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ORIGINAL PAPER

RELATIONSHIP BETWEEN ASTHMA CONTROL, HEALTH-RELATED QUALITY OF LIFE AND SUBJECTIVE WELL-BEING IN CZECH ADULTS WITH ASTHMA

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Abstract

Aims: To investigate the relationship between asthma control, health related quality of life and subjective well-being in Czech adult patients with asthma. *Design:* A prospective observational cohort study. *Methods:* The sample included 316 people with asthma. In this 12-month observational study, patients were tested three times – at the baseline and after six and 12 months. Asthma control, health related quality of life and subjective well-being were assessed at the initial time point and followed up at six and 12 months by using the Asthma Control Test, the Mini Asthma Quality of Life Questionnaire and the Personal Well-being Index. *Results:* Level of asthma control and health related quality of life improved during the 12-month period, although spirometric parameters and subjective well-being were without significant change. Asthma control remained a significant predictor of health-related quality of life and general subjective well-being in linear regression models. *Conclusions:* Health-related quality of life is a construct based on a larger set of clinical variables when compared to subjective well-being. The regular monitoring of asthma control is associated with increased awareness and therapeutic expectations in patients, and better asthma control and health-related quality of life.

Keywords: asthma control, health-related quality of life, subjective well-being.

Introduction

Asthma is a serious global health problem with significant social and economic impacts (Global Initiative for Asthma – GINA, 2012). It increases the cost of health care, results in loss of productivity and reduces participation in family life. The prevalence of asthma is increasing everywhere, including the Czech Republic. The prevalence of current asthma symptoms in the Czech Republic is estimated to be approximately 8% among adults (Masoli et al., 2004). The Czech Republic already has a similar prevalence of asthma to that of Western European countries (Masoli et al., 2004).

Keeping asthma under control is a central component of asthma management (GINA, 2012).

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Horne et al. (2007) report that controlled asthma is characterised by ´minimal or no symptoms during the day and at night, no asthma attacks, no emergency visits to physicians or hospitals, minimal need for reliever medications, no limitations on physical activities and exercise, nearly normal lung function and minimal or no side-effects from medication´. Despite the continued growth of improved treatments for asthma and the availability of regularly updated, evidence-based guidelines, a majority of adults with asthma are not optimally controlled (FitzGerald et al., 2006; Horne et al., 2007; Koolen et al. 2011; Rabe et al., 2000). This is supported by several international clinical studies (e.g. the International Asthma Patient Insight Research – INSPIRE study; The Asthma Insights and Reality in Central and Eastern Europe – AIRE study; The Reality of Asthma Control – TRAC study). Several clinical and behavioural determinants of asthma control have been identified in previous studies (Haughney et al., 2008; Horne et al., 2007; Yildiz, 2013) and large population-based studies (FitzGerald et al., 2006; Horne et al., 2007; Koolen et al., 2011; Rabe et al., 2000). However, studies

evaluating the factors of asthma control in the Czech Republic are still rare.

Asthma control determines patient reported outcomes such as functional status and quality of life (Correira de Sousa et al., 2013; Gandhi et al., 2013; Chen et al., 2007; Rosenzweig et al., 2004). Research on the relationship between asthma control and quality of life has predominantly focused on the association between objective assessments of asthma control (spirometric parameters, symptoms, reliever medication etc.), level of asthma severity, and subjective measures (quality of life, well-being). There is considerable international empirical evidence from several longitudinal and cross-sectional studies (Gandhi et al., 2013; Chen et al., 2007; Rosenzweig et al., 2004; Vollmer et al., 1999) suggesting a significant relationship between asthma control, level of asthma severity and health-related quality of life (HRQoL). Pulmonary function has not been confirmed as an independent predictor of HRQoL in adults with asthma (Gandhi et al., 2013; Chen et al., 2007; Kwon et al., 2008; Moy, Drazen, 2001; Rosenzweig et al., 2004; Vollmer et al., 1999).

In previous studies, the quality of life of adults with asthma was predominantly conceptualised and operationalised via the construct of HRQoL. In contrast to health care sciences, quality of life (QoL) in social sciences is conceptualised and operationalised via the construct of subjective well-being (SWB). Some social scientists (Cummins & Lau, 2006; Michalos, 2004) have reported ambiguity in the conceptualization of HRQoL or confusion between concepts of health and quality of life. These authors have also emphasised the importance of distinguishing between the perception of health and quality of life measures and do not interpret scores of the instruments of HRQoL as measures of quality of life. The International Well-being Group (2006) reports that SWB is equivalent to the subjective dimension of quality of life (SQoL).

Aim

The current study was proposed to describe asthma control, HRQoL and SWB in patients with asthma and to determine the relationship between these variables. It aimed to examine the longitudinal association between asthma control, HRQoL and SWB in Czech adult patients with asthma.

Methods

Design

A prospective observational cohort study was employed to examine the longitudinal association between asthma control, HRQoL and SWB in Czech adult patients with asthma.

Sample

Patients receiving care from an asthma specialty group at the Clinic of Tuberculosis and Respiratory Diseases at the University Hospital, Ostrava were recruited as participants in the study. Recruitment took place between November 2011 and July 2012. Patients matching the inclusion criteria (>18-years-old, with asthma diagnosed according to GINA during the previous six months, and willing to give written informed consent) were accepted for the study. Patients were excluded for the following criteria: a) they had any other illness thought to affect quality of life adversely, they had severe cardiac, hepatic, or renal comorbidities, were pregnant, or had a serious psychiatric illness; b) they had a known respiratory disorder other than asthma. Patients who could not complete lung function tests or complete the questionnaire were also excluded.

Data collection

Three questionnaires were used in this study, namely the Asthma Control Test (ACT) (Nathan et al., 2004); the Mini Asthma Quality of Life Questionnaire (Mini-AQLQ) (Juniper et al., 1999) and the Personal Well-being Index (PWI) (International Well-being Group, 2006).

The ACT, a validated five-item asthma control tool, was used to measure the level of asthma control. An ACT is scored on a scale of 5–25 with the higher scores reflective of better asthma control (Nathan et al., 2004). The Cronbach alpha of the five-item ACT in our study was 0.875.

Domains of health related to quality of life were operationalized by four domains of the Mini-AQLQ (Juniper et al., 1999). The scale consisted of 15 items grouped under four sub-scales: symptoms, emotion, activity, and environment. The tool focuses on the identification of dysfunctions that affect asthma patients most (Juniper et al., 1999). Prior to the start of the study the consent of the author of the Mini-AQLQ was obtained, along with methodical instructions for usage. Cronbach alphas for each of the four sub-scales in our study range between 0.767–0.920; the alpha for the global scale is 0.943.

SWB was assessed by the PWI (International Well-being Group, 2006), including eight items on satisfaction with different life domains including: standard of living, health, social relationships, achievement, personal security, connection to community, future security, and spirituality/religion. In addition, there is one item related to overall satisfaction with life. Each item was rated on an

11-point scale, ranging from zero (´completely dissatisfied´) to 10 (´completely satisfied´). The internal consistency of the scale ranges from Cronbach alpha 0.70 to 0.85 (International Well-being Group, 2006). The Cronbach alpha of the scale in our study was 0.88. The PWI has been used by over 100 researchers in 50 countries (International Well-being Group, 2006). It has normative data from 14 countries (Cummins et al., 2003). For Western populations, the normative set-point range is 70–80 points on a 0–100 scale distribution, with a mean of 75 (Cummins et al., 2003).

The clinical parameters were assessed by spirometry curves flow/volume. Spirometry tests were performed using a ZAN 100 Handy USB device before the application of morning medicaments. The specialist inquired about the presence of asthma exacerbations; use of rescue therapy; the need for oral corticosteroids; emergency room visits; and emergency visits to a doctor. Objective level of asthma control was assessed through the GINA (2012) scoring system. The pulmonologist then observed patients' inhaler technique.

In this 12-month observational study, patients were followed up three times: at the baseline and after six and 12 months. Asthma control and severity were assessed at the initial time point, and six and 12 months later by using the ACT and the GINA classification system. HRQoL was measured at the initial time point, six (the first follow-up) and 12 months later (the second follow-up) by using the Mini-AQLQ, a disease-specific psychometric measure of HRQoL, and the PWI, a generic preference based measure of SWB. At each visit, tests, questionnaires and patient discussions were completed in the following order: completion of questionnaires (the ACT; the Mini-AQLQ, the PWI); pre-bronchodilator measurement of forced expiratory volume in one second (FEV_1); assessment of asthma control; evaluation of inhaler techniques; and discussion on future use of medication. A total of 321 adult patients were invited to participate in the study; 316 (98.4%) agreed to participate at the baseline, of whom 301 (95.25%) completed the study. 15 patients (4.75%) failed to return for the final visit.

Data analysis

The statistical analysis was performed with the Statistical Package for the Social Sciences 15.0. The Likert scale data in the PWI scale were standardized into units of percent SM on a 0–100 distribution. For descriptive statistical analysis means, SD, absolute and relative frequencies were calculated. To determine the associations and correlations between variables, parametric Pearson correlations were used. The association between asthma control, HRQoL and SWB was analysed by multiple regression analyses. For group comparisons, a paired Student´s t test one way and multifactorial ANOVA, and Fisher's least significant difference (LSD) procedure were performed where appropriate. Comparison of proportions were carried out with the chi-square test and a p-value < 0.05 was taken to indicate statistical significance for all comparisons.

Results

Demographic characteristics

Demographic characteristics of the sample are summarized in Table 1. In terms of severity of condition, 7.9% of the patients had intermittent asthma, 43.7% had mild persistent asthma, 38.9% had moderate persistent asthma, and 9.5% had severe persistent asthma. Most of the patients were using preventative medication; the majority had uncontrolled (57%) or partly controlled (32%) asthma according to Asthma Control Test criteria and continued the same treatment after their visit. According to the results of the specialists' rating (GINA classification), the patients were classified into: an uncontrolled group (34.5%), a partly controlled group (51.3%), and a controlled group (14.2%). Surprisingly, only 3.2% of patients performed regular home self-monitoring of their peak expiratory flow (PEF), and 38% of patients reported that although they had a peak flow meter, they did not use it regularly. 55.7% of patients used their inhaler correctly. 44.3% of patients needed frequent education due to poor inhalation technique.

Asthma control

Tables 2–4 demonstrate significant differences in asthma control between the baseline and the six- and 12-month follow-ups. Post hoc tests and paired t tests revealed that there was a significantly higher level of asthma control in patients after 12 months compared to those at the baseline (Table 4). There was no significant difference in asthma control between patients at the six-month and patients at the 12-month follow-up (Table 4). However, there was a significantly higher level of asthma control in patients at the six-month follow-up compared to patients at the baseline (Table 4).

Table 1 Characteristic of the sample at baseline and 12 months of follow-up

Characteristic	Baseline (T0)		12 months (T2)	
	n	%	n	%
Highest grade in school completed				
Grammar school	94	29.7		
Secondary school or equivalent	148	46.8		
Trade school	33	10.4		
University degree	41	13.0		
Employment				
Employed	136	43.0		
Student	4	1.3		
Retired	140	44.3		
Unemployed	31	9.8		
Maternity leave	5	1.6		
Asthma duration				
0–5 years	88	27.8		
6–10 years	85	26.9		
11–15 years	65	20.6		
≥ 16 years	78	24.7		
Asthma severity according GINA				
Stage 1 – intermittent	25	7.9	23	7.6
Stage 2 – mild persistent	138	43.7	138	45.8
Stage 3 – moderate persistent	123	38.9	119	39.5
Stage 4 – severe persistent	30	9.5	21	6.9
Medication use before visit				
None	117	37.0	139	46.1
SABA	199	63.0	162	53.8
LABA	29	9.2	23	7.6
ICS	93	29.4	108	35.8
LABA and ICS	187	59.2	166	55.4
Theophylline	59	18.7	71	23.5
Leukotriene antagonists	46	14.6	71	23.5
Relief therapy	101	32.0	127	42.1
Inhalation technique				
Good	176	55.7	241	80.0
Incorrect	140	44.3	60	19.9
Self-monitoring of PEF				
Regular self-monitoring of PEF	10	3.1	10	3.3
Iregular self-monitoring of PEF	120	48.0	105	34.8
Patients without peak flow meter	186	58.9	186	61.7
FEV_1 % of predicted value				
0–44%	28	8.9	21	6.9
45–59%	35	11.1	39	12.9
60–79%	101	32.0	80	26.5
80%	152	48.1	161	53.4

ACT, Asthma control test ; FEV_1, forced expiratory volume in 1 second; GINA, Global Initiative for Asthma; ICS, Inhaled corticosteroid; LABA, Long-acting beta2-agonist; n, number of patients; PEF, Peak expiratory flow; SABA, Short-acting beta2-agonist

The three measures (at the baseline; six- and 12-month follow-ups) revealed significant differences (Table 2) in the number of patients with controlled, partly controlled and uncontrolled asthma according to the ACT criteria (p = 0.001). Over the 12-month follow-up period, the number of patients with controlled asthma and with correct inhalation technique increased significantly (Table 2). However, there was no significant difference in FEV_1 between patients at the baseline and patients at the six-month (mean difference = -1.24; p = 0.48) and 12-month (mean difference = -1.61; p = 0.360) follow-ups.

HRQoL and SWB

Table 3 displays significant differences in HRQoL between the baseline and the six- and 12-month follow-ups. Post hoc tests and paired t tests revealed that patients at the 12-month follow-up reported a significantly higher level of HRQoL (in mean scores and in symptoms, activity and enviromental domains) than patients at the baseline (Table 4). However, there was no significantly higher level in HRQoL between patients at the 6-month follow-up compared to those at the baseline and patients at the 12-month follow-up

(Table 4). Table 3 and 4 also demonstrate no significant difference in SWB between patients at the baseline compared to those at the six- and 12- month follow-ups (Table 4). Moreover, during the follow-up, the PWI scores were consistent with the normative range for the PWI for Western countries, namely 70–80% SM. The highest satisfaction level in patients with asthma was found in the domain of 'Personal relationships' and the lowest in the domain of 'Health' during the total follow-up period.

Table 2 Changes in asthma control and FEV_1 % of predicted value during 12-month follow-up period

Characteristic	Baseline (T0)	6-month follow-up (T1)	12-month follow-up (T2)	p
Asthma control (ACT classification)				
Uncontrolled	167 (55.4%)	132 (43.8%)	120 (39.8%)	
Partially controlled	99 (32.8%)	122 (40.5%)	123 (40.8%)	**0.001**
Controlled	35 (11.6%)	47 (15.6%)	58 (19.2%)	
Asthma control (GINA classification)				
Uncontrolled	61 (20.2%)	48 (15.9%)	61 (20.2%)	
Partially controlled	156 (51.8%)	126 (41.8%)	133 (44.1%)	**0.040**
Controlled	100 (33.2%)	127 (42.1%)	107(35.5%)	
FEV_1 % of predicted value				
0–44%	26 (8.63%)	18 (5.9%)	21 (6.9%)	
45–59%	34 (11.2%)	38 (12.6%)	39 (12.9%)	
60–79%	96 (31.8%)	86 (28.5%)	80 (26.5%)	
80%	145 (48.1%)	159 (52.8%)	161 (53.4%)	**0.360**
Inhalation technique				
Correct inhalation	170 (56.47%)	177 (58.8%)	241(80.0%)	
Incorrect inhalation	131 (43.5%)	124 (41.19%)	60 (19.9%)	**0.000**

Relationship between asthma control and subjective quality-of-life measures

There was a significant association between asthma control at the baseline and asthma-specific HRQoL at the 12-month follow-up ($r = 0.56$, $p < 0.01$) and with SWB at the 12-month follow-up ($r = 0.41$, $p < 0.01$). A similar relationship was observed between FEV_1 at the baseline and asthma-specific HRQoL at the 12-month follow-up ($r = 0.47$, $p < 0.01$) and with SWB at the 12-month follow-up ($r = 0.30$, $p < 0.01$). Age correlated negatively with asthma-specific HRQoL ($r = -0.15$, $p < 0.01$) and with SWB ($r = -0.14$, $p < 0.05$). A negative relationship was also found between the duration of asthma and asthma-specific HRQoL ($r = -0.25$, $p < 0.01$) and with SWB ($r = -0.19$, $p < 0.01$).

Table 3 Changes in FEV_1, asthma control, HRQoL and SWB during 12-month follow-up period (ANOVA tests)

Measure		N	Mean	SD	95% CI		Min	Max	p
FEV_1	**T0**	301	77.55	21.85	75.08	80.03	18	139	
	T1	301	78.80	21.71	76.34	81.27	13	142	
	T2	301	79.17	21.73	76.70	81.63	17	146	**0.630**
	Total	903	78.51	21.75	77.09	79.93	13	146	
ACT	**T0**	301	17.78	5.417	17.17	18.40	5	25	
	T1	301	18.72	5.291	18.12	19.32	5	25	
	T2	301	19.32	5.398	18.71	19.93	5	25	**0.002**
	Total	903	18.61	5.400	18.26	18.96	5	25	
Mini-AQLQ	**T0**	301	4.76	1.31	4.61	4.91	1.13	7.00	
	T1	301	4.93	1.25	4.78	5.07	1.66	7.00	
	T2	301	5.08	1.27	4.93	5.22	1.80	7.00	**0.010**
	Total	903	4.92	1.28	4.84	5.01	1.13	7.00	
PWI	**T0**	301	70.91	18.79	68.78	73.04	10.00	100.00	
	T1	301	71.67	18.16	69.61	73.73	21.25	98.75	
	T2	301	70.88	17.73	68.87	72.90	22.50	100.00	**0.830**
	Total	903	71.16	18.21	69.97	72.34	10.00	100.00	

T0 – at baseline; T1 – at 6-month follow-up; T2 – at 12-month follow-up

Table 4 Changes in domains of ACT, Mini-AQLQ and PWI during 12-month follow-up period

	T0	T1	p	T1	T2	p	T0	T2	p
ACT	**Mean (SD)**	**Mean (SD)**		**Mean (SD)**	**Mean (SD)**		**Mean (SD)**	**Mean (SD)**	
Asthma keeps you from getting much done at work/school	3.44 (1.26)	3.53 (1.06)	**0.530**	3.53 (1.06)	3.67 (1.07)	**0.100**	3.44 (1.26)	3.67 (1.07)	**0.090**
Shortness of breath	3.28 (1.37)	3.50 (1.31)	**0.040***	3.50 (1.31)	3.67 (1.29)	**0.090**	3.28 (1.37)	3.67 (1.29)	**0.002****
Asthma symptoms wake you up	3.85 (1.43)	4.10 (1.29)	**0.030**	4.10 (1.29)	4.21 (1.27)	**0.270**	3.85 (1.43)	4.21 (1.27)	**0.004****
Use of rescue medication	3.45 (1.40)	3.71 (1.35)	**0.020***	3.71 (1.35)	3.74 (1.37)	**0.760**	3.45 (1.40)	3.74 (1.37)	**0.017***
Patient rating of control	3.74 (1.16)	3.87 (1.08)	**0.240**	3.87 (1.08)	4.02 (1.08)	**0.050**	3.74 (1.16)	4.02 (1.08)	**0.010***
ACT score	**17.78 (5.41)**	**18.72 (5.29)**	**0.032***	**18.72 (5.29)**	**19.32 (5.39)**	**0.170**	**17.78 (5.41)**	**19.32 (5.39)**	**0.001****
Mini-AQLQ									
Symptoms domain	4.77 (1.39)	5.00 (1.33)	**0.050**	5.00 (1.33)	5.17 (1.36)	**0.090**	4.77 (1.39)	5.17 (1.36)	**0.002****
Activity domain	4.81 (1.63)	4.97 (1.61)	**0.230**	4.97 (1.61)	5.18 (1.66)	**0.060**	4.81 (1.63)	5.18 (1.66)	**0.008****
Emotion domain	5.47 (1.41)	5.51 (1.42)	**0.670**	5.51 (1.42)	5.63 (1.42)	**0.230**	5.47 (1.41)	5.63 (1.42)	**0.240**
Enviroment domain	3.95 (1.48)	4.18 (1.47)	**0.030***	4.18 (1.47)	4.24 (1.53)	**0.740**	3.95 (1.48)	4.24 (1.53)	**0.030***
Mean score	**4.76 (1.31)**	**4.93 (1.25)**	**0.100**	**4.93 (1.25)**	**5.08 (1.27)**	**0.150**	**4.76 (1.31)**	**5.08 (1.27)**	**0.003****
PWI									
Standard of living	69.53 (24.67)	73.16 (23.09)	**0.070**	73.16 (23.09)	72.09 (23.90)	**0.690**	69.53 (24.67)	72.09 (23.90)	**0.170**
Health	58.47 (28.88)	61.36 (29.04)	**0.190**	61.36 (29.04)	60.73 (28.32)	**0.690**	58.47 (28.88)	60.73 (28.32)	**0.380**
Achievements in life	76.21 (25.09)	77.57 (23.86)	**0.650**	77.57 (23.86)	78.44 (22.82)	**0.970**	76.21 (25.09)	78.44 (22.82)	**0.870**
Personal relationships	80.43 (24.47)	82.33 (22.79)	**0.480**	82.33 (22.79)	81.59 (22.44)	**0.380**	80.43 (24.47)	81.59 (22.44)	**0.650**
Personal safety	76.51 (22.12)	75.12 (22.10)	**0.360**	75.12 (22.10)	72.09 (23.46)	**0,140**	76.51 (22.12)	72.09 (23.46)	**0.060**
Part of your community	74.05 (23.58)	73.39 (23.00)	**0.600**	73.39 (23.00)	73.29 (23.41)	**0.960**	74.05 (23.58)	73.29 (23.41)	**0.850**
Future security	64.05 (26.36)	62.59 (27.62)	**0.630**	62.59 (27.62)	61.73 (26.71)	**0.590**	64.05 (26.36)	61.73 (26.71)	**0.590**
Religion and spirituality	68.04 (25.79)	67.91 (24.76)	**0.850**	67.91 (24.76)	67.14 (24.52)	**0.670**	68.04 (25.79)	67.14 (24.52)	**0.820**
Life as a whole	70.07 (25.15)	72.19 (24.57)	**0.240**	72.19 (24.57)	73.62 (23.46)	**0.590**	70.07 (25.15)	73.62 (23.46)	**0.190**
PWI mean score	**70.91 (18.79)**	**71.68 18.16**	**0.610**	**71.68 (18.16)**	**70.89 (17.73)**	**0.590**	**70.91 (18.79)**	**70.89 (17.73)**	**0.980**

Mini-AQLQ and PWI scores at each time point were compared.*significant at the $p < 0.05$ level.**significant at the $p < 0.01$ level. T0 – at baseline; T1 – at 6-month follow-up; T2 – at 12-month follow-up.

Table 5 Regression of SWB and HRQoL variables

Predictor	R	R²-change	b	T	p
SWB (12 months of follow up)			**(F_{total} = 32.73; p < 0.000)**		
Asthma control baseline	0.40	0.17***	1.13	5.79	0.000
FEV_1 baseline	0.42	0.01*	0.10	2.15	0.032
Constant			42.56		
HRQoL (12 months of follow up)			**(F= 62.88; p < 0.000)**		
Duration of asthma	0.21	0.05**	-0.01	-3.04	0.003
Asthma control baseline	0.58	0.29***	0.09	7.90	0.000
FEV_1 baseline	0.62	0.05***	0.01	5.17	0.000
Constant			2.30		

* p < 0.05; ** p < 0.01; *** p < 0.001

In order to clarify the relationship between asthma control at the baseline and asthma-specific HRQoL and SWB at the 12-month follow-up, stepwise multiple regression analyses were performed for HRQoL and SWB. Age, and the duration of asthma, were entered stepwise in the first block; FEV_1 at the baseline and the ACT baseline were entered stepwise in the second block. The accepted models ($p < 0.05$) are presented in Table 5. HRQoL (operationalised via the mean score of the Mini-AQLQ) was predicted by asthma control and FEV_1 at the baseline and asthma duration, accounting for 39% of the variance. SWB (operationalised via the mean score of the PWI) was predicted by asthma control and FEV_1 at the baseline, accounting for 18% of the variance. Higher FEV_1 at the baseline and better asthma control at the baseline contributed to higher asthma-specific HRQoL and SWB at the 12-month follow-up. Furthermore, taking FEV_1 at the baseline into account, the high percentage of variance (29%) suggests that HRQoL is strongly influenced by asthma control (Table 5).

Discussion

Our results, reflecting and expanding on previous studies (Gandhi et al., 2013; Chen et al., 2007; Rosenzweig et al., 2004; Vollmer et al., 1999), confirm the significant association between HRQoL and level of asthma control. Several studies have examined the longitudinal association between asthma control and quality of life in adults with asthma (Chen et al., 2007; Moy et al., 2001; Rosenzweig et al., 2004). In our study we focused on the evaluation of one-year development of asthma control and two complementary approaches to assess quality of life – HRQoL and SWB. We used the Mini-AQLQ to assess asthma specific HRQoL and used the PWI as a measure of SWB or general life satisfaction. In multiple regression analyses adjusted for age, asthma duration, and lung function (FEV_1) at the baseline, asthma control at the baseline remained a significant predictor of asthma-specific HRQoL and SWB at the 12-month follow-up. Furthermore, asthma control at the baseline accounted for only 17% of the variance in SWB and 29% in HRQoL at the 12-month follow-up. Asthma control was confirmed as a significant predictor of asthma-specific HRQoL and SWB. In a previous cross-sectional study (Popelková, Gurková, 2013) we found that the correlations between HRQoL (assessed by the Mini AQLQ) and SWB (assessed by the PWI) are positive and moderate. The perception of asthma control was also identified as a significant predictor of both constructs. However, it produced greater variance in the context of HRQoL. Asthma control accounted for only 13% of the variance in SWB and 64% in HRQoL in the previous cross-sectional study (Popelková, Gurková, 2013). Our longitudinal results show a generally significant association between asthma control at the baseline and SWB at the 12-month follow-up. However, we confirmed that asthma control has a substantial effect on HRQoL by using a disease-specific psychometric measure (Mini-AQLQ). These results support the notion of HRQoL as a construct based on a larger set of clinical variables as compared to SWB. In addition, we also confirmed significant differences in symptoms, activity and enviroment domains of the Mini-AQLQ between the baseline and the 12-month follow-up. This suggests that the impact of asthma is greater on the physical function component of HRQoL (symptom and activity limitation) than on the mental or emotional component of HRQoL (National Heart Lung and Blood Institute, 2007) or the domains of SWB.

The association between asthma control (measured by the ACT) and HRQoL (measured by the Mini-AQLQ) has been described in other studies (Correira de Sousa et al., 2013; Gandhi et al., 2013; Chen et al., 2007; Kwon et al., 2008; Rosenzweig et al., 2004; Schatz et al., 2007; Vollmer et al., 1999). Consistent with the previous studies mentioned, we also observed a significant association between asthma control and HRQoL over time. Correira de Sousa et al. (2013) found a strong association between asthma control and

quality of life in a random sample of asthma patients treated in general practice. The authors also noted that the following variables were associated with worse HRQoL: female gender, and moderate and severe persistent asthma. By using a multivariate longitudinal approach, Chen et al. (2007) reported that asthma control remained an independent predictor of HRQoL at 12 months. Consistent with this study, we also confirmed that the influence of asthma control on HRQoL was significant, even when objective measures (FEV_1) are taken into consideration. However, we also found that asthma control at the baseline did not significantly predict SWB at follow-up. Notably, FEV_1 at the baseline was not confirmed as a significant predictor of HRQoL and SWB, which is consistent with previous studies (Chen et al., 2007; Juniper et al., 1999; Moy, Drazen, 2001).

Factors influencing asthma control, which in turn affect HRQoL, are complex and undetermined. One of the most important and interesting findings of our study came from the observed longitudinal changes in FEV_1, asthma control, HRQoL and SWB during the 12-month follow-up period. The present study shows that level of asthma control and HRQoL improved, allthough FEV_1 and SWB were without significant change at follow-up. One explanation might be the increased number of patients with correct inhalation technique and education about the importance of asthma control during follow-up or the focus of attention on asthma control during the study. Factors such as low patient expectations of treatment, and patients´ underestimation of the significance of symptoms and lack of awareness of achievable control were identified as the main patient-related determinants of asthma control (Haughney et al., 2008; Horne et al., 2007). The International Primary Care Respiratory Group (Haughney et al., 2008; Horne et al., 2007) explained that ´patients may accept symptoms, assuming that frequent symptoms, exacerbations and lifestyle limitations are an inevitable consequence of having asthma´ (Horne et al., 2007). For example, Rabe et al. (2000) reported that in the AIRE study, the majority of patients considered themselves to have controlled asthma, yet symptom levels showed control had failed to reach the levels expected in management guidelines. Therefore, there is a need to raise patient expectations by increasing awareness of the quality of life that can be attained.

Limitation of study

This study has several limitations, including the possibility of patient selection bias as participants represent a convenience sample from a university hospital that may not be representative of the overall population of outpatients with asthma in the Czech Republic.

Conclusion

Asthma control remains a significant predictor of disease-specific quality of life and general SWB in linear regression models and is a better longitudinal predictor than FEV_1 at the baseline. The results of the longitudinal study provide information concerning the level of asthma control and HRQoL and SWB in an outpatient setting and their development over a 12-month period. We ascertained that during the 12 months there were significant changes in the physical domain of quality of life (the perception of symptoms and level of physical activity). Changes in the emotional domain of quality of life and overall satisfaction of life were not significant. Our findings emphasized the role of regular monitoring in asthma control. It can lead to more active participation of patients and the boosting of their expectations of therapy results.

Ethical aspects and conflict of interest

The study was approved by the institutional Ethics Committee of the University Hospital, Ostrava. Prior to this study, patients were informed of the purpose of the research. Participants were informed of their right to refuse to participate in or to withdraw from the study at any stage. Anonymity and confidentiality of participants were maintained.

Author contribution

Study conception and design (EG, PP), statistical expertise, analysis and interpretation of data and supervision (EG, PP, PO), manuscript preparation, supervision, administrative support and critical revision of the paper (EG, PP).

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