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Factors associated with generic health-related quality of life in adult asthma patients in Germany: Cross-sectional study

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ABSTRACT

Objectives: Given a 9% lifetime prevalence of asthma in Germany and the impairment of health-related quality of life (HRQOL) that goes along with it, it is important to understand parameters affecting HRQOL in asthma patients. Objective of this study was therefore to determine factors associated with generic HRQOL in asthma patients. **Methods:** Data for cross-sectional analyses were obtained from the baseline of an ongoing cohort study. Inclusion criteria: physician-diagnosed asthma; age ≥ 18 years; disease duration ≥ 3 months; no acute psychiatric/neurological disease; sufficient knowledge of German. HRQOL was assessed by the Short Form 12 Health Survey Questionnaire (SF-12), which comprises a physical (PCS-12) and a mental component (MCS-12). Information on a broad range of parameters potentially influencing HRQOL was collected by examining the patients' medical records and via a self-administered questionnaire. Those parameters were of socio-demographic, disease-specific, treatment-related or psychosocial nature. We conducted multivariable linear regression analyses to assess determinants of HRQOL. **Results:** In total, 196 asthma patients participated in the study (mean age: 48 years (range: 18–90); 60.2% females). In multivariable analysis, PCS-12 was negatively associated with older age, being female, insufficient disease control, higher number of medications in tablet form and reporting symptoms of depression. MCS-12 was negatively associated with being female, living alone, insufficient disease control, and reporting symptoms of anxiety or depression. **Conclusions:** Focusing on disease control and screening for depression and anxiety may be promising approaches to improve HRQOL in adult asthma patients. If a patient shows alarming symptoms of anxiety and/or depression, the patient should then be referred for psychiatric treatment.

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Introduction

Asthma is a quite common respiratory disease with prevalences ranging in European countries from 1.6% in Romania to 7% in France among adolescents and adults aged 15 years and above [1]. Approximately 9% of the adult general population in Germany have been diagnosed with asthma at some point of lifetime [2]. Asthma disease is characterized by a chronic inflammation of the lower respiratory tract [3]. As a rule, the obstruction of air-flow is reversible in asthma. However, irreversible airflow obstruction has been described [4]. Leading symptoms of asthma are recurrent wheezing, coughing, tightness of chest and shortness of breath [1].

When comparing health-related quality of life (HRQOL) in asthma patients with persons without asthma, a significantly lower physical and mental HRQOL has been observed [5]. Recent publications concerning chronic respiratory illnesses have therefore concluded

that measuring HRQOL in addition to traditional lung function parameters is vital in patients suffering from asthma [6, 7].

HRQOL is related to the part of the quality of life that is determined by health, whereas quality of life in general “conveys an overall sense of well-being, including aspects of happiness and satisfaction with life as a whole” [8]. The instruments used to assess the quality of life can be roughly divided into two categories. Disease-specific instruments query specific aspects of a particular disease. Generic instruments, such as the Short Form 12 Health Survey Questionnaire (SF-12; [9]) used in this study, measure the overall health status in a generic way.

Clinically, the assessment of HRQOL is, however, only of benefit if we know which factors are associated with the outcome. There are quite a few studies investigating the determinants of HRQOL in patients with asthma (e.g. [6, 7, 10–23]). While most of these studies use

asthma-specific instruments such as the Asthma Quality of Life Questionnaire (AQLQ; [24, 25]), generic instruments are scarcely utilized for assessing HRQOL in patients with asthma. The latter have the major advantage that they allow comparisons between patients with different diseases and with the general population. The generic instrument SF-12 is widely used for a broad range of diseases and is well-validated (e.g. [26]). With regard to the assessment of HRQOL in individuals with asthma, however, the SF-12 has been used only in two previous studies [15, 22] to our knowledge.

Regarding the determinants of HRQOL in patients with asthma studies have shown divergent results. In some studies, older age, for instance, was associated with reduced HRQOL (e.g. [6, 23]) and in others with increased HRQOL (e.g. [7]). Several studies consider only selected factors, like asthma control, age, sex, socioeconomic status, or other sociodemographic parameters in individuals with asthma (e.g. [14, 23, 27]). In further studies, the role of depression was examined (e.g. [28–30]).

We identified only one study investigating HRQOL in adult asthma patients living in Germany [15]. The focus of this small study ($n = 88$) by Kulowatz et al. was, however, to explore whether depression specifically is associated with quality of life when effects of anxiety are controlled for. Despite the high lifetime prevalence of asthma in Germany [2] and a large population of approximately 82 million cross-sectional and longitudinal studies investigating a broad range of parameters from different domains potentially associated with HRQOL in individuals with asthma were lacking up to the present day.

The objective of our study was therefore to identify factors potentially associated with generic health-related quality of life in patients with asthma in Germany.

Methods

Study design and study population

Data for cross-sectional analyses were obtained from the baseline of an ongoing prospective patient cohort study. The main objective of the cohort study is to determine the influence of beliefs about medicines on adherence in patients with asthma or COPD. The current cross-sectional study examined only patients with asthma as main diagnosis. The cohort study has two follow-up points (after 3 and 12 months). The study population comprises patients from primary care and specialist practices as well as hospital in- and outpatients. The heterogeneous settings were chosen in order to sample patients with a broad range of disease severity. The study is being conducted in the Regensburg region in the German federal state of Bavaria (~12.7 million inhabitants;

[31]). Data for the baseline survey were collected from June 2013 until December 2014. Patients with asthma as main diagnosis ascertained by a physician were asked at the respective study site whether they wanted to take part in the study or not. Inclusion criteria for enrollment into the study were: age ≥ 18 years, disease duration ≥ 3 months, no acute psychiatric/neurological disease (exception: depression or other affective disorder), and sufficient knowledge of the German language. Informed consent to participate was obtained from all patients. The questionnaire was filled in on-site by the patients after a short introductory explanation.

Definition of variables

Health-related quality of life (dependent variable)

HRQOL was measured by means of the Short Form 12 Health Survey Questionnaire (SF-12; [9]). The SF-12 is a short version of the SF-36 [32] and explains the majority of its variance (80–85%). Two different scores can be derived from the SF-12: a physical health (PCS-12) and a mental health score (MCS-12). Scores for the two scales were calculated as described by Ware et al. [9]. A range of 0 (worst conceivable quality of life) to 100 (best conceivable quality of life) is hereby possible. For standardization of scale scores we used the German norm sample which has mean values of 50 in both the mental and the physical scale [33].

Independent variables

We aimed to take a broad perspective on variables likely to influence HRQOL and determined a priori we would investigate variables belonging to the domains patient characteristics, disease characteristics, treatment-related factors and psychosocial characteristics.

Patient characteristics

Information was gathered on age, sex, migration background, travel time to practitioner providing care for asthma (in minutes) and on whether the patient lives alone or not. Education levels were generated by taking into account the school education of participants. The structure of the German school system is hierarchical. Basic primary school (grades 1–4) is followed by the secondary general school that covers grades 5–9 or 5–10. Secondary schools (German “Gymnasium”) that cover grades 5–12 (or 5–13, depending on region) qualify for university entrance. For analysis, the level of education was divided into two groups: low education level (no school degree or school leaving diploma after 9 school years) and high education level (school diploma after 10 school years or university entrance diploma).

Disease characteristics

Asthma control was assessed using a shortened version of the Asthma Control Questionnaire (ACQ) [34, 35]. This self-administered questionnaire has seven items in its original form. In this study, we used a validated version with only six items [35]. Each item has seven response categories, ranging from 0 (well controlled) to 6 (extremely poorly controlled). The six ACQ items are equally weighted. The overall ACQ score was therefore obtained by calculating the mean of the six questions. In accordance with other studies (e.g. [36]), the distinction between “well-controlled” and “not well-controlled” asthma was made between a score of >0.75 and a score of ≤ 0.75 . Furthermore, we assessed need for ambulance services due to asthmatic symptoms (“Have you ever called emergency medical services because of your asthma? If yes, how often?”) as an important reflection of disease control. Additionally, the latest forced expiratory volume in 1 second (FEV₁)-value (in % predicted) was obtained from the patient’s medical record. FEV₁-values of $>80\%$ are considered normal [37].

Asthma treatment

Information on the patient’s current medication was also obtained from the medical record. Types of medication were classified into three subgroups: inhaler medication, medication in tablet form and other medication (like intravenous application of corticosteroids). The occurrence of severe side effects due to asthma medication and the number of medical consultations due to asthmatic problems during the last year were assessed via questionnaire.

Psychosocial variables/characteristics

Symptoms of anxiety and depression were measured by means of the Hospital Anxiety and Depression Scale (HADS) [38]. We used the German version [39] with 14 items in two subscales with seven items each. As the name already indicates, the HADS comprises one subscale for anxiety (HADS-A) and one for depression (HADS-D). The scores for both subscales were classified into three categories: not alarming (sum score ≤ 7); marginally alarming (sum score 8–10), and alarming (sum score ≥ 11) [39]. The mean scores of women and men living in Germany are 5.0 and 4.4 for HADS-A and 4.7 and 4.6 for HADS-D, respectively [40].

Statistical analysis

Data analyses were performed using the software package SPSS 22 (SPSS Inc., Chicago, USA). In a first step, descriptive analysis was performed to describe the study population. For this purpose, we calculated mean values

for continuous variables and proportions for categorical variables. All potential determinants were then entered separately in linear regression models with PCS-12 or MCS-12 as dependent variable (= univariate analysis). Finally, multivariable linear regression analysis was used to predict PCS-12 and MCS-12 in patients with asthma. For this purpose each variable with a p value < 0.20 in univariate analysis was entered into the respective initial multivariable model (compare Katz 2011 [41]). The final multivariable models were produced by using manual backward elimination. With regard to multivariable linear regression analysis the significance level was set to a p value of < 0.05 . Standardized regression coefficients (β) and unstandardized regression coefficients (B) as well as 95% confidence intervals (CI) were calculated as appropriate. In case of missing data, respective variables of these patients were not included in the analysis.

Ethics

The study was approved by the ethics committee of Regensburg University on 26 July 2012.

Results

Characteristics of the study population

Patients were recruited in seven different places of which three were practice and four hospital settings. In total, 402 patients diagnosed with COPD or asthma were included in the baseline of the ongoing cohort study. Only participants diagnosed with asthma ($n = 196$) were included in further analyses for this study. The characteristics of the study population are depicted in Table 1. Mean age was 48 years with a broad range from 18–90 years. The proportion of female compared to male patients was higher in our study population (60% vs. 40%). Referred to disease-related factors, the mean FEV₁-value in percent predicted was 89.2%. In total, 29.2% had an FEV₁-value below the benchmark of 80%, indicating obstruction. Mean ACQ score was 1.5. One third (34%) of asthma patients had an ACQ score indicating “not well-controlled” asthma. The number of medications taken in tablet form ranged from zero to 14. On average, patients with asthma consulted their treating physician three times during the last year due to asthmatic problems. Almost one third and 10% of asthma patients had an alarming score in the HADS-A and HADS-D scale, respectively. One asthma patient had a clinically diagnosed depression, none of the patients had a clinically diagnosed anxiety disorder. The mean PCS-12 and MCS-12 score of asthma patients was 46.5 and 44.0, respectively.

Table 1. Characteristics of the study population [individuals with asthma ($n = 196$)].

Characteristics	N	Mean value or absolute number	[Minimum; Maximum] or %
<i>Socio-demographic factors</i>			
Age	196	47.70	[18; 90]
Sex	196		
Male		78	39.8%
Female		118	60.2%
Education level	191		
Low		77	40.3%
High		114	59.7%
Living alone	196	32	16.3%
Having migration background	196	14	7.1%
Travel time to treating physician (in minutes)	193	24.17	[3; 120]
<i>Disease specific factors</i>			
FEV ₁ in % predicted	178	89.19	[26.6; 147]
ACQ	191	1.50	[0; 5.67]
Need for ambulance services due to asthma	192	31	16.1%
Number of comorbidities	196	1.31	[0; 8]
Duration of disease (in years)	184	11.49	[0; 50]
<i>Treatment-related factors</i>			
Number of inhaler medications	195	1.72	[0; 6]
Number of medications in tablet form	195	0.83	[0; 14]
Number of other medications	195	0.10	[0; 4]
Serious side effects due to asthma medication	192	16	8.3%
Change of treating physician since first occurrence of asthma	191	48	25.1%
Number of physician visits during the last 12 months	192	3.04	[0; 14]
Treatment	196		
Outpatient		183	93.4%
Inpatient		13	6.6%
<i>Psychosocial factors</i>			
HADS-A	194	7.41	[0; 17]
Not alarming		109	56.2%
Marginal alarming		31	16%
Alarming		54	27.8%
HADS-D	194	5.23	[0; 21]
Not alarming		127	65.5%
Marginal alarming		48	24.7%
Alarming		19	9.8%
<i>Health-related quality of life (SF-12)</i>			
MCS-12	189	43.97	[12.68; 62.51]
PCS-12	189	46.46	[21.58; 64.34]

Note. ACQ = Asthma Control Questionnaire; FEV₁ = Forced Expiratory Volume in 1 second; HADS-A = Hospital Anxiety and Depression Scale – anxiety scale; HADS-D = Hospital Anxiety and Depression Scale – depression scale; SF-12 = Short Form (12) Health Survey Questionnaire; MCS-12 = mental component of the SF-12; PCS-12 = physical component of the SF-12.

Factors associated with the physical component of HRQOL

Results of univariate and multivariable analyses of factors associated with the physical component of HRQOL (PCS-12) are presented in Table 2. In total, seven asthma patients did not fully complete items belonging to the SF-12 and were therefore excluded from univariate and multivariable analysis. Multivariable analysis identified

worsening disease control (assessed by ACQ) as the factor that showed the strongest significant association with PCS-12 ($\beta = -0.42$). Additionally, increasing age, being female, higher number of medications taken in tablet form as well as reporting symptoms of depression showed significant negative associations with PCS-12. Beta-coefficients ranged between -0.13 and -0.27 . The above-mentioned variables explain 49% of the variance in the PCS-12 variable in the final (reduced) multivariable model (Table 2).

In univariate analyses, significant negative associations were moreover found between PCS-12 and the number of physician visits due to asthmatic problems as well as reporting symptoms of anxiety. A positive association was found between PCS-12 and education level in univariate analysis (Table 2).

Factors associated with the mental component of HRQOL

Results of univariate and multivariable analysis of factors associated with the mental component of HRQOL (MCS-12) are shown in Table 3. In parallel with the findings for the physical component, worsening disease control and reporting symptoms of depression showed significant negative associations with MCS-12. Unlike PCS-12 (see Table 2), MCS-12 was additionally associated with living alone and reporting alarming symptoms of anxiety in a negative manner. Beta-coefficients of significant variables ranged between -0.14 and -0.31 . In total, 33% of the variance in the MCS-12 variable was explained by the remaining variables of the final (reduced) multivariable model (Table 3). Univariate analysis moreover revealed a weak (but significant) positive association between MCS-12 and educational status (Table 3).

Discussion

Our results indicate that having asthma is associated with an impairment of generic HRQOL in adults. The respective mean scores for the physical and mental component of HRQOL in our study were lower than those of the German norm population [33]. We were able to identify several factors associated with generic HRQOL, which varied depending on the examined component of HRQOL. First, our results show that reporting symptoms of depression was associated with both the physical and mental component of the SF-12, while reporting symptoms of anxiety was only associated with the mental component. Second, both HRQOL components were found to be strongly associated with disease control. Third, additional associations were found for female gender, older age and taking

Table 2. Associations between PCS-12 and potential determinants in patients with asthma ($n = 189$): results of univariate and multivariable linear regression analyses.

	Univariate Analysis		Multivariable Analysis			
	B	β	B	β	95% CI (B)	P
Constant			63.53		59.77–67.29	<0.001
<i>Disease-specific factors</i>						
ACQ	– 5.17	– 0.58 **	– 3.79	– 0.42	– 4.82 – –2.77	< 0.001
FEV ₁ in % predicted	0.08	0.16 *				
Need for ambulance services due to asthma						
No (Ref.)						
Yes	– 1.02	– 0.04				
Disease duration (in years)	0.02	0.02				
<i>Socio-demographic factors</i>						
Age (in years)	– 0.31	– 0.48 **	– 0.18	– 0.27	– 0.26 – –0.11	<0.001
Sex						
Male (Ref.)						
Female	– 2.93	– 0.13	– 2.82	– 0.13	– 5.16 – –0.49	0.018
Migration background						
No (Ref.)						
Yes	2.79	0.07				
Living alone						
No (Ref.)						
Yes	– 2.78	– 0.09				
Travel time to treating physician (in minutes)	– 0.001	– 0.002				
Education level						
Low (Ref.)						
High	6.43	0.29 **				
<i>Treatment-related factors</i>						
Number of inhaler medications	0.10	0.01				
Number of medications in tablet form	– 1.94	– 0.35 **	– 0.90	– 0.16	– 1.55 – –0.26	0.006
Number of other medications	0.25	0.01				
Serious side effects due to asthma medication						
No (Ref.)						
Yes	– 3.16	– 0.08				
Change of treating physician since first occurrence of asthma						
No (Ref.)						
Yes	0.66	0.03				
Number of physicians visits during last 12 months	– 1.29	– 0.30 **				
<i>Psychosocial factors</i>						
HADS-A						
Not alarming (Ref.)						
Marginally alarming	– 1.37	– 0.05				
Alarming	– 6.16	– 0.25 **				
HADS-D						
Not alarming (Ref.)						
Marginally alarming	– 4.39	– 0.18 *				
Alarming	– 10.49	– 0.29 **	– 5.40	– 0.15	– 9.32 – –1.48	0.007
$R^2 = 0.49$						

* $p \leq 0.05$; ** $p \leq 0.001$; Ref. = reference category; CI = confidence interval; ACQ = Asthma Control Questionnaire; FEV₁ = Forced Expiratory Volume in 1 second; HADS-A = Hospital Anxiety and Depression Scale – anxiety scale; HADS-D = Hospital Anxiety and Depression Scale – depression scale; PCS-12 = physical component of the Short Form 12 Health Survey Questionnaire (SF-12); MCS-12 = mental component of the SF-12. Bold print = constant (intercept) of the multivariable regression model.

medication in tablet form (physical component) and living alone (mental component), respectively.

Sociodemographic factors

Previous studies concordantly reported that female asthma patients have a lower HRQOL than male patients

(e.g. [11, 16, 42]). Our results are therefore in line with data from literature. One may think of two possible explanations for this finding, namely that female patients with asthma have either a more severe disease than male patients [17] or that they have increased recognition of their symptoms and a higher likelihood of seeking medical care [43, 44]. Because gender differences may have

Table 3. Associations between MCS-12 and potential determinants in patients with asthma ($n = 189$): results of univariate and multivariable linear regression analyses.

	Univariate Analysis		Multivariable Analysis			
	B	β	B	β	95% CI (B)	p
Constant			53.13		49.92–56.33	
<i>Disease-specific factors</i>						
ACQ	– 2.34	– 0.23*	– 1.40	– 0.14	– 2.73 – – 0.08	0.038
FEV ₁ in % predicted	– 0.08	– 0.13				
Need for ambulance services due to asthma						
No (Ref.)						
Yes	2.33	0.07				
Disease duration (in years)	0.12	0.09				
<i>Socio-demographic factors</i>						
Age (in years)	– 0.03	– 0.04				
Sex						
Male (Ref.)						
Female	– 3.94	– 0.16*	– 2.77	– 0.11	– 5.91 – 0.36	0.083
Migration background						
No (Ref.)						
Yes	– 4.34	– 0.09				
Living alone						
No (Ref.)						
Yes	– 5.29	– 0.15*	– 7.96	– 0.22	– 12.36 – – 3.56	<0.001
Travel time to treating physician (in minutes)	– 0.05	– 0.07				
Education level						
Low (Ref.)						
High	4.08	0.16*				
<i>Treatment-related factors</i>						
Number of inhaler medications	– 0.89	– 0.06				
Number of medications in tablet form	– 0.46	– 0.07				
Number of other medications	2.55	0.08				
Serious side effects due to asthma medication						
No (Ref.)						
Yes	– 3.34	– 0.08				
Change of treating physician since first occurrence of asthma						
No (Ref.)						
Yes	– 0.73	– 0.03				
Number of physicians visits during last 12 months	– 0.31	– 0.06				
<i>Psychosocial factors</i>						
HADS-A						
Not alarming (Ref.)						
Marginal alarming	– 11.31	– 0.34 **	– 10.35	– 0.31	– 14.68 – – 6.02	<0.001
Alarming	– 10.15	– 0.36 **	– 5.47	– 0.20	– 9.55 – – 1.39	0.009
HADS-D						
Not alarming (Ref.)						
Marginally alarming	– 5.88	– 0.20 *				
Alarming	– 17.71	– 0.42 **	– 12.22	– 0.29	– 17.93 – – 6.51	<0.001

R² = 0.33

* $p \leq 0.05$ ** $p \leq 0.001$; Ref. = reference category; CI = confidence interval; ACQ = Asthma Control Questionnaire; FEV₁ = Forced Expiratory Volume in 1 second; HADS-A = Hospital Anxiety and Depression Scale – anxiety scale; HADS-D = Hospital Anxiety and Depression Scale – depression scale; PCS-12 = physical component of the Short Form 12 Health Survey Questionnaire (SF-12); MCS-12 = mental component of the SF-12. Bold print = constant (intercept) of the multivariable regression model.

implications for the adequate treatment of asthma, further studies investigating this phenomenon should be conducted.

In our study, older age was significantly associated with a decline in the score of the physical component of HRQOL. The effect of age on HRQOL in asthma patients is discussed controversially in literature [6, 7] and the direction of the effect is not yet fully determined. However, since aging by itself leads to a decrease in lung

function [45], an impairment of HRQOL in the elderly may be assumed.

Moreover, living alone was significantly associated with a lower score in the mental component of HRQOL in our study. Though no studies investigating the relationship between HRQOL and living alone in asthma patients could be identified, the general phenomenon is well described in literature. Several studies have found an association between depression and living alone, not

only among the elderly [46] but also in the working-age population [47]. The same goes for the relationship between anxiety and living alone [48].

Disease control and severity

Most studies examine factors that determine the control of disease in asthma patients. In our study we go a step further by analyzing how disease control affects HRQOL. Disease control was identified as a major determining factor for both the physical and the mental component of HRQOL ($\beta = -0.58$ and $\beta = -0.23$, respectively). Our results therefore corroborate the findings of few previous studies indicating that poorly controlled asthma is associated with a lower HRQOL in adult asthma patients (e.g. [12, 13, 49]). When comparing all determining factors, control of asthma had the strongest influence on PCS-12 in our study. A study by Pereira et al. [9] also found a significant impact of asthma control on HRQOL, even though control of disease and HRQOL were measured by different instruments than the ones used in our study. A cross-sectional study with 5,679 individuals with asthma compared the HRQOL of controlled and uncontrolled asthma patients [50]. The results of the respective study showed that controlled asthma is associated with a higher physical ($B = 5.3$) and mental ($B = 3.9$) HRQOL score than uncontrolled asthma.

Only a univariate association was found between disease severity (measured by means of the FEV_1 in % predicted) and the physical component of HRQOL ($\beta = 0.16$). Our findings are, however, congruent with a prospective cohort study by Hesselink et al. [6], in which no significant association was found between the FEV_1 -value of 380 asthma patients and their HRQOL. The weak association found in this study may assume that objective parameters such as the FEV_1 are important for clinical implications. However, for the HRQOL of individuals with asthma, disease control seems to be of higher relevance.

Psychosocial factors

In our study, the variables *HADS-A* and *HADS-D* together explain the majority of variance in the mental component of HRQOL. Thus they are the most important variables associated with this component. We found a multi-variable association between an alarming *HADS-D* score and the physical component of HRQOL. With regard to the mental component, a marginal alarming *HADS-A* as well as an alarming *HADS-A* affected the outcome negatively in addition to an alarming *HADS-D*. Our findings are in line with Mancuso et al. [29], who enrolled 230 individuals with asthma in a cross-sectional study. In the respective study, asthma patients with fewer depressive symptoms had a better HRQOL than patients with

similar disease severity and higher number of depressive symptoms. Additionally, Afari et al. [28] reported that asthma patients with a comorbid major depression had a lower PCS and MCS than asthma patients without major depression. In a German study by Kullowatz et al. enrolling 88 patients with moderate or severe asthma, depression was associated with a decrease in HRQOL, even after controlling for symptoms of anxiety [15]. The findings of Kullowatz et al. corroborate our findings with regard to the mental component of HRQOL (compare Table 3).

However, for the MCS-12 not only patients with an alarming *HADS-D* or *HADS-A* but even with a marginally alarming *HADS-A* score showed a significantly decreased HRQOL. A clear association between showing depressive or anxious symptoms and HRQOL in individuals with asthma can be assumed. However, it has to be noted, that both *HADS* and MCS-12 tap into related constructs and are therefore expected to correlate to some extent.

Limitations

Our study has several limitations that should be acknowledged. Due to the cross-sectional design of our study, it was not possible to reveal or investigate causality. Since sequence cannot be reconstructed, the association observed between reporting symptoms of depression and HRQOL may either mean that patients with depression subsequently report lower HRQOL or vice versa. Furthermore, *HADS* was obtained as a self-reported outcome in our study, implying that for example variable factors like stress or bad mood may have influenced the patient's answer. Moreover, the most severely ill patients were not able to answer the questionnaire and are therefore underrepresented in our study. Though we think that we covered a wide range of different practices, there was no random selection of participating physicians. Unfortunately, the patients' medical records contained no information on how the asthma diagnosis was established by the physicians, so inevitably there will be variation. Since information on the number of patients who refused to take part in the study was not systematically collected, we were not able to determine a response rate.

Conclusions

In conclusion, we found that generic HRQOL of individuals with asthma is determined by several factors. The strongest HRQOL-determining factors identified in the current study were disease control for the physical component of HRQOL and reporting depressive and anxious symptoms for the mental component. Improving disease control and screening for depression and anxiety

may be promising approaches to enhance the quality of life in patients with asthma. If a patient shows alarming symptoms of anxiety and/or depression, the patient should then be referred for psychiatric treatment. Longitudinal studies and – in a further step – robust interventional studies are warranted to confirm the findings of our study.

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Declaration of interests

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

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