

Anxiety, Depression, and Asthma Control: Changes After Standardized Treatment



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What is already known about this topic? Anxiety and depression are prevalent in patients with asthma and are associated with greater frequency of exacerbations, increased use of health care resources, and poor asthma control.

What does this article add to our knowledge? Our study confirms that anxiety and depression are independent risk factors for poor asthma control. One novel finding is that under specialist supervision, there were significantly improved levels of anxiety and depression, asthma control, and FEV₁.

How does this study impact current management guidelines? In patients with moderate to severe asthma, regular specialist care improves many asthma outcomes frequently affecting these patients, including symptoms of anxiety and depression.

BACKGROUND: It has been documented that anxiety and depression are prevalent in patients with asthma and are associated with greater frequency of exacerbations, increased use of health care resources, and poor asthma control.

OBJECTIVE: To examine the association of asthma diagnosis with symptoms of depression/anxiety and asthma control not only at baseline but also over a 6-month period of specialist supervision.

METHODS: We enrolled 3182 patients with moderate to severe asthma. All were evaluated with spirometry, the Asthma Control Test, and the Hospital Anxiety and Depression Scale at baseline and at 6 months. Treatments were decided by specialists according to published guidelines.

RESULTS: At baseline, 24.2% and 12% of the patients were diagnosed with anxiety and depression, respectively, according to the Hospital Anxiety and Depression Scale. After 6 months, anxiety and depression improved, affecting 15.3% and 8.1% of patients,

respectively ($P < .001$); mean FEV₁ and asthma control also improved (FEV₁ from $81.6\% \pm 20.9\%$ to $86\% \pm 20.8\%$; Asthma Control Test score from 15.8 ± 4.7 to 19.4 ± 4.4 ; both $P < .001$). Patients with anxiety and depression used significantly more health care resources and had more exacerbations. A multivariate analysis showed that patients with anxiety, depression, and lower FEV₁ (odds ratio, 0.20, 0.34, 0.62, respectively; $P < .001$) were independently associated with poor asthma control. A multiple linear regression analysis showed that anxiety had a nearly 4-fold greater influence over asthma control than depression ($0.326/0.085 = 4.075$).

CONCLUSION: Under standardized asthma care and after a specific visit with the specialist, patients present significant improvement in these psychological disorders and exhibit better asthma control and functional parameters. © 2018 American Academy of Allergy, Asthma & Immunology (J Allergy Clin Immunol Pract 2018;6:1953-9)

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Abbreviations used

ACT- Asthma Control Test
FVC- Forced vital capacity
GEMA- Spanish asthma guidelines
GINA- Global Initiative for Asthma
HADS- Hospital Anxiety and Depression Scale

Key words: Asthma; Depression; Anxiety; Asthma control; Asthma exacerbations; Health care resources

INTRODUCTION

Observational epidemiological studies in different patient populations have consistently documented that anxiety and depression are prevalent in patients with asthma and are associated with greater frequency of exacerbations, increased use of health care resources, and poor asthma control.¹⁻⁸ Emotional factors such as stress, hostility, and negativity can be aggravating factors in the pathogenesis and evolution of asthma.⁹⁻¹³ In addition to these findings, multiple epidemiological studies show that patients with asthma and other respiratory conditions have greater psychiatric comorbidity than the general population.¹⁴⁻¹⁷

From a clinical perspective, it is essential to provide patients with asthma with optimal medical care, including treatment of possible psychiatric disorders, because accurate diagnosis of anxiety/depression and effective treatment of these disorders can improve disease outcomes. Given that some asthma symptoms can mimic those accompanying anxiety disorders, patients with asthma sometimes experience cognitive reactions that can lead to anxiety, especially among the so-called hyper-perceivers.^{1,4-9,11,13-16} As a result, patients with asthma may have a higher incidence of anxiety disorders than the general population. Nevertheless, patients with asthma who are aware that they have an anxiety disorder may mistakenly perceive genuine asthma symptoms as symptoms of anxiety. Such inaccuracies in the perception of symptoms have consequences

that are detrimental to the health and empowerment of the patient. In addition, there is a link between perceptual inaccuracy in the symptoms of asthma and inappropriate use of medication, overuse of health services, and mortality.¹⁸ It has also been found that psychiatric diagnoses were associated with a greater perceived impairment of asthma, but not with an objective measurement of lung function.³ Mechanistic research in this area has been focused on the effect of asthma pathophysiology on the activity of the hypothalamic-pituitary-adrenal axis and the autonomic nervous system¹⁹ as well as the effect of psychosocial stress that may induce allelic variation in genes that regulate stress responses.²⁰

To date, however, the course of psychiatric pathology has not been evaluated after diagnosis and follow-up by the respiratory specialist.

Our study aimed to explore the relationship between asthma control and these 2 psychological disorders in a Spanish population, and also to measure changes over a 6-month period of specialist treatment according to standardized asthma guidelines.

METHODS**Study subjects**

Patients with a previous diagnosis of moderate to severe asthma presenting to a specialist clinic (pulmonology/allergy) for the first time were included in the study. Diagnosis was confirmed by specialists in agreement with the Spanish asthma guidelines (GEMA), including asthma symptoms and reversible airflow limitation.²¹ All patients were referred from primary care centers (no self-referrals), because the Spanish health system does not allow for patients to present for specialist care without a referral. Management of patients followed the GEMA guidelines, which closely resemble the Global Initiative for Asthma (GINA) guidelines.²² Treatment was decided independently of the Hospital Anxiety and Depression Scale (HADS) results. Antiasthmatic medications were prescribed by the National Health System. In Spain, these medications are reimbursed nearly in full.

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Patients not receiving the standard care established in the GEMA guidelines, patients with alcohol or drug abuse, women who were pregnant or breast-feeding, and patients with severe chronic comorbidities (malignancies, severe chronic renal or hepatic failure, or active autoimmune diseases) were excluded from the study.

The patients first visited the specialist, with 2 follow-up visits. Sociodemographic data including smoking and literacy were obtained at baseline. Spirometry was performed at baseline and at 6 months.

Severe exacerbations (use of oral steroids >3 days and/or treatment in the emergency department and/or hospitalization for asthma) during the study were recorded at months 3 and 6.

Use of health resources (visits to emergency departments, hospital admissions, and extra visits for nursing or primary care or specialist treatment) was measured by medical interview and by analyzing medical records at the conclusion of the study.

Recruitment of patients was carried out from March to September 2015. The study protocol was approved by all ethics committees from the participating medical centers and by the health authority of Spain. All patients gave written informed consent before being included.

Measurement of asthma control, anxiety, and depression

Asthma control was measured with the validated Spanish version of the Asthma Control Test (ACT).²³ Asthma severity according to the GINA guidelines was also recorded by physicians.²²

To screen for mood and anxiety symptoms, we used the validated Spanish version of HADS.^{24,25} For the anxiety subscale, a score of 0 to 7 points was considered no anxiety, 8 to 10 points borderline anxiety, and more than 10 points anxiety. For the depression subscale, 0 to 7 points was considered no depression, 8 to 10 points borderline depression, and more than 10 points depression. Physicians were not blinded to these results, but treatment was decided independently of the HADS results. All patients were required to complete the ACT at baseline and at months 3 and 6 and were administered the HADS questionnaire at baseline and at month 6.

Use of health care resources was evaluated on the basis of the occurrence of extra visits to primary care physicians, specialists, and nurses and also hospitalizations due to asthma.

Statistical analysis

Continuous data were described as mean and SD. The *t* test or the Mann-Whitney *U* test was used to compare 2 means. Continuous variables were compared using the *t* test and ANOVA or the Kruskal-Wallis test. For comparison of quantitative variables at 2 points in time, a paired *t* test or the Wilcoxon test was used, and the McNemar test was used for qualitative variables. Qualitative variables (independent samples) were compared using chi-square analysis or the Fisher exact test. Correlation coefficients were calculated by the Pearson test, assuming normal distribution of the sample because of the large number of patients. The following quantitative variables were analyzed as discrete categories in logistic regression:

1. Age (1: ≤60 years vs 2: >60 years);
2. Baseline depression (1: normal [≤10] vs 2: disease [>10]);
3. Depression, month 6 (1: normal [≤10] vs 2: disease [>10]);
4. Baseline anxiety (1: normal [≤10] vs 2: disease [>10]);
5. Anxiety, month 6 (1: normal [≤10] vs 2: disease [>10]);
6. FEV₁% baseline (0: ≥80% vs 1: <80%); and
7. FEV₁%, month 6 (0: ≥80% vs 1: <80%).

There were other continuous variables that were analyzed as discrete categories for some analyses (ACT score <20 [uncontrolled] vs ACT score ≥20 [well-controlled], anxiety ≥11, anxiety >8, depression ≥11, and depression >8).

Two logistic regression models were used. A bivariate analysis was performed first, followed by a multivariate analysis with the statistically significant variables obtained in bivariate analysis.

To evaluate which factors were associated with good asthma control, a multivariate logistic regression analysis was carried out, taking ACT score of 20 or more at baseline and at month 6 as dependent variables (1: well-controlled vs 0: uncontrolled). The independent variables were as follows:

1. Age (1: ≤60 years vs 2: >60 years);
2. Sex (1: male vs 2: female [>60 years]);
3. Depression, baseline (1: normal vs 2: disease);
4. Anxiety at baseline (1: normal vs 2: disease);
5. Smoking habit (1: smoker vs 2: ex-smokers vs 3: nonsmokers [reference: nonsmoker]);
6. Literacy (1: illiteracy vs 2: read and write vs 3: primary school vs 4: secondary school vs 5: university education [reference: illiteracy]); and
7. FEV₁%, baseline (0: ≥80% vs 1: <80%).

We used a multivariate model to determine which factors may influence the magnitude of change in ACT score. Change in ACT score (month 6 vs baseline) was used as a dependent variable, whereas the independent variables were depression scale change (baseline vs month 6), change in anxiety scale value (baseline vs month 6), sex, age, smoking, level of education, and baseline FEV₁.

Another multivariate linear regression analysis (including variables that reached a significance <.20, because although in the bivariate analysis they did not reach statistical significance, in a multivariate analysis they could acquire statistical significance) was performed to investigate whether the change in depression or anxiety scores influenced asthma control (calculated as “changes” from the continuous variables—anxiety, depression, and ACT scores between baseline and month 6), and the additional significance that the aforementioned factors may have.

Statistical significance was set at a *P* value of less than .05. All statistical analyses were conducted using SPSS version 22.0 (IBM Corporation, Armonk, NY).

RESULTS

A total of 3182 patients were included in the study. Table I presents the sociodemographic characteristics and outcomes at baseline and at 6 months. One hundred eighty-three patients were lost throughout the study. Causes of dropout were as follows: 136 lost to follow-up, 9 for retraction of informed consent, impossibility of follow-up by the investigator in 23, 1 death not due to asthma, and other causes in 14.

At baseline, males had a statistically significant lower FEV₁% and FEV₁/forced vital capacity (FVC) ratio than did females (*P* < .001; chi-square, both). However, females had significantly worse asthma control according to the ACT and GINA criteria (*P* < .01; both). There was no statistical difference between males and females in GINA asthma severity criteria. Asthma control as measured by ACT or GINA criteria was not influenced by age or duration of asthma. ACT-determined asthma control was associated with level of education (*P* < .001), marital

TABLE I. Sociodemographic characteristics and outcomes at baseline and at 6 mo

Characteristic	Baseline	Visit, 3 mo	Visit, 6 mo (final)	P value (baseline vs month 6)
Sociodemographic data				
Age, mean $\pm$ SD	46.8 $\pm$ 16.7	—	—	—
Sex, female, n (%)	1,948 (61.2)	—	—	—
Illiteracy, n (%)	13 (0.4)	—	—	—
Only read and write, n (%)	253 (7.9)	—	—	—
Primary school education, n (%)	823 (25.9)	—	—	—
Secondary school education, n (%)	1,008 (31.7)	—	—	—
University education, n (%)	1,086 (34.1)	—	—	—
Clinical data				
Smoking habit, n (%)	—	—	—	—
Smoker	391 (12.3)	—	—	—
Ex-smoker	757 (23.8)	—	—	—
Nonsmoker	2,035 (63.9)	—	—	—
Years of asthma, mean $\pm$ SD	7.6 $\pm$ 9.6	—	—	—
Asthma severity, n (%)	—	—	—	—
Moderate	2,577 (81.0)	—	85%	<.001*
Severe	605 (19.0)	—	15%	<.001*
Number of exacerbations in the last 6 mo, mean $\pm$ SD	—	—	2.3 $\pm$ 1.8	—
Asthma control and FEV₁				
ACT score, mean $\pm$ SD	15.8 $\pm$ 4.7	19.3 $\pm$ 4.2	19.4 $\pm$ 4.4	<.001†
Patients well controlled (ACT score $\geq$ 20), n (%)	785 (24.7)	1,700 (55.6)	1,667 (57.5)	<.001*
Well-controlled GINA, n (%)	297 (9.3)	1,047 (34.2)	1,255 (57.4)	<.001*
Partially controlled GINA, n (%)	1,035 (32.5)	1,255 (41.1)	662 (22.8)	<.001*
Not controlled GINA, n (%)	1,850 (58)	1,255 (24.7)	572 (19.7)	<.001*
FEV ₁ %, mean $\pm$ SD	81.6 $\pm$ 20.9	—	86 $\pm$ 20.8	<.001†
FEV ₁ /FVC <70%	1,344 (42%)	—	911 (31.4%)	<.001*
HADS questionnaire				
Anxiety subscale, mean $\pm$ SD	7.1 $\pm$ 4.3	—	5.9 $\pm$ 4.2	<.001†
Anxiety (score $\geq$ 11)	769 $\pm$ 24.2	—	445 $\pm$ 15.3	<.001*
Anxiety + borderline anxiety (score $\geq$ 8)	1,423 $\pm$ 44.7	—	1,005 $\pm$ 34.6	<.001*
Depression subscale, mean $\pm$ SD	5.2 $\pm$ 4.1	—	4.4 $\pm$ 4.0	<.001†
Depression (score $\geq$ 11)	373 $\pm$ 11.7	—	234 $\pm$ 8.1	<.001*
Depression + borderline depression (score $\geq$ 8)	975 $\pm$ 30.6	—	713 $\pm$ 24.6	<.001*
Global HADS, mean $\pm$ SD	12.4 $\pm$ 7.8	—	10.3 $\pm$ 7.6	<.001†

*McNemar test.

†Wilcoxon test.

status ($P < .05$), smoking ($P < .001$), asthma severity ($P < .0001$), lower FEV₁ ($P < .001$), and lower FEV₁/FVC ratio ($P < .001$).

Depression, anxiety, and correlation with the ACT

HADS global score decreased from 12.4 $\pm$ 7.8 to 10.3 $\pm$ 7.6, that is, more than the minimal important difference for this scale (1.5 points).²⁶ At baseline, females had a mean score of 11.9 $\pm$ 2.7 on the subscale of anxiety, and the score among males was 12.2 $\pm$ 2.6 ($P < .005$); there was no difference observed in the depression subscale ($P = .293$). However, there were significantly more females than males who had more than 10 points in the subscale of anxiety and depression ($P < .01$ and $P < .05$, respectively). One important finding is that significant ($P < .001$) negative correlations were found between ACT scores and subscale scores of anxiety and depression, not only at baseline but also at 6 months (Table I). ACT scores increased more

than 3 points at 3 and 6 months, which is greater than the 3-point minimally important difference.²⁷

We found statistically significant ($P < .001$) negative correlations between ACT scores and subscale scores of anxiety and depression at baseline and at month 6 as well as the number of exacerbations during the study (Table II). Significant positive correlations were obtained for the number of exacerbations during the study and anxiety and depression scores.

At baseline, depression was significantly associated with females ($P = .008$), age of more than 60 years ($P < .001$), and smoking ($P < .001$); after 6 months of treatment, depression was associated with age of more than 60 years ($P < .002$) and current smoking ($P < .001$).

At baseline and at month 6, anxiety was significantly associated with females ($P < .001$), age of more than 60 years ($P = .001$), and current smoking ($P < .001$).

Anxiety and depression were not independent variables at baseline or at 6 months ($P < .001$), and a bivariate correlation

TABLE II. Pearson correlation coefficient 2-tailed *P* values for different variables

Variable	Depression score at baseline	Anxiety score at month 6	Depression score at month 6	ACT score at baseline	ACT score at month 3	ACT score at month 6	Exacerbations in last 6 mo
Anxiety score at baseline	.708	.678	.539	-.477	-.373	-.390	.295
	.000	.000	.000	.000	.000	.000	.000
Depression score at baseline		.535	.653	-.447	-.389	-.388	.315
		.000	.000	.000	.000	.000	.000
Anxiety score at month 6			.732	-.334	-.443	-.553	.368
			.000	.000	.000	.000	.000
Depression score at month 6				-.323	-.427	-.489	.361
				.000	.000	.000	.000
ACT score at baseline					.475	.467	-.283
					.000	.000	.000
ACT score at month 3						.640	-.490
						.000	.000
ACT score at month 6							-.464
							.000

TABLE III. Multivariate analysis of characteristics related to asthma control at baseline and at month 6

Characteristic	Odds ratio (95% CI)	<i>P</i> value
Depression at baseline	0.354 (0.231-0.545)	<.000
Depression at month 6	0.533 (0.375-0.760)	<.001
Anxiety at baseline	0.201 (0.148-0.272)	<.000
Anxiety at month 6	0.269 (0.203-0.356)	<.000
FEV ₁ <80% at baseline	0.628 (0.530-0.744)	<.000
FEV ₁ <80% at month 6	0.388 (0.327-0.492)	<.000

grid showed a significant correlation between anxiety and depression (Table II).

Multivariate analysis of poorly controlled asthma (ACT score <20)

Multivariate logistic regression was performed after a bivariate analysis showed that depression, anxiety, and lower FEV₁ were risk factors associated with poor asthma control as evaluated by ACT at baseline and at month 6 (Table III).

Table IV presents the statistically significant differences found between the different parameters analyzed (ie, anxiety, depression, age, sex, smoking, ACT, pulmonary function test, use of health care resources, exacerbations, and asthma severity). Patients with depression and anxiety at baseline had a higher number of exacerbations than patients without these baseline conditions. At month 6, patients with depression and anxiety had a greater number of exacerbations than patients without depression or anxiety. Ex-smokers had a greater number of exacerbations than nonsmokers. Patients with FEV₁% less than 80% at month 6 had a greater number of exacerbations than patients with FEV₁% more than 80%.

The only 2 variables that reached statistical significance and thus qualified as modifiable risk factors associated with the main effect “change in ACT score” were change in anxiety and change in depression (Table V). In addition, when anxiety and depression improved, the effect associated with improvements in anxiety was 4 times greater than the impact of depression ($0.326/0.85 = 4.075$), as presented in Table V.

DISCUSSION

In our population of patients with moderate to severe asthma, anxiety symptoms were common and associated with poorer asthma control, as previously described.²⁶ As a novel contribution, this study shows that after 6 months of specialist care, a significantly lower number of patients had anxiety and depression, more patients had well-controlled asthma, severe asthma was less prevalent, and an improvement in FEV₁ had occurred.

We found that the overall prevalence of probable anxiety as measured by the HADS questionnaire was higher among adults with moderate to severe asthma compared with the general population in Spain, where the prevalence is 9.4%.²³ However, depression prevalence was similar to that in the general population in Spain (11.5%).²⁵ Contrasting with our results, some studies have found a higher prevalence of depression among patients with asthma, with others noting greater prevalence of anxiety among these patients.²⁸⁻³⁰

A previous study of patients with asthma in Spain found that 32% had anxiety and 14% had depression.³¹ A comparison with nearby countries with similar sociodemographic characteristics reveals that depression affects 21% of patients with asthma in Portugal, 12% (9.3% severe depression) in France, and 11% (5.9% severe depression)^{31,32} in Italy, where anxiety was reported in 36.9% of patients with asthma.³³ In this last study, the authors used essentially the same measures as in the present work and found the same associations, although the research in Italy was limited to cross-sectional data.

Anxiety and depression were significantly associated with poor asthma control. Significant ($P < .001$) negative correlations were found between ACT scores and subscale scores of anxiety and depression not only at baseline but also at 6 months.

A multivariate analysis showed that depression and anxiety were independent risk factors associated with poor asthma control as evaluated by ACT at baseline and at 6 months together with a lower FEV₁; these findings are in accordance with many other studies.^{1,4-6,34} Changes in anxiety and depression control play a significantly positive role; better control of anxiety and depression (as measured by the corresponding questionnaires) was associated with better control of asthma (as measured by the

TABLE IV. Statistically significant differences ($P < .05$) between different clinical and functional parameters

Parameter	Anxiety		Depression		ACT score <20		FEV ₁ /FVC <70%		Age >60 y		Females		Smoking
	Bas	M6	Bas	M6	Bas	M6	Bas	M6	Bas	M6	Bas	M6	M6
Pulmonary function tests													
Lower FEV ₁	*		†	*			†	†					
FEV ₁ /FVC <70%	†	†	†	†									
Use of health care resources													
Visits to primary care physicians	†	†	†	†	†		†		†				
Visits to specialist physicians	†				*	†			*		†		
Visits to primary care nurses		†		†									
Visits to emergency wards				*	†	*					*		
Hospitalizations due to asthma		†		*								†	
Exacerbations (number)							†	†	†				*
Severe asthma							†	†		*			*

Bas, Baseline; M6, month 6.

* $P < .01$.† $P < .001$.‡ $P < .05$.**TABLE V.** Statistically significant modifiable risk factors associated with changes in asthma control (ACT score) (multivariate analysis)

Multivariate linear regressions dependent variable: change in the ACT score in the last 6 mo	Nonstandardized coefficients		Typified coefficients		95% CI for B
	B	Student's t test value	Beta	Significance	
Change in anxiety	0.452	0.029	0.326	.000	0.396-0.508
Change in depression	0.120	0.029	0.085	.000	0.063-0.176

Note: Variables that were included in the model but not significant: age, sex, baseline severity level, baseline FEV₁%, and smoking habit; 2,901 patients were included in this analysis.

ACT questionnaire). When both anxiety and depression are improved, the effect exerted by improvements in anxiety is approximately 4 times greater than the impact of depression ($0.326/0.085 = 4.075$), as presented in Table V. This would mean that, for example, a 10-point improvement in the anxiety control score would result in an average ACT score increase of 4.5 points.

Interestingly, other variables such as bronchial obstruction, severe exacerbations, and use of health care resources were influenced by depression and anxiety. Throughout the study, FEV₁ or FEV₁/FVC was significantly lower in patients with depression and anxiety. The number of severe exacerbations, visits to emergency departments, hospitalizations, and use of other health care resources were significantly higher in patients with anxiety and depression.

All these findings strongly support the influence of anxiety and depression on asthma control. Asthma control was significantly associated with lower education, marital status, females, smoking, asthma severity, lower FEV₁, and lower FEV₁/FVC ratio ($P < .001$), as has been previously described.³⁵

The major strength of our study and its source of novelty stem from the fact that we measured different variables after 6 months of care by specialists who followed asthma guidelines. At the end of the study, a significantly lower number of patients had anxiety and depression, more patients had well-controlled asthma, an improvement was seen in FEV₁, and severe asthma was less prevalent. However, the magnitude of the decrease in the number of patients with severe asthma likely limits the clinical relevance of this finding ($P < .001$ for all parameters). In addition, significant inverse correlations between anxiety or

depression and ACT scores were maintained throughout the study. The influence of psychological disorders and asthma control may be bidirectional, although because no intervention has been carried out using psychiatric drugs, and given that all patients received standardized asthma treatment, we can speculate that asthma control improves depression and anxiety symptoms in patients with asthma. The relative influence of the different components of interventions applied during the study—such as correct medication dose and inhalation technique, better compliance, and application of asthma exacerbation action plans—is difficult to isolate. Also, it is likely that patients are more positive and optimistic when facing the challenge of disease while under specialist care, because in doing so they may achieve the most optimal asthma control.

The underlying biological mechanisms of psychological factors and asthma are largely unknown. Some studies have hypothesized roles played by neuroimmunomodulatory mechanisms such as altered regulation of the hypothalamic-pituitary-adrenal axis and the sympathetic-adreno-medullary nervous system, with the subsequent change in levels of neurohormones^{19,36} and changes induced by stress.²⁰

A potential limitation of this study is the use of the HADS questionnaire as the only means of measuring the presence of anxiety and depression, because this tool may have limited reliability and cannot be taken as a definitive diagnosis. However, both the validity and accuracy of these instruments were tested in Spanish and other populations. Inclusion of a large number of patients ($n = 3,000$) from many asthma clinics reduces the risk of selection bias and makes our results generalizable.

CONCLUSIONS

Our study highlights the high prevalence of anxiety and depression symptoms in patients with poorly controlled asthma and confirms these as independent risk factors for poorer asthma control together with low pulmonary function. Anxiety and depression also affect other asthma outcomes.^{37,38} Patients with asthma under the supervision of a specialist exhibit significantly improved levels of anxiety and depression, obtain better asthma control, and demonstrate an improvement in FEV₁. Nevertheless, further studies in other countries are required to establish a relationship between specialist care and improvement in anxiety and depression among patients with moderate to severe asthma.

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