

Perceived Stress, Severity of Asthma, and Quality of Life in Young Adults with Asthma

Tomoaki Kimura¹, Akihito Yokoyama², Nobuoki Kohno³, Hiroyuki Nakamura⁴ and Akira Eboshida¹

ABSTRACT

Background: People suffering from asthmatic symptoms have a lower quality of life than those without. The aim of this study is to clarify the association of quality of life with the severity of asthma, perceived stress, and other factors such as the comorbidity of allergic diseases among young adults with asthma.

Methods: The study participants were 695 asthma patients, aged 20–44 years, from 29 medical centers in Japan. We excluded from the analysis of the result of the study 116 patients with complications of serious diseases, cough-variant asthma or aspirin-intolerant asthma. The patients completed the 8-Item Short-Form Health Survey (SF-8), the Airways Questionnaire 20 (AQ20), and the Japanese version of the Perceived Stress Scale (JPSS) and their doctors also provided clinical information including diagnosis, complications, severity of asthma, and results of pulmonary function and immunological tests.

Results: There was a weak correlation between the generic quality of life (SF-8) and the disease-specific quality of life (AQ20). The AQ 20 revealed almost no association with the results of pulmonary function and immunological tests, and only a slight association with comorbidity of allergic rhinitis and food allergy. The AQ20 showed a moderate relation with perceived stress (JPSS) but a weak association with the severity of asthma. The multiple logistic models demonstrated that there was no relationship between the severity of asthma and the AQ20 in females, and in the age group of 20–34 years.

Conclusions: A major variable related to the disease-specific quality of life was perceived stress, followed by the severity of asthma. Stress management of patients with asthma may improve their quality of life.

KEY WORDS

adults, bronchial asthma, psychological stress, quality of life, severity of asthma

INTRODUCTION

Although recent therapeutic advances in asthma management, such as the increased use of inhaled corticosteroids, are remarkable, people with asthma symptoms generally have a lower quality of life than the national norm.^{1,2} The broad range of severity of asthma may be related to differences in the quality of life. Although patients with mild asthma are not required to see a doctor so often to maintain their prescribed medication. Severe asthma can occasionally result in death if the medication dosage is not well-controlled. Previous studies^{3,4} have suggested that

chronic symptoms of asthma, the severity of asthma, and the burden for asthma management are associated with the impairment of health-related quality of life among adults with asthma.

Adults with asthma symptoms have more psychological problems, such as stress and anxiety, than those without.⁵⁻⁹ Although the relationship between stress and asthma is still a traditional belief and an empirical issue,¹⁰ a number of molecular biological studies have demonstrated that emotional factors such as stress can disrupt physiological pathways, including autonomic control of airways, the endocrine system, and immune functions, which can result in

¹Department of Public Health and Health Policy, ³Department of Molecular and Internal Medicine, Graduate School of Biomedical Sciences, Hiroshima University, Hiroshima, ²Department of Hematology and Respiratory Medicine, Kochi Medical School, Kochi and ⁴Department of Environmental and Preventive Medicine, Graduate School of Medical Science, Kanazawa University, Kanazawa, Japan.

Correspondence: Tomoaki Kimura, Department of Public Health

and Health Policy, Hiroshima University Graduate School of Biomedical Sciences, 1–2–3 Kasumi, Minami-ku, Hiroshima 734–8551, Japan.

Email: tkim-moa@umin.ac.jp

Received 12 December 2007. Accepted for publication 3 July 2008.

©2009 Japanese Society of Allergology

the onset of an attack or exacerbation of asthma.^{11,12} Nevertheless, the relationship between stress and quality of life in adults with asthma has not been clearly determined. One study¹³ demonstrated that negative life events, which are stressors for patients, are associated with a lower quality of life among adults with asthma. However, a psychometrically valid measure of perceived stress can be a better predictor of health and health-related outcomes than measures using simply the number of stressful life events.¹⁴

In addition to perceived stress, comorbidity should be considered as a factor associated with quality of life. A considerable number of patients with asthma have comorbid allergic diseases, such as allergic rhinitis, which may reduce their quality of life.¹⁵ Some patients with asthma may be suffering from another respiratory disease or more severe diseases such as cardiovascular disease or cancer. The factor of comorbidity should be controlled or excluded to assess a more accurate quality of life of patients with asthma.

Few concurrent analyses have been conducted on the association of the quality of life of asthma patients with various factors, such as the severity of asthma, stress, and comorbidity. We therefore conducted this study to clarify and compare the associations of the quality of life with these factors in young adults with asthma. Our hypothesis was that the severity of asthma is most related to the quality of life, while perceived stress and comorbidity of allergic diseases are also significantly associated.

METHODS

This survey was conducted from November 2005 to June 2006 at 29 medical centers (including hospitals and clinics) in Japan. These medical centers were distributed among 7 prefectures (provinces) west of Tokyo. Subjects were age 20–44 years, given a diagnosis of asthma by specialists in the field (pulmonologists or allergists), and included cases of both adult onset and progression of childhood asthma. The subjects gave consent to take part in the survey after hearing an explanation of the purpose and content of the questionnaires by medical doctors in charge of outpatients. The exclusion criteria were the presence of chronic obstructive pulmonary disease (COPD), pregnancy, physically or mentally impairments, and current treatment for injury.

The participants completed the following self-administered questionnaires: the 8-Item Short-Form Health Survey (SF-8) Japanese version¹⁶ for generic health-related quality of life; the Airways Questionnaire 20 (AQ20) Japanese version¹⁷ for disease-specific quality of life; the Japanese version of the Perceived Stress Scale (JPSS)¹⁸ for subjective stress assessment; and a study questionnaire about other allergic symptoms and smoking status. The patients'

doctors also provided clinical information concerning the participants, including the basis for the diagnosis of asthma, complications of other diseases, severity of asthma, hospital admissions, use of a reliever, side effects of medication, and results of pulmonary function and immunological tests.

This study was conducted with the approval of the Ethics Committee of Hiroshima University School of Medicine and, when necessary, the institutional review board of the participating medical centers.

QUESTIONNAIRES

The SF-8 was created in the USA¹⁹ and translated into Japanese.¹⁶ This measure is a shortened version (8 items) of the SF-36 (36 items),²⁰ and yields two summary scores: a physical component summary (PCS) and a mental component summary (MCS), which are presented as standard deviation scores (the national standard score is 50.). Higher scores indicate a higher quality health status. The AQ20 was designed at St. George's Hospital Medical School in the UK as a short and simple measure of the health status of individuals with asthma.²¹ It has been translated into Japanese and its validity confirmed in patients with COPD¹⁷ and asthma.²² This questionnaire comprises 20 items with yes/no responses; the number of yes responses is the total score on the AQ20. Higher scores indicate a decline in the quality of life due to asthma symptoms. Concurrent use of two instruments is recommended for assessing generic and disease-specific quality of life and monitoring outcomes of adults with asthma.²³

The JPSS was originally developed by Cohen *et al.*¹⁴ and translated into Japanese.¹⁸ This scale is a self-administered measure of the degree to which situations in a subject's life are appraised as stressful, and consists of 14 five-point Likert-type items; 7 of the items are reverse scoring questions. Each item is scored from 0 to 4; the total score ranges from 0–56. Higher scores indicate greater perceived stress.

The study questions concerning other allergic symptoms were:

- "Have you ever had hay fever or allergic rhinitis?"
- "Have you ever had atopic dermatitis or hives?"
- "Do you have a food allergy?"

Each question has 4 responses: 'yes, in the past year', 'no, but had it previously', 'never', and 'unknown'. Participants were also asked about their current and previous smoking status and were placed into 3 categories: smoker (current), ex-smoker, and non-smoker (no history).

CLINICAL INFORMATION OF THE PARTICIPANTS

Clinical information concerning the participants was obtained from their attending doctors (specialists), who described the data through a review of the par-

ticipants' medical records. The diagnosis of asthma comprises bronchial asthma, aspirin-intolerant asthma, and cough variant asthma. The doctors also classified the type of asthma (atopic or nonatopic) and onset of asthma (childhood asthma, relapse after remission of childhood asthma, or adult onset). The severity of asthma was determined based on the Japanese guidelines for the prevention and management of asthma,²⁴ which comprises 4 categories of therapy (therapeutic steps): 1) mild, intermittent and usually no use of corticosteroids, 2) mild, persistent and low dosage of inhaled corticosteroids (200–400 µg/day of chlorofluorocarbon-beclomethasone dipropionate [CFC-BDP] equivalent), 3) moderate, persistent and medium dosage of corticosteroids (CFC-BDP 400–800 µg/day), 4) severe, persistent and high dosage of corticosteroids (CFC-BDP 800–1600 µg/day).

The items concerning hospital admissions and side effects had 3 possible responses: 'yes', 'no', and 'unknown'. Use of a reliever (short-acting beta 2 agonist) had 6 responses: 'always', 'sometimes', 'rarely', 'only previously', 'never', and 'unknown'. Results of the pulmonary function test using spirometry consisted of the forced expiratory volume in one second (FEV₁) and FEV₁ per forced vital capacity (FEV₁%). Results of the immunological test for allergy were the total IgE serum levels.

STATISTICAL ANALYSIS

Of the initial 695 patients with asthma, 71 patients with complications of serious diseases were excluded, leaving 624 patients. These exclusionary diseases were cerebrovascular or cardiovascular diseases, cancer or tumor, fibroid, diabetes, kidney diseases, immune diseases, neurological diseases, mental disorders, epilepsy, anemia, hepatitis, thyroid diseases, gastrointestinal diseases, and pulmonary diseases except asthma. After patients with cough-variant asthma ($n = 25$), aspirin-intolerant asthma ($n = 17$) and missing data concerning the kind of asthma ($n = 3$) were also excluded, the remaining number of patients with bronchial asthma (aspirin-tolerant asthma) were included in the analysis ($n = 579$).

The means and standard deviations of the SF-8 (PCS and MCS), AQ20, JPSS, and clinical data were calculated for the final sample. If any of the 8 items of the SF-8 were missing, the score was considered invalid. However, since the AQ20 and JPSS are one-dimensional scales based on simple addition, missing values were substituted within half of the item numbers using the mean imputation method.²⁵ The scores of the AQ20 indicated a skewed distribution and a ceiling effect; similar to a previous study.²² Non-parametric analyses were performed because the AQ20 data and other variables had non-normal distributions. Correlations between the severity of asthma, quality of life, perceived stress, and clinical data were analyzed using Spearman's correlations.

Multiple logistic regression analyses were conducted using the stepwise backward elimination method. The scores of disease-specific quality of life (AQ20) were divided into 2 categories (cutoff point = 4), and this binary item was set as a dependent variable (high quality of life = 0, low quality of life = 1). The items of other allergic symptoms (allergic rhinitis, atopic dermatitis, and food allergy), perceived stress (JPSS), severity of asthma, and age were set as covariates. The items of hospital admission, use of a reliever, and side effects were not set in the model because there could be considerable collinearity with the severity of asthma. The items of other allergic symptoms were changed into dichotomous variables (yes = 1, other = 0). The JPSS scores were divided into 4 categories of quartiles (1, 2, 3, or 4). Ordinal variables (quartile of perceived stress and severity of asthma) were set as dummy variables as a standard for the first category, and the contrast between categories was determined using reverse Helmert coding to validate the tendency between the categories.

Multiple logistic regression models were developed not only towards all subjects but also by gender and by age group (age 20–34 and 35–44 years). Statistical significance was set at $p < 0.05$, but variables at $p < 0.1$ were retained in the final models. These statistical analyses were conducted using SPSS for Windows, version 13.0.²⁶

RESULTS

Of the outpatients with asthma whose doctors asked them to take part in this survey, 65% agreed to participate. The major reasons for declining the request to participate were the burden on the patient and lack of incentive. The subjects of the analysis consisted of 213 men (36.8%) and 366 women (63.2%). The mean age was 33.2 years (6.6 SD). (See Table 1 for descriptive information about the sample group). Regarding time of onset, childhood onset including relapse after remission of childhood asthma ($n = 270$, 47.6%) was approximately equal to that of adult onset. Among the subjects, 147 were smokers (current) (25.4%), however, smoking status was not related to the quality of life (unpublished data).

Table 2 indicates the mean scores on the SF-8, AQ20 and JPSS, and correlations between these questionnaires and the severity of asthma. PCS (50.4) of the SF-8 was equal to the national standard (50), and MCS (47.1) was also close. The AQ20 revealed weak correlations with the severity of asthma, the PCS and the MCS. The JPSS did not correlate with the severity of asthma, but showed a strong correlation with the MCS and a moderate correlation with the AQ20.

The clinical data of pulmonary function and immunological tests were minimally associated with the severity of asthma and the AQ20. Weak correlations between FEV₁, the severity of asthma ($r = -0.144$, $p = 0.003$), the AQ20 ($r = -0.121$, $p = 0.013$), and the

Table 1 Profile of the sample using for analysis (the frequencies in each category)

Gender	male	213	Use of reliever	always	53
	female	366		sometimes	151
Age group				rarely	133
	20–24	70		only previously	157
	25–29	105		never	76
	30–34	133		missing†	9
	35–39	156	Side effect	yes	21
	40–44	115		no	546
Asthma severity	step 1	99		missing†	12
	step 2	235	Hospital admission (experienced)	yes	151
	step 3	174		no	396
	step 4	66		missing†	32
	missing	5			
Type	atopic	414	<i>Complication of allergic symptoms</i>		
	nonatopic	116	allergic rhinitis	yes	270
	missing †	49		only previously	114
Onset				never	116
	childhood	187		missing†	79
	relapse ‡	83	atopic dermatitis	yes	148
	adult	293		only previously	185
	missing †	16		never	197
Smoking				missing†	49
	current smoker	147	food allergy	yes	79
	ex-smoker	99		only previously	35
	never	328		never	403
	missing	5		missing†	62

†This category includes “unknown”.

‡This category means adult recurrence after remission of childhood asthma.

JPSS ($r = -0.112$, $p = 0.022$) were established. However, no correlations between FEV₁% and either the severity of asthma or the AQ20 were found. The result of the immunological test (the total IgE) was not associated with the severity of asthma or the AQ20.

The result of the multiple logistic regression analysis for the total sample using the stepwise backward elimination method is given in Table 3. In the logistic regression model, the odds ratio (OR) indicates the relative probability associated with the disease-specific quality of life (the AQ20). A larger value of OR indicates a high risk for the deterioration of the disease-specific quality of life. The OR of perceived stress for the dichotomous variable of the AQ20 was the highest, and the OR of the fourth quartile was 7.2. The OR of asthma severity was also very high. Both of these ORs tended to increase in the reverse Helmert contrast. The ORs of allergic rhinitis (1.6) and food allergy (1.8) were significant but not as high.

The multiple logistic regression models are pre-

sented according to gender (Table 4) and age group (Table 5). For the male model, the ORs were higher, especially for the fourth quartile (11.7) and the OR of category 4 of asthma severity (7.0). In contrast, for the female model, the OR of asthma severity was not significant. In the model for age group 20–34 years, the ORs of asthma severity, allergic rhinitis and food allergy were not significant. This model was similar to that of the age group of 20–29 years (unpublished data).

DISCUSSION

This study reveals that a major factor related to the disease-specific quality of life among the subjects of this study is perceived stress, followed by the severity of asthma. Although a significant association between the severity of asthma and the disease-specific quality of life was found in male subjects, it was not found in female subjects. In the younger age group of 20–34 years, the severity of asthma was not associated with the quality of life. The number of women

Table 2 Mean scores (SD) of generic quality of life (SF-8), disease-specific quality of life (AQ20), and perceived stress (JPSS), and correlations between them and with the severity of asthma

	Number of data	Mean $\pm$ SD	Correlation coefficient†			
			Asthma severity	PCS	MCS	AQ20
SF-8	559					
PCS		50.4 $\pm$ 6.8	– 0.144 * *			
MCS		47.1 $\pm$ 7.2	NS	NS		
AQ20	578	4.3 $\pm$ 4.0	0.199 * *	– 0.322 * *	– 0.314 * *	
JPSS	578	23.9 $\pm$ 7.4	NS	– 0.088 *	– 0.587 * *	0.368 * *

†Spearman's correlation coefficients are indicated.

* * $p < 0.001$, * $p < 0.05$, NS: Not significant.**Table 3** Result of multiple logistic regression analysis using stepwise backward elimination method ($p > 0.1$)†

Covariate	Category	Number	Crude odds ratio (95% confidence interval)	p value	Adjusted odds ratio (95% confidence interval)	p value	Contrast ‡
Allergic rhinitis	no	290	1		1		
	yes	266	1.4 (1.0–2.0)	0.042	1.6 (1.1–2.3)	0.014	
Atopic dermatitis	no	412	1		1		
	yes	144	1.6 (1.1–2.4)	0.012	1.2 (0.781–1.8) *	0.403	
Food allergy	no	479	1		1		
	yes	77	2.0 (1.2–3.2)	0.006	1.8 (1.0–3.0)	0.036	
Perceived stress	1st	136	1		1		
	2nd	135	2.4 (1.4–4.1)	0.001	2.4 (1.4–4.2)	0.001	0.001
	3rd	158	3.4 (2.0–5.6)	< 0.001	3.4 (2.0–5.8)	< 0.001	< 0.001
	4th	127	6.9 (4.0–11.8)	< 0.001	7.2 (4.1–12.5)	< 0.001	< 0.001
Asthma severity	1st	97	1		1		
	2nd	224	1.5 (0.91–2.5)	0.114	1.5 (0.89–2.6)	0.128	0.128
	3rd	170	2.0 (1.2–3.3)	0.010	1.9 (1.1–3.3)	0.024	0.042
	4th	65	3.2 (1.7–6.3)	< 0.001	3.2 (1.6–6.5)	0.001	0.005

† Disease-specific quality of life (AQ20) was set as a dependent variable at high QOL: 0, low QOL: 1. Initial covariates were allergic rhinitis, atopic dermatitis, food allergy, perceived stress, asthma severity and age. Ordinal variables (perceived stress and asthma severity) among covariates were set at dummy variables as a standard of the first category. The Hosmer-Lemeshow goodness-of-fit statistic was 14.8 ($p = 0.063$). Crude odds ratio was calculated by simple logistic regression analysis.

‡Contrast was performed using the reverse Helmert coding.

* This category was an eliminated covariate from a logistic regression model ($p > 0.1$). The odds ratio in the first step of logistic regression analysis was shown.

($n = 350$) was more than the number of men ($n = 206$), and similarly, the age group 20–34 ($n = 299$) consisted of more subjects than the age group 35–44 ($n = 257$). The size of the groups was considered enough to avoid the risk of beta errors (false negative). The findings from the multiple logistic regression models do not support our hypothesis and are inconsistent with previous studies.^{3,4}

The fact that the severity of asthma was not associated with the disease-specific quality of life among women is a new finding. The authors' previous article, which focused on gender differences, though unrelated to asthma,²⁷ suggested that women are more likely to become stressed by small events and more

likely to acknowledge their feelings. These characteristics of women may have affected responses to the questionnaire concerning quality of life in this present study. The possibility of overestimating the correlation between perceived stress and quality of life as a result of the response bias of women was considered. Matud's article²⁸ demonstrated gender differences in stress and coping styles, which suggested that women tend to score significantly higher in chronic stress, minor daily stressors, and somatic symptoms such as asthma or hypertension. Matud²⁸ also discussed that the women's coping style is more emotion-focused and less problem-centered than that of men. Differences in the logistic regression models

Table 4 Comparison of multiple logistic regression models between genders using stepwise backward elimination method ($p > 0.1$)†

Covariate	Category	Male ($n = 206$)			Female ($n = 350$)		
		Number	Adjusted odds ratio (95% confidence interval)	p value	Number	Adjusted odds ratio (95% confidence interval)	p value
Allergic rhinitis	no	116	1		174	1	
	yes	90	2.1 (1.1–4.0)	0.021	176	1.3 (0.81–2.1) *	0.283
Atopic dermatitis	no	153	1		259	1	
	yes	53	0.78 (0.36–1.7) *	0.524	91	1.7 (0.99–2.8)	0.055
Food allergy	no	181	1		298	1	
	yes	25	2.6 (0.99–6.8)	0.053	52	1.3 (0.67–2.5) *	0.451
Perceived stress	1st	59	1		77	1	
	2nd	49	2.3 (0.95–5.5)	0.066	86	2.5 (1.2–4.9)	0.010
	3rd	58	3.3 (1.4–7.6)	0.006	100	3.6 (1.8–7.0)	< 0.001
	4th	40	11.7 (4.3–31.7)	< 0.001	87	6.0 (3.0–12.1)	< 0.001
Asthma severity	1st	30	1		67	1	
	2nd	84	2.6 (0.93–7.2)	0.068	140	1.3 (0.67–2.4) *	0.459
	3rd	64	2.6 (0.89–7.4)	0.082	106	1.8 (0.91–3.5) *	0.092
	4th	28	7.0 (2.0–24.3)	0.002	37	2.3 (0.95–5.6) *	0.066
Age‡			*	0.499		—	0.008

†Disease-specific quality of life (AQ20) was set as a dependent variable at high QOL: 0, low QOL: 1. Initial covariates were allergic rhinitis, atopic dermatitis, food allergy, perceived stress, asthma severity and age. Ordinal variables (perceived stress and asthma severity) among covariates were set at dummy variables as a standard of the first category. The Hosmer-Lemeshow goodness-of-fit statistic was 3.7 ($p = 0.810$) in male and 3.5 ($p = 0.898$) in female.

‡Odds ratio was not shown because age is continuous variable.

* This category was an eliminated covariate from a logistic regression model ($p > 0.1$). The odds ratio in the first step of logistic regression analysis was shown.

between genders and between different age groups should be confirmed by further studies on stressors and coping styles.

An intensive treatment regimen is generally acknowledged as a stressor, because it is thought to interfere with daily activities, and increase anxiety about the disease in patients. However, a relationship between perceived stress and the severity of asthma was not found in this study. Cohen²⁹ explained that only a subset of people at risk for asthma are subject to stress-induced onset, and susceptibility to stress may be attributable to specific kinds of asthma or specific kinds of psychological characteristics. Our findings partly support his theory. Nishimura *et al.*³⁰ suggested that the psychological well-being may continue to be affected even in patients with well-controlled stable asthma. Our participants may have included those with stable asthma, because all of the subjects with asthma received medical treatment from specialists in allergy or pulmonology. Therefore, findings regarding perceived stress might be consistent with the suggestions of stable patients, and their suggestions could provide a different perspective of the link between mental well-being and asthma. Our findings are not contradictory to those of a previous study using negative life events,¹³ discussed in the In-

troduction. However, positive life events can also induce stress as well, and some people may experience chronic stress in daily activities, such as in business and interpersonal relationships, which is not associated with enumerated life events. Therefore, our findings may reveal more about the relationship between stress and quality of life.

Comorbid allergic rhinitis was weakly associated with quality of life, but this association was not found in the younger age group. The reason for this could not be fully explained, because allergic symptoms except for asthma were not investigated in detail, and this group included a number of nonatopic asthma patients. Future research may account for associations with other allergic symptoms. The clinical data of pulmonary function and immune tests showed very little association with quality of life in the entire sample, which corresponds to the findings of previous studies.^{21,31–33}

Our study has several limitations. One limitation is that the subjects were not selected by random sampling, and thus may not be representative of Japanese patients with asthma, although the data were collected at a number of hospitals in a comparatively wide area. Since data of socioeconomic factors were not collected, we could not determine whether these

Table 5 Comparison of multiple logistic regression models between age groups using stepwise backward elimination method ($p > 0.1$)†

Covariate	Category	Age 20–34 ($n = 299$)			Age 35–44 ($n = 257$)		
		Number	Adjusted odds ratio (95% confidence interval)	p value	Number	Adjusted odds ratio (95% confidence interval)	p value
Allergic rhinitis	no	155	1		135	1	
	yes	144	1.4 (0.79–2.4) *	0.259	122	1.7 (0.997–2.9)	0.051
Atopic dermatitis	no	213	1		199	1	
	yes	86	1.4 (0.80–2.6) *	0.230	58	1.0 (0.51–1.9) *	0.988
Food allergy	no	267	1		212	1	
	yes	32	0.89 (0.39–2.1) *	0.789	45	2.5 (1.2–5.2)	0.017
Perceived stress	1st	76	1		60	1	
	2nd	69	1.8 (0.83–3.9)	0.136	66	3.6 (1.6–7.9)	0.001
	3rd	81	3.2 (1.5–6.6)	0.002	77	3.7 (1.7–7.9)	< 0.001
	4th	73	11.7 (5.4–25.5)	< 0.001	54	3.8 (1.7–8.7)	0.001
Asthma severity	1st	59	1		38	1	
	2nd	125	1.7 (0.84–3.6) *	0.137	99	1.3 (0.59–3.1)	0.482
	3rd	88	1.7 (0.76–3.6) *	0.202	82	2.3 (0.99–5.5)	0.053
	4th	27	2.4 (0.85–6.9) *	0.099	38	3.8 (1.4–10.6)	< 0.001

†Disease-specific quality of life (AQ20) was set as a dependent variable at high QOL: 0, low QOL: 1. Initial covariates were allergic rhinitis, atopic dermatitis, food allergy, perceived stress, asthma severity and age. Ordinal variables (perceived stress and asthma severity) among covariates were set at dummy variables as a standard of the first category. The Hosmer-Lemeshow goodness-of-fit statistic was 0 ($p = 1.0$) in age 20–34 and 6.1 ($p = 0.634$) in age 35–44.

* This category was an eliminated covariate from a logistic regression model ($p > 0.1$). The odds ratio in the first step of logistic regression analysis was shown.

factors might confound the results. In addition, our interpretations were considerably limited by the cross-sectional setting. Despite these limitations, our findings suggest that stress is an important factor associated with the quality of life among young adults with asthma.

It can be concluded that a major variable related to the disease-specific quality of life is perceived stress, and therefore, it can be suggested that stress management of patients with asthma might improve their quality of life. This hypothesis, however, must be confirmed by further investigations using a stress management intervention and a follow-up study designed to take gender differences into consideration. Kilpelainen *et al.*³⁴ suggested that stressful life events promote the manifestation of allergic diseases such as asthma, allergic rhinitis or conjunctivitis, and atopic dermatitis. This previous study demonstrated that severe disease, a death of a family member, and parental or personal conflicts were risk factors for asthma. A key issue in stress management is ways of coping with stressful life events and daily chronic stressors, such as business and interpersonal problems. In future researches, the kinds of stressors and the relationship between stressors and asthma symptoms should be examined. In this study, we defined the severity of asthma based on therapeutic steps rated by medical specialists. The therapeutic steps,

clinical data, and quality of life were considered independent factors, which suggests the importance of rating the severity of asthma in terms of multiple dimensions.

ACKNOWLEDGEMENTS

The authors are grateful to the asthma patients who participated in this study and to the doctors and staff of the medical facilities who cooperated in this study (listed below). The authors also wish to express their sincere thanks to Professor Megu Ohtaki of Hiroshima University for helpful suggestions about the study design and statistical analysis, and to Dr. Sankei Nishima at Fukuoka National Hospital and Dr. Takako Morita at Hiroshima University for their review of this manuscript.

This study was supported, in part, by a scientific research grant (Chief researcher: Dr. Akira Akazawa, National Center for Child Health and Development) of the Ministry of Health, Labour and Welfare in Japan. One of the authors (T. Kimura) is also affiliated with the MOA Health Science Foundation, which does not have any interest in this study.

The medical facilities which participated in this study were:

4 university hospitals: (Second Department of Internal Medicine, Ehime University; Department of Molecular and Internal Medicine, Hiroshima University;

First Department of Internal Medicine, Kurume University; Department of Hematology, Oncology and Respiratory Medicine, Okayama University); 13 national/public hospitals: (Ehime Prefectural Central Hospital, Ehime Prefectural Imabari Hospital, Hiroshima City Asa Hospital, Hiroshima City Funairi Hospital, Hiroshima City Hospital, National Hospital Organization Ehime National Hospital, National Hospital Organization Fukuoka National Hospital, National Hospital Organization Fukuoka-Higashi Medical Center, National Hospital Organization Higashihiroshima Medical Center, National Hospital Organization Kumamoto Saishunso National Hospital, National Hospital Organization Minami-Okayama Medical Center, National Hospital Organization Sagami-hara National Hospital, National Hospital Organization Sanyo National Hospital); and 12 private hospitals and clinics: (Andoh Clinic, Chugoku Rousai Hospital, Hiroshima Allergy & Respiration Clinic, Ikuta Clinic, Kitakyushu General Hospital, Maeda Clinic, Matsuzaka Clinic, Shimoyama Clinic, Takahashi Clinic, Tsuya Clinic, Yoshida Internal & Respiratory Medicine Clinic, Yoshijima Hospital).

REFERENCES

1. Bousquet J, Knani J, Dhivert H *et al.* Quality of life in asthma: I. Internal consistency and validity of the SF-36 questionnaire. *Am J Respir Crit Care Med* 1994;**149**:371-5.
2. Ford ES, Mannino DM, Homa DM *et al.* Self-reported asthma and health-related quality of life: Findings from the Behavioral Risk Factor Surveillance System. *Chest* 2003;**123**:119-27.
3. Schmier JK, Chan KS, Leidy NK. The impact of asthma on health-related quality of life. *J Asthma* 1998;**35**:585-97.
4. Erickson SR, Christian RD Jr, Kirking DM, Halman LJ. Relationship between patient and disease characteristics, and health-related quality of life in adults with asthma. *Respir Med* 2002;**96**:450-60.
5. Adams RJ, Wilson DH, Taylor AW *et al.* Psychological factors and asthma quality of life: A population based study. *Thorax* 2004;**59**:930-5.
6. Strine TW, Ford ES, Balluz L, Chapman DP, Mokdad AH. Risk behaviors and health-related quality of life among adults with asthma: The role of mental health status. *Chest* 2004;**126**:1849-54.
7. Lehrer PM, Isenberg S, Hochron SM. Asthma and emotion: A review. *J Asthma* 1993;**30**:5-21.
8. Janson C, Bjornsson E, Hetta J, Boman G. Anxiety and depression in relation to respiratory symptoms and asthma. *Am J Respir Crit Care Med* 1994;**149**:930-4.
9. Rietveld S, Everaerd W, Creer TL. Stress-induced asthma: A review of research and potential mechanisms. *Clin Exp Allergy* 2000;**30**:1058-66.
10. Busse WW, Kiecolt-Glaser JK, Coe C, Martin RJ, Weiss ST, Parker SR. NHLBI workshop summary: Stress and asthma. *Am J Respir Crit Care Med* 1995;**151**:249-52.
11. Wright RJ, Rodriguez M, Cohen S. Review of psychosocial stress and asthma: An integrated biopsychosocial approach. *Thorax* 1998;**53**:1066-74.
12. Wright RJ. Stress and atopic disorders. *J Allergy Clin Immunol* 2005;**116**:1301-6.
13. Archea C, Yen IH, Chen H *et al.* Negative life events and quality of life in adults with asthma. *Thorax* 2007;**62**:139-46.
14. Cohen S, Kamarck T, Mermelstein R. A global measure of perceived stress. *J Health Soc Behav* 1983;**24**:385-96.
15. Leynaert B, Neukirch C, Liard R, Bousquet J, Neukirch F. Quality of life in allergic rhinitis and asthma: A population-based study of young adults. *Am J Respir Crit Care Med* 2000;**162**:1391-6.
16. Fukuhara S, Suzukamo Y. [Manual of the SF-8 Japanese Version]. Kyoto: Institute for Health Outcomes & Process Evaluation Research, 2004 (in Japanese).
17. Hajiuro T, Nishimura K, Jones PW *et al.* A novel, short, and simple questionnaire to measure health-related quality of life in patients with chronic obstructive pulmonary disease. *Am J Crit Care Med* 1999;**159**:1874-8.
18. Iwahashi S, Tanaka Y, Fukudo S, Hongo M. [The development of the Japanese version of the Perceived Stress Scale]. *Shinshin Igaku [Jpn J Psychosom Med]* 2002;**42**:459-66 (in Japanese).
19. Ware JE, Kosinski M, Dewey JE, Gandek B. *How to Score and Interpret Single-Item Health Status Measures: A Manual for Users of the SF-8TM Health Survey*. Lincoln: QualityMetric Incorporated, 2001.
20. Ware JE, Sherbourne CD. The MOS 36-Item Short-Form Health Survey (SF-36): I. Conceptual framework and item selection. *Med Care* 1992;**30**:473-83.
21. Barley EA, Quirk FH, Jones PW. Asthma health status measurement in clinical practice: Validity of a new short and simple instrument. *Respir Med* 1998;**92**:1207-14.
22. Oga T, Nishimura K, Tsukino M, Sato S, Hajiuro T, Mishima M. Comparison of the responsiveness of different disease-specific health status measures in patients with asthma. *Chest* 2003;**122**:1228-33.
23. Ware JE, Kemp JP, Buchner DA, Singer AE, Nolen KB, Goss TF. The responsiveness of disease-specific and generic health measures to change in the severity of asthma among adults. *Qual Life Res* 1998;**7**:235-44.
24. [Asthma Prevention and Management Guidelines 2003, Japan (Updated from: JGL 1998)]. Tokyo:Kyowa Kikaku, 2003 (in Japanese). English summary available: *Int Arch Allergy Immunol* 2005;**136** (Suppl 1):1-49.
25. Roth PL, Switzer FS, Switzer DM. Missing data in multiple item scales: a Monte Carlo analysis of missing data techniques. *Organ Res Methods* 1999;**2**:211-32.
26. *SPSS 13.0J Brief Guide*. Chicago: SPSS, 2004.
27. Kimura T, Tsuda Y, Uchida S, Eboshida A. Association of perceived stress and stiff neck/shoulder with health status: Multiple regression models by gender. *Hiroshima J Med Sci* 2006;**55**:101-7.
28. Matud MP. Gender differences in stress and coping styles. *Pers Individ Dif* 2004;**37**:1401-15.
29. Cohen S, Rodriguez M. Stress, viral respiratory infections, and asthma. In: Skoner DP (ed). *Asthma and Respiratory Infections*. New York: Dekker, 2001:193-208.
30. Nishimura K, Hajiuro T, Oga T, Tsukino M, Ikeda A. Health-related quality of life in stable asthma: What are remaining quality of life problems in patients with well-controlled asthma? *J Asthma* 2004;**41**:57-65.
31. Oga T, Nishimura K, Tsukino M, Sato S, Hajiuro T, Mishima M. A comparison of the responsiveness of different generic health status measures in patients with asthma. *Qual Life Res* 2003;**12**:555-63.
32. Matheson M, Raven J, Woods RK, Thien F, Walters EH, Abramson M. Wheeze not current asthma affects quality of life in young adults with asthma. *Thorax* 2002;**57**:165-7.
33. Ekici A, Ekici M, Kara T, Keles H, Kocyigit P. Negative

- mood and quality of life with asthma. *Qual Life Res* 2006;
15:49-56.
- 34.** Kilpelainen M, Koskenvuo M, Helenius H, Terho EO.

Stressful life events promote the manifestation of asthma
and atopic diseases. *Clin Exp Allergy* 2002;**32**:256-63.