Theoretical validity and reliability of Vespide Quality of Life Questionnaire in Polish adolescents with *Hymenoptera* venom allergy

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Post Dermatol Alergol 2012; XXIX, 1: 8–13

Abstract

Introduction: Measurement of health-related quality of life is mostly used with advanced measurement tools, such as scales. The use of a certain scale in different cultural settings or in age groups other than those it was designed for needs conducting the adaptation process and assessment of psychometric properties of the adapted scale.
Aim: This paper presents the results of theoretical validity and reliability analysis of the Polish adaptation of the VQLQ scale for adolescents with Hymenoptera venom allergy.
Material and methods: The study sample consisted of 78 adolescents aged 14-19 years, who were treated with venom immunotherapy in Polish allergological centers in 2008 year. Theoretical validity of the scale was analyzed with exploratory factor analysis using the principal components method. Reliability analysis was assessed in terms of internal consistency with Cronbach's α coefficient and by testing Kline's criterion.
Results: The results showed satisfactory validity of the scale: factor analysis revealed a 3-factor structure of the scale – extracted factors were described as anxiety, caution and discomfort. All the scale items contributed to unique factors, except for one item concerning limitation in summer due to allergy, which was identified as a separate dimension of health-related quality of life of Polish adolescents with *Hymenoptera* venom allergy. All the extracted subscales were characterized by values of α coefficient equal or higher than 0.8, what is usually considered as a high-level reliability coefficient.
Conclusions: The adapted scale is a valid and reliable tool measuring health-related quality of life in Polish adolescents treated with venom-specific immunotherapy.

Key words: adolescents, health-related quality of life, psychometric properties, venom immunotherapy, Vespide Allergy Quality of Life Questionnaire.

Introduction

Health-related quality of life (HRQoL) is a multidimensional concept and its dimensions are represented by variables which are difficult for direct measurement – the so-called latent variables. They should be measured with the use of multi-item tools, which measure each of these variables with a set of items – observable indica-

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tors of a particular latent variable. The methodology of development, validation and use of such instruments – the so-called patient reported outcomes – in adults is well established and still being improved. Measuring HRQoL in adolescents is still a challenge, usually due to lack of tools dedicated to this particular group of patients.

In the first trials of HRQoL measurement in adolescents and children, parents were treated as proxy respondents, answering the questions concerning their children, but data from early 1990s showed that the use of parents' reports provided information which may reflect the real child situation in no more than 10% to 30% [1]. Parents tended to report children's quality of life (QoL) to be worse as reported by children and concordance between children and their parents differed due to the measured dimension of HRQoL: a higher correlation was obtained in the case of physical activity, functioning and some symptoms, while a poorer one was seen in the case of emotional and social HRQoL dimension [2, 3]. Parents were less reliable when reporting children's internalizing, (e.g. sadness, anxiety) than when reporting externalizing issues (e.g. aggression, activity) [3]. Also other data showed that the use of proxy respondents in the case of HRQoL measurement leads to imperfect agreement and not equivalent results [4, 5].

Along with an increasing importance of HRQoL for clinical decisions, and a rising interest in measuring HRQoL in adolescents and children, measurement practice led to construction of many scales, both generic [6] and specific, addressed to a specific group of patients such as women [7, 8] or adolescents [9-11]. In the case of lack of a specific tool addressed to this age group, tools for adults are adapted to adolescents' conditions, or their original versions are used in adolescents aged over 14 in HRQoL measurement [6, 12, 13], as well as in psychological practice [14, 15] or health diagnostics [16].

Studies of HRQoL in adolescents with allergic conditions have been conducted for several years, and led to development of many tools for this group of patients, such as: Adolescent Rhinoconjunctivitis Quality of Life Questionnaire [17], or Adolescent Asthma Quality of Life Questionnaire [18]. But there are still some diseases, including Hymenoptera venom allergy (HVA), in which there is still no specific tool for measurement of HRQoL in adolescent patients. The original tool dedicated to adult patients suffering from HVA, Vespide Allergy Quality of Life Questionnaire (VQLQ), was developed in the Netherlands [19].

Aim

This paper presents the results of cultural adaptation of this scale for Polish adolescents with HVA.

Material and methods

The study sample consisted of 78 adolescents, aged 14 to 19 years (mean age 16.6 years, SD 1.7), from 5 clinical centers in Poland, covering almost the whole population at this age treated with venom-specific immunotherapy (VIT) in Poland in September 2008. The detailed sociodemographic and medical characteristics of the group are listed in Table 1. The data were gathered in all adolescents who were treated with VIT in centers participating in the study. The interviews were conducted using a structured questionnaire containing demographic data (gender, age and place of residence), and Polish adolescent version of VQLQ scale. The original scale is an index developed according to impact methodology and consisting of 14 items concerning: anxiety of being stung by certain insects, behaviors leading to avoidance of restings, limitations during summer and feelings of being troubled by looking for insects in different settings. Only one question concerning "being scared of being stung" concerns the strength of this feeling, in other questions, answer options are formulated in terms of frequency of the feeling or behavior. Five "being troubled" items have a conditional construction: patients may not respond if the item does not concern them. Each item has a 7-point Likert response scale. Based on theoretical considerations, the authors suggested this tool to be used as an unidimensional one [19].

The adaptation of VQLQ for Polish adolescents was based on an unpublished Polish version of VQLQ for adults

Table 1. Medical characteristics of the group

Parameter	*N*	%
Gender		
Men	65	83.3
Women	13	16.7
Place of residence		
Urban	29	37.2
Rural	49	62.8
Immunotherapy against		
Wasp	36	46.2
Bee	39	50.0
Both	3	3.8
Mueller's grade before VIT		
2	8	10.3
3	49	62.8
4	21	26.9
VIT protocol		
Ultra rush	16	20.5
Rush	41	52.6
Conventional	21	26.9
Total	78	100.0

(translation by M. Niedoszytko, Allergy Clinic, Medical University of Gdansk, approved by authors of the VQLQ).

The theoretical validity of the Polish adolescent version of the VQLQ scale was assessed using principal component analysis (PCA), with Varimax rotation to obtain clear interpretation of extracted factors [20]. The criterion for the number of extracted factors was eigenvalue greater than 1. The results of PCA were presented as a matrix of factor loadings (standardized regression coefficients of variable on principal components). Usually, a value of factor loading equal or higher than 0.7 is used when regarding a particular item as defining a particular factor.

Zero-order correlation coefficients were used to establish a range of variance shared by dimensions of HRQoL measured by VQLQ scale.

Table 2. Matrix of factor loadings (PCA – Varimax rotation) of Polish adolescent adaptation of VQLQ*

	Component		
	1	2	3
Variance explained (%)	50.3	16.2	12.0
Discomfort while playing in garden	0.96		
Discomfort while being at school	0.95		
Discomfort while eating outdoors	0.85		
Discomfort outdoors	0.87		
Discomfort on holiday	0.87		
Discomfort in countryside settings	0.81		
General discomfort	0.80	0.49	
Leaving places where insects are present		0.84	
Avoiding places where insects may be present		0.74	
Looking for insects		0.74	
Panicking in the presence of insects		0.60	
Fear of being stung			0.89
Fear after being stung			0.86
Limitations on activities during summer	0.47		0.70

**Factor loadings lower than 0.4 were hidden for more clear presentation of results*

Table 3. Pearson correlations between dimensions of Polish adolescent adaptation of VQLQ

	Anxiety	Caution	Limitations	Discomfort
Anxiety	1			
Caution	0.65	1		
Limitations	0.53	0.59	1	
Discomfort	0.50	0.68	0.72	1

Reliability of the scale and its subscales, in terms of internal consistency, was evaluated with Cronbach's α coefficient [21]. Values of particular coefficients higher than 0.7 were regarded as acceptable, while higher than 0.8 – as satisfactory [22].

The statistical analysis was conducted with SPSS 15 for Windows.

Results

The study sample consisted mainly of boys (83%), and mostly residents of rural areas (63%). The mean age of adolescents under study was 16.6 years (SD 1.7, range 14-19 years). The number of patients allergic to either bee venom or yellow jacket venom was almost equal. Most of the patients were treated with rush protocol and most of them reported the 3rd grade of Mueller's classification of anaphylactic reaction before beginning VIT (Table 1).

The patients were studied at different stages of VIT with a mean of 2.6 years of treatment (SD 1.9). The mean age of the first sting was 9.5 years (SD 3.3), while the mean age of beginning VIT equaled 13.1 (SD 2.3). The mean number of stings before VIT was equal to 3.8 (SD 2.9).

Principal component analysis with Varimax rotation, conducted for 14 items included in the Polish adolescent version of the VQLQ, extracted three principal components with eigenvalues higher than 1, explaining together 78.5% of total variance of this set of variables. The first principal component, explaining 50.3% of the variance, was highly loaded by 7 variables describing feelings of discomfort caused by looking for insects in different situations. These variables constituted subsequently the discomfort subscale. The second factor, explaining 16.2% of the variance, was defined by variables subsequently included in the caution scale: avoiding or leaving places where insects may occur, looking for insects, and having panic attacks in the presence of insects. On the third principal component, explaining 12.0% of total variance, variables concerning fear of being stung and fear after being stung had their highest factor loadings (Table 2). Those variables constituted the subscale of anxiety. Based on the results of content validity analysis, a variable concerning sense of limitations in activity during summer because of allergy, also having its highest loading on the third principal component, and after comparison with results of adaptation of VQLQ for Polish children treated with VIT and for their parents, it was treated as a separate dimension of HRQoL in adolescents treated with VIT [22].

Pearson correlations between scores of dimensions of the Oude-Elberink scale adapted for Polish adolescents were between 0.50 (for anxiety and discomfort) and 0.72 (for limitations and discomfort), pointing to a strong relationship between the analyzed domains (Table 3).

Reliability of the constructed scales, measured in terms of internal consistency, with the use of Cronbach α

coefficient, was equal: 0.95 for discomfort subscale, 0.82 for anxiety subscale, 0.80 for caution subscale, and 0.91 for the total score of the 14-item tool.

Discussion

Quality of life in venom allergy patients is poorly evaluated. Until the development of VQLQ by Oude-Elberink *et al.* [19], which was the first measurement tool specific to venom allergic adult patients, studies on that topic were of a strictly exploratory character [23, 24]. The presented study shows the results of adaptation of this tool for Polish adolescents with Hymenoptera venom allergy treated with VIT.

The studies based on VQLQ were performed in the Netherlands and English-speaking countries, but the factor structure of the original VQLQ has not been evaluated yet [19, 25]. The results of PCA showed that VQLQ adapted for Polish adolescents had a three-factor structure, which based on content validity analysis may be described as anxiety, caution and discomfort. Presented results are similar to the result of an analogous analysis conducted for VQLQ adaptations for Polish children, and for their parents [22]. The analyses conducted for Polish children revealed a four-factor structure, but two of these factors were defined by seven variables describing the feelings of discomfort, which in the results presented in this paper are correlated with a common factor. The result of PCA for parents' adaptation of VQLQ showed that all these variables were highly loaded on a common factor, but two of them also had high loadings on the factor which was defined by variables describing the level of caution [22].

The comparison of those suggested that in adolescents another factor – limitations – should be considered. The position of this item in the factor structure varied between different adaptations of VQLQ: in the presented results, this variable highly loaded on the factor defined by items related to anxiety, while in the children's adaptation, this variable was highly correlated with the factor defined by items measuring caution, and, finally, what was the strongest argument for treating this variable as a separate dimension, in the parents' adaptation, this variable constituted a separate factor [22].

Differences observed in the case of different adaptations of VQLQ also focused on the number of items measuring anxiety and caution, which varied from two items included in the anxiety subscale and four items included in the caution subscale in the presented results, to three items included in both subscales in the parents' adaptation, to four items included in the anxiety subscale and two items included in the caution subscale in children VQLQ adaptation. These differences may in part be caused by diversity in formulation of questions in different versions, which followed variability in the context of a particular item (versions for affected adolescents, affected children, and their healthy parents), or those related to differences in verbal resources of children, adolescents and adults – parents of the studied children.

The impact method used for construction of VQLQ scale for adults with yellow-jacket allergy indicates that factors defined by items of the index are the most important dimensions of HRQoL in these patients. The question arises whether in adolescents they are the only ones.

The authors of VQLQ defined this tool as unidimensional, but subscales measuring particular dimensions of HRQoL in adolescents with HVA (as well as in children and their parents) are so different in nature that the probability that they measure the same latent variable is limited [22]. This conclusion is supported by the fact that the amount of variance of caution explained by anxiety seems to be too low to believe that higher caution has to be regarded as deterioration of HRQoL, because it is possible that patients exhibit cautious behaviors to avoid restings and to lower their level of anxiety and to achieve higher levels of safety. It is also not obvious why higher scores in caution have to be treated the same way as higher scores in anxiety: a one-point difference on the anxiety score may not equal a one-point difference on a score of other dimensions (e.g. caution) in the perception of the studied patients, while both are reflected as a one-point difference on the total score.

The presented study confirmed a high reliability of VQLQ adapted for Polish adolescents, but revealed also some concerns about the scale. Internal consistency of the total score in our study was estimated at 0.93, while the authors of the scale reported the value of 0.96 [19]. However, it should be stated that Cronbach α coefficient should not be used to assess reliability of multidimensional scales, because it estimates the amount of variance shared by all scale items with the first latent variable, of those which explain total variance of the scale [21]. The results of the presented study (as well as of validity analysis of other adaptations of VQLQ) suggest that discomfort is this latent variable [22].

All the subscales extracted from the set of 14 items were characterized by satisfactory values of Cronbach α coefficients. Their reliability, measured with this coefficient, was equal to 0.95 for the discomfort subscale, 0.82 for the anxiety subscale and 0.80 for the caution subscale. These results are comparable with the values obtained during adaptation of VQLQ scale for Polish children with HVA and for their parents: reliability of the discomfort subscale was in both cases equal to at least 0.9 (0.93 and 0.90, respectively), whereas reliability of the anxiety subscale was close to 0.8 or higher (0.79 and 0.90, respectively). Only reliability of the caution subscale in parents was higher than that obtained in the case of adolescents' adaptation ($\alpha = 0.86$), whereas in the case of children's adaptation, it was rather weak ($\alpha = 0.53$). However, it should be noted that, based on factor analysis results, this subscale in children's adaptation was built with two items only [22].

Reliability of the limitations subscale was impossible to assess using the methods applied in the study, which are based on the number of items and mean level of their interrelation (Cronbach α coefficient), because they may be applied to scales consisting of at least two items [26]. It is also doubtful whether one simple question may cover the full sense of limitations experienced by a person with HVA, because individuals may perceive their level of limitations as very diverse, regarding different fields of activities. Formulation of the item raises doubts as to the kind of activities it addresses: self-care, helping parents to do housework, activities related to performing social roles or professional duties (attending school in the case of adolescents), or leisure time activities, or possibly activities related to personal affairs?

The discomfort subscale score as well as items it includes were skewed to the extent which did not prevent from treating their distributions as normal, but this similarity in distribution could result in a high correlation between items (higher than 0.60). It may also be a result of the specific sample under study, which occurred in similar scoring of the level of discomfort in different situations. It may be also the effect of strong similarity in formulation and meaning of items, which also provokes giving similar answers to particular items, especially when they are located in the scale next to each other [27]. Thus, a high number of discomfort items in VQLQ is a result of construction process of the original questionnaire, based on the impact method, which usually leads to not strong, but substantially different properties of the final questionnaire as compared to methods based on factor analysis [28, 29].

Based on the presented results we may conclude that the process of adaptation of the VQLQ scale for Polish adolescents led to the construction of a scale with good psychometric properties, which should be used as a multidimensional tool. Vespide Allergy Quality of Life Questionnaire may be treated as a good foundation for development of a measurement instrument dedicated to measuring HRQoL in adolescents with venom allergy, helpful in making medical decisions on venom specific immunotherapy.

Conclusions

Vespide Allergy Quality of Life Questionnaire adapted for Polish adolescents is a valid and reliable tool, which makes it possible to assess the level of HRQoL in this group of patients.

Acknowledgments

Supported by the research grant from the Polish Ministry of Science and Higher Education (registration number N N407 254 134).

The study was conducted at the Department of Pediatrics, Polish-American Institute of Pediatrics, Jagiellonian University Medical College, Krakow, Poland. Work should be attributed to the Department of Medical Sociology, Chair of Epidemiology and Preventive Medicine, Jagiellonian University Medical College, Krakow, Poland.

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