tolerance was present in 37 (70%) patients, chronic cough in 19 (36%), and heartburn in 25 (47%).

On the basis of reported body weight and height, BMI was calculated for each patient. Twenty-three (43%) had normal BMI (< 25), 17 (32%) were overweight with BMI 25–30, and 13 (24%) were obese with BMI > 30.

Fourteen (26%) patients were still active cigarette smokers (1–40 pack years, mean 12.5). The number of passive smokers was as high as 27 (51%).

Twenty-five patients had been vaccinated against flu; 21 (40%) were in possession of their own PEF meter, but only one in three of them knew his or her best PEF result.

The mean frequency of asthma-related doctor's appointments during the preceding 2 years was once every 4 months (range from once a month to once every 2 years). Despite regular specialist supervision, during this period of time as many as 37 (70%) patients were in need of treatment intensification for the exacerbations (mean of annual

exacerbation events was 0.57), and 19 (36%) patients required treatment in an in-patient setting (mean of annual hospitalisations was 0.23). The majority of patients (69%) considered their exacerbations to be due to infections. Other reported causes included: seasonal allergies — 10%, stress — 7%, physical effort — 7%, and tobacco smoking — 7%.

As many as 36 (68%) patients declared their asthma to be well controlled despite the occurrence of exacerbations.

The majority (47, 88%) of patients, expressed a willingness to broaden their knowledge about asthma. Only a few patients did not feel the need for such education. For most of the patients (88%) the main resources of the disease-related information were books and booklets. Every third (32%) questioned patient had sought information on the Internet. Only 7 (13%) patients had attended special training courses organised by qualified medical personnel; 40–50% reported that their family members had actively searched for knowledge about the disease.

### Results of ACT

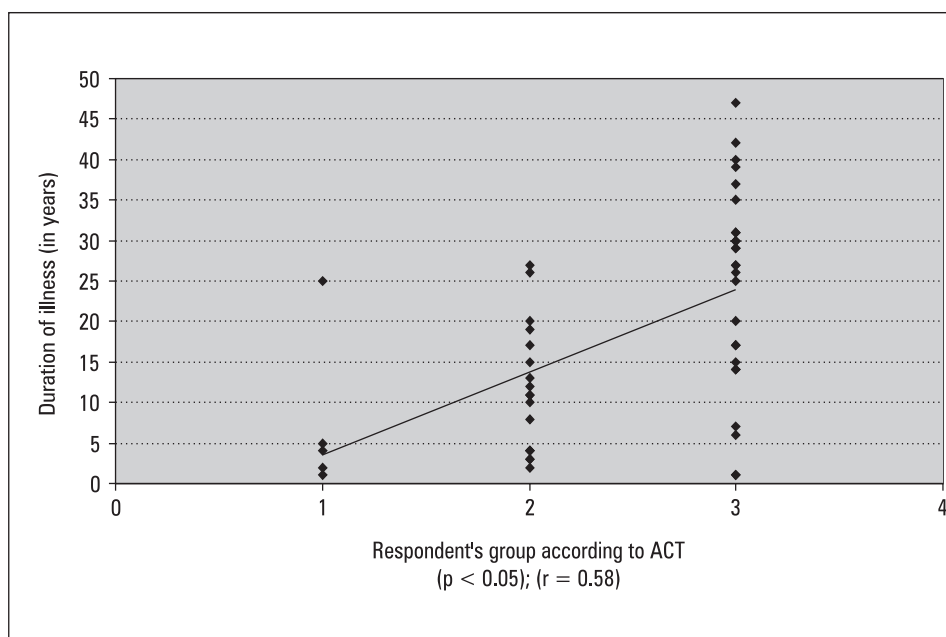
On the basis of ACT score, 5 patients (9%) were included into group 1 (controlled asthma), 18 (34%) into group 2 (partly controlled asthma), and 30 (57%) into group 3 (uncontrolled asthma).

### Comparison of ACT score and data from our questionnaire

As many as 36 (68%) questioned patients considered their disease to be well controlled. When

**Table 1. Asthma control declared in the questionnaire in relation to Asthma Control Test (ACT) score**

ACT group	Number of patients	Subjective assessment of asthma control	
		Well-controlled	Poorly controlled/lack of control
1	5	5	0
2	18	14	4
3	30	17	13
Total	53	36	17

**Figure 2.** Relationship between Asthma Control Test (ACT) group and duration of the disease

ACT scoring was applied, it appeared that in only in 5 (9%) patients full control of asthma had been achieved. In all patients from group 1, subjective assessment was consistent with ACT score. In the remaining two groups subjective assessment indicated better control of the disease than it was according to ACT score. Discrepancies in the obtained data are presented in table 1.

Table 2 shows the characteristics of the groups distinguished on the basis of ACT score. The oldest patients and those suffering from asthma for the longest period of time fell into group 3. Analysis of the relation between the age and the level of asthma control (according to ACT) showed significant differences between group 3 and the rest of the studied population ( $p < 0.05$ ). Median times from asthma diagnosis to questionnaire completion were: in group 1—5 years, in group 2—11 years, and in group 3—27 years. A significant correlation between length of disease duration and ACT score was revealed (fig. 2).

Analysis of the relationship between body weight and asthma control level according to ACT (Tab. 2) showed a tendency towards higher BMI in patients with worse disease control. Median values for BMI in groups 1–3 were: 24.3, 26, and 27.2, respectively. Obesity (BMI > 30) was present only in patients from groups 2 and 3: in 5/18 (28%) patients and 8/30 (27%) patients, respectively. However, these differences were not statistically significant.

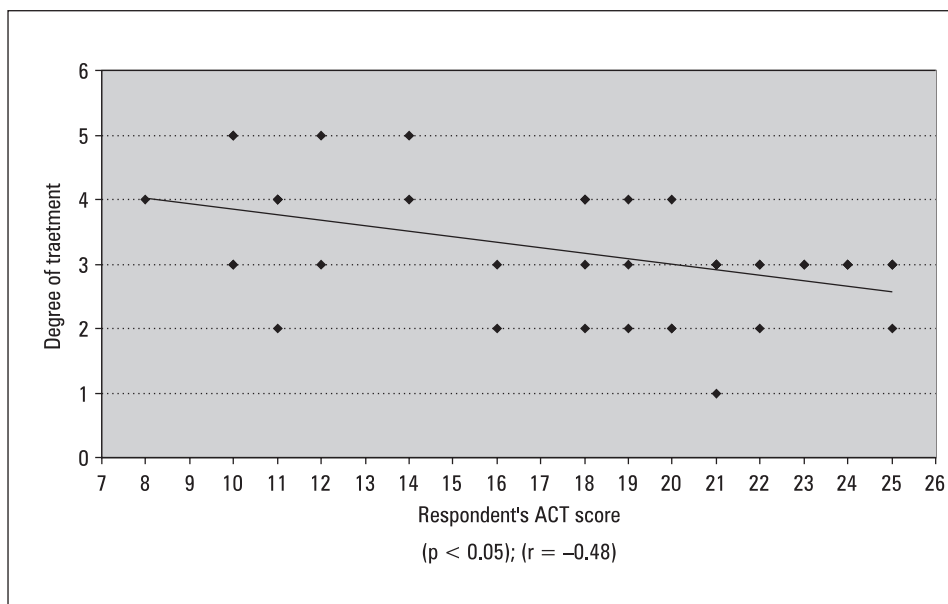
Table 3 shows the number of exacerbations and hospitalisations that had occurred in the preceding two years, in each group. It was proven that patients with uncontrolled asthma (group 3) had had significantly more exacerbations ( $p < 0.01$ ) and significantly more hospitalisations ( $p < 0.05$ ) than the others.

Patients from group 3 had more comorbidities than the rest of the studied population; coronary disease, diabetes mellitus type 2, and GERD were especially more frequent. Detailed data about this is shown in table 4.

**Table 2. Characteristics of patients according to Asthma Control Test (ACT) on the basis of data obtained from the questionnaire**

Group	Number of patients	Age (years) Median (range)	BMI Median (range)	Time from diagnosis (years) Median (range)
1.	5	57 (27–66)	24.3 (20.4–28.4)	5 (1–25)
2.	18	46.5 (21–72)	26 (17.2–34.9)	11 (2–27)
3.	30	60 (24–80)	27.2 (20.8–32.6)	27 (1–47)

BMI — body mass index



**Figure 3.** Relationship between Asthma Control Test (ACT) score and the treatment stage according to Global Initiative for Asthma

**Table 3. Course of the disease during past two years according to data from the survey in different Asthma Control Test (ACT) groups**

Group	Number of patients	Number of control visits Median (range)	Number of exacerbations Median (range)	Number of hospitalizations Median (range)
1.	5	4.5 (1–10)	0 (0–1)	0 (0–1)
2.	18	5 (0–12)	1 (0–3)	0 (0–1)
3.	30	8 (0–24)	1 (0–5)	1 (0–3)

**Table 4. Comorbidity according to data from the survey, in different Asthma Control Test (ACT) groups**

Comorbidity	Number of patients in different ACT groups		
	Group 1 (5)	Group 2 (18)	Group 3 (30)
Hypertension	1	5	7
Coronary artery disease	0	0	5
Gastro-oesophageal reflux	0	0	4
Diabetes type 2	0	0	3
Thyroid disease	0	2	1

A significant negative correlation ( $r = -0.48$ ,  $p < 0.05$ ) between stage of treatment according to GINA and ACT score was found (fig. 3).

Vaccination against flu was performed in all patients from group 1, 7/18 (39%) from group 2, and 14/30 (47%) from group 3. The difference in the frequency of flu vaccination between group 1 and groups 2 and 3 was borderline for statistical significance ( $p = 0.05$ ). Furthermore, it was shown that patients who had been vaccinated against flu had significantly fewer exacerbation episodes ( $p < 0.05$ ). However, there was no significant difference in terms of need for hospitalisation between vaccinated and non vaccinated subjects.

We also failed to reveal a relationship between ACT score and physical activity. In group 1 only 1 out of 5 persons (20%) took part in regular physical training, in group 2 — 9/18 (50%), and in group 3 — 5/30 (17%). Similarly, we could not establish any significant relationship between ACT score and possession of a PEF meter.

There was no relation between tobacco smoking and asthma control level according to ACT score either. Among 14 smokers, in group 1 there were 2 out of 5 (40%), in group 2 — 4 out of 18 (22%), and in group 3 — 8 out of 30 (27%).

## Discussion

The quality of life of patients with asthma depends on the level of disease control [4]. It is known that asthma, being a chronic disease, is a source of many difficulties, limiting active functioning.

Using our questionnaire we established that patients' subjective assessment of their disease control level was not in agreement with classification based on ACT score. The majority, i.e. 68% of studied patients, stated that their disease was well controlled while ACT score allowed for recognition of controlled asthma in only 9%. We regard ACT, a commonly accepted and simple tool for assessment of asthma control degree [5–7], superior to our questionnaire. This discrepancy gives rise to the question of why our patients assessed their disease control level incorrectly and what factors could have an influence on this?

The discrepancy in assessment could have been caused by the way that the questions in the questionnaire were formulated. For most of the questioned people good asthma control could simply mean regular doctor's appointments rather than a lack of disease symptoms. Perhaps, a better understanding could be achieved by asking whether

their asthma-related symptoms caused any limitations in activities of daily life. Besides, probably some asthma patients accept the constant presence of disease-related symptoms as a natural state. In addition, our questionnaire was meant to collect data from the preceding two years, while ACT only from the preceding 4 weeks.

Although most of the patients had been receiving anti-inflammatory treatment and bronchodilators (corresponding to GINA's third stage), it was not enough to provide full control over the disease. It is also worth mentioning that 34% of studied patients had required a hospitalisation, and 69% had required treatment intensification for asthma exacerbation.

It is significant that the number of exacerbations and hospitalisations corresponded to an asthma control level based on ACT score better than the patients' subjective assessment. This is an additional argument supporting the hypothesis that the patients had interpreted the questions from our questionnaire incorrectly.

The number of patients enrolled in our study was rather small, so it was not easy to draw conclusions about causes of bad asthma control.

Our questionnaire showed that there was a significantly higher number of older patients, those with long asthma duration and those with many coexisting chronic diseases, in the group with uncontrolled asthma (group 3 according to ACT score). These comorbidities were probably partly responsible for worse exercise tolerance, which was present in 73% of the patients in our group.

The other factor probably associated with worse disease control in the studied group was increased body weight. None of the patients with controlled asthma was obese, while 27–28% of patients from groups 2 and 3 were. The difference was not statistically significant, although this was probably due to the small numbers of patients in the groups.

Other authors pay particular attention to worse asthma control in obese patients [8]. Browatzki et al. showed that higher asthma prevalence and more severe disease course are associated with obesity, which is seen especially in young adults [9]. Furthermore, available data indicate that physical activity, leading to body weight reduction, improves exercise capacity, decreases intensity of asthma-related symptoms, and results in better disease control [10]. For this reason it is recommended to encourage patients to maintain proper body weight and to have regular physical exercise. In our study only a small number of patients (28%) confirmed taking part in regular training, so no signi-

ficant differences between the groups could be proven.

Another factor potentially influencing asthma control in the studied group was flu vaccination. All patients with controlled asthma had been vaccinated but only 44% of the remaining patients had. It is known that routine vaccination against influenza in asthma patients does not affect the level of the disease control directly, but may have an indirect impact through decreasing the number of infective exacerbations [11]. This was also confirmed in our study.

Fifty-one per cent of patients from the studied group were exposed to cigarette smoke in childhood, mainly at home, due to their parents smoking. Available data suggests that cigarette smoke exposure may increase the risk of asthma in children [12].

Almost one in three of the studied patients was an active smoker. Such a widespread habit of cigarette smoking among asthma patients has been confirmed in our previous studies [13]. Smoking may be a cause of occurrence of asthma and chronic obstructive pulmonary disease (COPD) overlap syndrome. It leads to a smaller degree of airway obstruction reversibility and worse treatment effectiveness [14,15] as well as difficulties in achieving disease control [16]. However, we failed to reveal any relation between active or passive cigarette smoking and ACT score.

Despite significant exposure to tobacco smoke, only 7% of the questioned patients considered it to be a cause of dyspnoea attacks. As leading reasons for exacerbations, patients reported infections (69%) and less frequently — seasonal allergies, stress, or physical effort (7–10%).

It remains the task of medical staff to convince patients to use their medications regularly and correctly. It is known that educating patients may improve the results of treatment, and a good opportunity for this is through special training courses. It is crucial to encourage patients to participate in such courses. This should be done by chest physicians, allergologists, and general practitioners [17]. Most of the patients from our study (more than 88%) had an interest in their disease and were actively searching for information on that subject. The main resources for the majority of them were books and booklets. Slightly less popular was the Internet (perhaps due to the patients' age). As shown, only 9% of our patients had attended courses for asthma patients (despite intense promotion of free courses organised in the centre where the study was conducted). At the same time, most of the patients (88%) declared a desire to take part in such educational projects. The

level of encouragement appeared to be insufficient despite the patients were under the regular medical supervision.

A PEF meter is a tool facilitating asthma self-control. In long-lasting treatment it is recommended that an individual plan of management be developed based on symptoms and PEF measurement [18]. Knowledge of the best PEF value is helpful in preparing a written plan in case of exacerbation [19]. Measurement of PEF has an advantage over subjective assessment of the disease, especially in patients ignoring or not noticing symptoms of increasing bronchial obstruction, or in patients with significant levels of anxiety, who have a feeling of airway obstruction even when it is not the case. In such patients, a treatment plan based only on symptom control may result in treatment commencement either too late or too early. Forty per cent of patients from our study were in possession of a PEF meter. There was, however, no correlation between possessing of a PEF meter and ACT score. It may be that they were not performing measurements of PEF systematically, as only every third owner of PEF meter was able to give his or her best PEF result.

Our questionnaire, developed for the purposes of this study, provided a great deal of information about asthma patients and allowed us to determine factors that might be modified in order to improve control of the disease. At the same time it indicated the need for medical staff to propagate the idea of training courses among patients, to help them to understand disease-related problems and to improve the efficacy of the treatment in that way.

The issue, which is still open, concerns the way of reaching patients and encouraging them to participate in educational courses. It is interesting how few patients had participated in such courses, and how many declared the need for it. Books, booklets, and the Internet cannot replace direct information exchange. The aim of the training is to show that achievement of full disease control is possible and to teach how to eliminate factors worsening the course of the disease. The statement that 'an asthma patient who knows more lives longer and better' is really obvious [20].

## Conclusions

1. There was a significant discrepancy between subjective patients' assessment of the level of asthma control and ACT score (patients indicated better disease control than was given by ACT) in the studied group.
2. The frequency of infective exacerbations and hospitalisations was in better agreement with

- the ACT score than the patients' self-assessment.
- Uncontrolled (according to ACT score) asthma occurred significantly more frequently in older patients and those with longer duration of the disease.
  - There was a tendency towards higher BMI and higher number of comorbidities in patients with uncontrolled asthma in comparison to the others.
  - Flu vaccination was related to better asthma control, probably due to prevention of infective exacerbations.

### Conflicts of interest

There is no conflict of interest related to this article to declare, neither in the form of financial relation, personal relation nor in the form of academic competition. There was no sponsorship involved.

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**Attachment 1. Questionnaire**

Sex:	Age:	Body weight:	Body height:
Q. 1. When did you notice attacks of breathlessness for the first time?			
Q. 2. When was your asthma diagnosed?			
Q. 3. For how long have you been on treatment for asthma?			
Q. 4. Who supervises your asthma treatment?			
Q. 5. What asthma medications are you on?			
Q. 6. Do you suffer from any other chronic conditions? (since when?)			
Q. 7. Are you on medication for any other chronic conditions?			
Q. 8. Do you know how well your asthma is controlled?			
<input type="checkbox"/> I do not know <input type="checkbox"/> yes I do, it is well controlled <input type="checkbox"/> yes I do, it is partly controlled <input type="checkbox"/> yes I do, it is uncontrolled			
Q. 9. How many times over the last two years have you:			
<input type="checkbox"/> had a routine doctor’s appointment? <input type="checkbox"/> had asthma exacerbations? What triggered them? <input type="checkbox"/> stayed in hospital because of your asthma? <input type="checkbox"/> been off sick from your work due to asthma?			
Q. 10. Have you ever had skin tests performed?			
Q. 11. Do you have your own PEF meter?			
Q. 12. Do you check your PEF at home?			
Q. 13. Do you know your best PEF reading?			
Q. 14. When pregnant, have you noticed that your asthma:			
<input type="checkbox"/> deteriorated <input type="checkbox"/> improved <input type="checkbox"/> did not change?			
Q. 15. During menstruations does your asthma:			
<input type="checkbox"/> deteriorate <input type="checkbox"/> improve <input type="checkbox"/> not change?			
Q. 16. Do/did your parents suffer from asthma?			
Q. 17. Have you tried to find more information about asthma?			
<input type="checkbox"/> no, I have not <input type="checkbox"/> yes, I have read books about asthma <input type="checkbox"/> yes, I have participated in an educational project <input type="checkbox"/> yes, I have searched the Internet for information <input type="checkbox"/> yes, other sources:			
Q. 18. Have your family tried to find information about asthma?			
Q. 19. Could you indicate the months or season of the year when your asthma becomes the most troublesome?			
Q. 20. Have you ever smoked cigarettes?			
How many cigarettes per day?			
For how long?			
When did you stop?			
Q. 21. Do you have smoking persons around you?			

### **Attachment 1. Questionnaire**

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Q. 22. Have you ever noticed:

- chronic cough? no/yes (since when?)
- impairment of exercise tolerance? no/yes (since when?)
- heartburn; no/yes (since when?)
- an unpleasant taste in your mouth? no/yes (since when?)

Q. 23. Have you ever been diagnosed with:

- gastroesophageal reflux? no/yes (when?)
- nasal polyps? no/yes (when?)
- allergy to aspirin or other analgesics? no/yes

If so please give the name of the medication and describe the adverse reactions that it caused:

Q. 24. Where do you live?

- town ? countryside

Q. 25. What do you do for living?

Q. 26. Do you keep pets at home? what pet? since when?

Q. 27. How many times a month is your house cleaned?

Q. 28. What is your diet like?

- my diet is healthy, I eat fruit and vegetables every day
- I try to eat healthily, but sometimes I buy ready-made food
- my diet consists mostly of ready-made food

*How many times during the week do you eat dairy products (cottage cheese, milk, yogurt)?*

Q. 29. Do you exercise?

Q. 30. Do you have a flu vaccination every year?

Q. 31. Did your parents smoke cigarettes when you were a child?

Q. 32. Do you have siblings?

Q. 33. Were you born prematurely?

Q. 34. Were you breastfed as a child?

Q. 35. Did you attend nursery or kindergarten as a child?

Q. 36. Were you of poor health as a child?

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