ORIGINAL ARTICLE
Pediatrics

JKMS

http://dx.doi.org/10.3346/jkms.2013.28.12.1788 • J Korean Med Sci 2013; 28: 1788-1795

Cross-Cultural Adaptation of the Korean Version of the Minneapolis-Manchester Quality of Life Instrument-Adolescent Form

Hyeon Jin Park,[1]* Hyung Kook Yang,[2]* Dong Wook Shin,[3,4] Yoon Yi Kim,[5] Young Ae Kim,[6] Young Ho Yun,[7] Byung Ho Nam,[8] Smita Bhatia,[9] Byung Kiu Park,[1] Thad T. Ghim,[1] Hyoung Jin Kang,[10] Kyung Duk Park,[10] Hee Young Shin,[10] and Hyo Seop Ahn[10]

[1]Center for Pediatric Oncology, National Cancer Center, Goyang; [2]Cancer Policy Branch, National Cancer Control Institute, National Cancer Center, Goyang; [3]Department of Family Medicine & Health Promotion Center, Seoul National University Hospital, Seoul; [4]Cancer Survivorship Clinic, Seoul National University Cancer Hospital, Seoul; [5]Korea Childhood Leukemia Foundation, Seoul; [6]Research Institute and Hospital, National Cancer Center, Goyang; [7]Cancer Research Institute, Seoul National University Hospital and College of Medicine, Seoul; [8]Cancer Biostatistics Branch, National Cancer Research Institute, National Cancer Center, Goyang, Korea; [9]Department of Population Sciences, City of Hope Comprehensive Cancer Center, Duarte, CA, USA; [10]Department of Pediatrics, Cancer Research Institute, Seoul National University College of Medicine, Seoul, Korea

*Hyeon Jin Park and Hyung Kook Yang contributed equally to this work.

Received: 19 July 2013
Accepted: 8 October 2013

Address for Correspondence:
Hee Young Shin, MD
Department of Pediatrics, Cancer Research Institute, Seoul National University College of Medicine, 101 Daehak-ro, Jongno-gu, Seoul 110-774, Korea
Tel: +82.2-3675-0999, Fax: +82.2-2072-2917
E-mail: hyshin@snu.ac.kr

This study was supported by a grant from the National R&D Program for Cancer Control, Ministry of Health, Welfare and Family Affairs, Republic of Korea (No. 0620460).

We verified the reliability and validity of the Korean version of the Minneapolis-Manchester Quality of Life Instrument-Adolescent Form (KMMQL-AF) among Korean childhood cancer survivors. A total of 107 childhood cancer patients undergoing cancer treatment and 98 childhood cancer survivors who completed cancer treatment were recruited. To assess the internal structure of the KMMQL-AF, we performed multi-trait scaling analyses and exploratory factor analysis. Additionally, we compared each domains of the KMMQL-AF with those of the Karnofsky Performance Status Scale and the Revised Children's Manifest Anxiety Scale (RCMAS). Internal consistency of the KMMQL-AF was sufficient (Cronbach's alpha: 0.78-0.92). In multi-trait scaling analyses, the KMMQL-AF showed sufficient construct validity. The "physical functioning" domain showed moderate correlation with Karnofsky scores and the "psychological functioning" domain showed moderate-to-high correlation with the RCMAS. The KMMQL-AF discriminated between subgroups of different adolescent cancer survivors depending on treatment completion. The KMMQL-AF is a sufficiently reliable and valid instrument for measuring quality of life among Korean childhood cancer survivors.

Key Words: Quality of Life; Questionnaires; Validation Studies; Child Psychology; Neoplasms; Survivors

INTRODUCTION

Because of remarkable improvements in childhood cancer treatment, the 5-yr survival rate of childhood cancer has reached nearly 80% in developed countries (1). In Korea, the 5-yr survival rate of childhood cancer reached as high as 76.7% for those who were diagnosed between 2006 and 2010 from only 54.6% for those who were diagnosed between 1993 and 1995 (2). Such outstanding improvement in the survival rate has resulted in a growing population of childhood cancer survivors and an increasing need to address their health related quality of life (HRQoL).

Although some instruments measuring HRQoL have been used in childhood and adolescent cancer survivors (3-12), most of them are only applicable to a specific cancer type (11, 12) or cannot be used simultaneously in childhood cancer patients on treatment and in those off treatment (4, 7, 9, 13). Moreover,

pISSN 1011-8934
eISSN 1598-6357

some instruments have been used proxy assessments, completed by parents or physicians (14, 15). The Minneapolis-Manchester Quality of Life (MMQL) instrument is a reliable and well-validated self-reporting inventory (5, 16, 17), which has also been adapted for British (18, 19) and Swedish populations (20). Because childhood cancer survivors often cross developmental stages during cancer treatment and follow-up (21), longitudinal assessment of HRQoL in childhood cancer patients is difficult. To address this problem, 3 versions of the MMQL were developed. The Youth Form (YF) was used for children aged between 8 and 12 yr and was administered to the child by interview. The Adolescent Form (AF) was used for adolescents aged between 13 and 20 yr and was self-administered. The Young Adult Form was used for cancer survivors aged between 21 and 45 yr and was self-administered. These tools can reflect the changes in the developmental stages of the patients and be applicable to childhood cancer patients on treatment and those off treatment.

This study aimed at verifying the reliability and validity of the Korean version of the Minneapolis-Manchester Quality of Life Instrument-Adolescent Form (KMMQL-AF) among Korean childhood cancer survivors.

MATERIALS AND METHODS

Study design, subjects, and data collection

We recruited study participants from Seoul National University Children's Hospital and the Center for Pediatric Cancer, National Cancer Center in Korea between May 2008 and January 2010. The study interviewers recruited the childhood and adolescent cancer patients from either the outpatient clinic or the inpatient wards. The patients were asked to complete the self-administered questionnaire alone in the room when the interview was conducted. All subjects were between 13 and 20 yr of age and were able to read and understand Korean. We divided the participants into 2 groups: 1) 13- to 20-yr-old patients receiving cancer treatment for 2 or more months prior to study participation ('on treatment' cancer patients), and 2) the same-aged participants who had completed cancer treatment over a year ago ('off treatment' cancer survivors). We recruited 107 'on treatment' cancer patients and 98 'off treatment' cancer survivors.

Instruments

We obtained consent from the original author of the original English version of the MMQL-AF. Linguistic validation of the MMQL-AF was performed through a standard forward-backward translation process. A provisional version of the Korean MMQL-AF was pretested on 15 patients during their follow-up clinic visit at the National Cancer Center in Korea. Subjects were asked to comment on the comprehensiveness and clarity of the items in the KMMQL-AF and on the degree of difficulty encountered when answering the questionnaires.

The original version of the MMQL-AF was developed for subjects aged between 13 and 20 yr, and it comprises 46 items pertaining to 7 HRQoL domains: 1) physical functioning, 2) psychological functioning, 3) social functioning, 4) cognitive functioning, 5) body image, 6) outlook on life, and 7) intimate relations. Scoring on the MMQL-AF ranges from 1 (minimal HRQoL) to 5 (maximal HRQoL). However, items 20, 21, and 22 are scored on a 4-point Likert scale and their scoring advances by 1.25. Thus, in these cases, the lowest score is 1.25 and the highest is 5. Therefore, higher scores indicate minimal negative impact and thus greater HRQoL (5). We computed the domain-specific score by summing the scores for all items in each domain and dividing the value by the number of items in that domain. An overall QOL score is calculated by summing the scores for all items, and dividing the value by the number of items in the questionnaire. Because of a low missing rate, we excluded responses with missing values from the calculation.

For assessing concurrent validity, we used Karnofsky Performance Status Scale (KPS) (22) and the Revised Children's Manifest Anxiety Scale (RCMAS) (23, 24). KPS was developed to measure the level of patient activity and medical care requirements. It has been widely used in childhood cancer patients. Karnofsky score ranges from 0 (death) to 100 (perfect). The higher the Karnofsky score, the better the performance status. We hypothesized that the "physical functioning" domain of the KMMQL-AF might have moderate correlation with the Karnofsky score.

RCMAS is a self-report to assess the degree and nature of anxiety experienced by children and adolescents. RCMAS has 37 items that assess trait anxiety of school-aged children. A total anxiety score is computed based on 28 items, which are divided into 3 anxiety domains: physiological anxiety (10 items related to somatic manifestations of anxiety such as sleep difficulties, nausea, and fatigue), worry/oversensitivity (11 items measuring obsessive concerns about a variety of things, most of which are typically vague and ill-defined, as well as fears about being hurt or emotionally isolated), and social concerns/concentration (7 items measuring distracting thoughts and fears that have a social or interpersonal nature). The remaining 9 items on the RCMAS constitute the Lie domain. All the items use a simple "yes-or-no" response format, and each item is given a score of 1 for a "yes" response, yielding a total anxiety score. High scores on the subscales can represent different aspects of anxiety, which can be used to develop hypotheses about the origin and nature of a child's anxiety. We hypothesized that the "psychological functioning" domain of the KMMQL-AF might have moderate correlation with 3 anxiety domains of RCMAS.

Statistical analyses

Descriptive analyses were conducted to evaluate the characteristics of the study participants and to confirm the presence of

the ceiling or floor effect in the questionnaires. Cronbach's alpha coefficients were calculated for each of the 7 domains to assess the internal consistency of the KMMQL-AF. A Cronbach's alpha value of 0.7 or more was considered satisfactory.

To assess the underlying factor structure of the KMMQL-AF, exploratory factor analysis with varimax rotation was done. We hypothesized that the KMMQL-AF would have a similar factor structure as the original English version. We extracted components with eigenvalues of more than 1.00. After rotation, individual items with loadings exceeding 0.40 were considered as significant.

To assess the correlations between items and domains within the KMMQL-AF, we conducted multi-trait scaling analysis (25). Convergent validity for each domain was examined by assessing the correlation between each item and its own domain (corrected for overlap) with Pearson's correlation coefficients. Items with correlation values ≥ 0.4 were considered as valid. The discriminant validity of the KMMQL-AF was assessed by comparing the correlation of each item with its own domain (corrected for overlap) with the correlation of each item with the other domains of the KMMQL-AF. Scaling errors were defined as cases in which an item correlated significantly less with its own domain than with the other domains.

To assess concurrent validity, we analyzed Pearson's correlation coefficients among the KMMQL-AF, KPS, and RCMAS. Coefficients below 0.40 revealed weak correlation, and those between 0.40 and 0.60 revealed moderate correlations. Coefficients above 0.60 showed high correlation between the domains.

Known group validity was examined by comparing the 2 study participant groups ('on treatment' and 'off treatment' groups). Student's t-tests for each domain of the KMMQL-AF were conducted to determine which scales were able to differentiate between 'on treatment' and 'off treatment' groups.

All the statistical analyses were performed using STATA 12.1 (STATA Corp., Houston, TX, USA). Statistical significance was defined as *P* value ≤ 0.05 on 2-tailed analyses.

Ethics statement

This study was approved by the institutional review boards of the National Cancer Center (NCCNCS-08-111) and Seoul National University Hospital (H-0803-046-238). The study interviewers explained the survey purpose and procedures to the patients and their parents. They also obtained informed consent from both the patients and parents.

RESULTS

Baseline characteristics of the study participants

The baseline characteristics of the study participants are shown in Table 1. The mean age of the participants was 17.9 yr (standard deviation [SD] = 2.1 yr). Male participants were more common (n = 120, 58.5%) than were female participants; and most of the participants had graduated elementary school (n = 89, 43.4%) or middle school (n = 75, 35.6%). Leukemia/lymphoma was the most common cancer type (n = 88, 42.9%), followed by solid tumors/other types (n = 82, 40.0%). All of the participants had received chemotherapy, and about 40% of the participants had undergone surgery (n = 82, 40.0%) and radiotherapy (n = 77, 37.6%). There was no significant difference in the baseline characteristics between 'on treatment' and 'off treatment' groups.

Table 1. Baseline characteristics of the study participants

Characteristics	On treatment (n = 107) No. (%)	Off treatment (n = 98) No. (%)	*P* value
Age (yr)			0.20
Mean ± SD (yr)	17.7 ± 2.2	18.1 ± 2.0	
Sex			0.86
Male	62 (57.9)	58 (59.2)	
Female	45 (42.1)	40 (40.8)	
Educational status			0.87
Elementary school graduation	48 (44.9)	41 (41.8)	
Middle school graduation	40 (37.4)	35 (35.7)	
High school graduation	15 (14.0)	17 (17.4)	
Missing	4 (3.7)	5 (5.1)	
Diagnosis			0.21
Leukemia/Lymphoma	42 (39.2)	46 (46.9)	
Brain tumor	16 (15.0)	19 (19.4)	
Solid tumor/Other	49 (45.8)	33 (33.7)	
Surgery			0.49
No	62 (57.9)	60 (61.2)	
Yes	45 (42.1)	37 (37.8)	
Missing	0 (0.0)	1 (1.0)	
Chemotherapy			
No	0 (0.0)	0 (0.0)	
Yes	107 (100.0)	98 (100.0)	
Radiotherapy			0.57
No	67 (62.7)	60 (61.2)	
Yes	40 (37.4)	37 (37.8)	
Missing	0 (0.0)	1 (1.0)	

Frequency distribution of responses

The frequency distribution of responses is shown in Table 2. All of the items showed low missing proportions below 2%, except item 2 (8.3%). Although all items showed the low proportions of the lowest score (below 40%), 11 items (items 7, 12, 13, 16, 27, 30, 31, 33, 35, 38, and 40) showed the high proportions of the highest score (over 40%) (Table 2).

Internal consistency and multi-trait scaling analyses

Table 3 represents the internal consistency and multi-trait scaling analyses of the KMMQL-AF. All of the domains had satisfactory Cronbach's alpha coefficients ranging between 0.78 and 0.92. When we omitted items 4, 11, and 40 from the scales, the internal consistency improved (not shown in Table).

Multi-trait scaling analyses of the KMMQL-AF confirmed the suggested structure with low scaling errors (6/322 = 1.9%). How-

http://dx.doi.org/10.3346/jkms.2013.28.12.1788

Table 2. Distribution of responses

Domains	Items	No. (%) of response frequency		
		Missing	Lowest score (1)	Highest score (5)†
Physical functioning				
Item 2	Unable to keep up with others of their age when taking part in sports	17 (8.3)	19 (9.3)	13 (6.3)
Item 3*	Have a lot of energy	2 (1.0)	7 (3.4)	35 (17.1)
Item 4	Need time to rest during the day	3 (1.5)	42 (20.5)	2 (1.0)
Item 5*	Have a lot of energy for running or other sports	2 (1.0)	23 (11.2)	31 (15.1)
Item 6	Unable to do many activities because of health conditions	2 (1.0)	29 (14.2)	54 (26.3)
Item 7	Unable to do many activities because of arms or legs	2 (1.0)	19 (9.3)	102 (49.8)
Item 8	Prefer to watch rather than take part in games and sports	2 (1.0)	37 (18.1)	39 (19.0)
Item 11*	Feeling tired during the day	0 (0.0)	6 (2.9)	46 (22.4)
Item 15	Feel strong and healthy	2 (1.0)	26 (12.7)	29 (14.2)
Cognitive functioning				
Item 34	Difficulty in concentrating at work or in school	1 (0.5)	8 (3.9)	56 (27.3)
Item 35	Difficulty concentrating at other times (computer, games, playing card, reading)	0 (0.0)	5 (2.4)	119 (58.1)
Item 36	Homework or study is hard for them	0 (0.0)	6 (2.9)	39 (19.0)
Item 37	Needing more help with school work compared to others in class	0 (0.0)	3 (1.5)	74 (36.1)
Item 38*	Difficulty with remembering things at school	0 (0.0)	0 (0.0)	102 (49.8)
Item 39*	Difficulty in concentrating at work or in school	0 (0.0)	2 (1.0)	78 (38.1)
Item 40*	Difficulty with reading or writing	0 (0.0)	1 (0.5)	148 (72.2)
Item 41*	Difficulty with math or calculations	0 (0.0)	10 (4.9)	86 (42.0)
Item 42*	Difficulty with school work compared to others in class	0 (0.0)	6 (2.9)	76 (37.1)
Psychological functioning				
Item 9*	Feeling sad	0 (0.0)	0 (0.0)	78 (38.1)
Item 10*	Feeling angry	0 (0.0)	0 (0.0)	66 (32.2)
Item 12*	Feeling lonely	0 (0.0)	7 (3.4)	121 (59.0)
Item 13*	Feeling frightened	0 (0.0)	0 (0.0)	120 (58.5)
Item 14*	Feeling nervous or anxious	0 (0.0)	4 (2.0)	65 (31.7)
Item 16*	Worried about dying	0 (0.0)	3 (1.5)	119 (58.1)
Item 17*	Worried about their health	1 (0.5)	8 (3.9)	62 (30.2)
Item 18*	Worried about things in general	0 (0.0)	7 (3.4)	61 (30.0)
Item 19*	Feeling inferior to most people	0 (0.0)	3 (1.5)	87 (42.4)
Body image				
Item 20*	Being satisfied with their weight	0 (0.0)	38 (18.5)	32 (15.6)
Item 21*	Being happy about the way they look	0 (0.0)	26 (12.7)	37 (18.1)
Item 22*	Feeling about their body development	0 (0.0)	36 (17.6)	34 (16.6)
Item 23*	Liking their body the way it is	0 (0.0)	21 (10.2)	48 (23.4)
Item 24	Feeling that others think that their body is poorly developed	0 (0.0)	12 (5.9)	71 (34.6)
Item 25	Feeling uncomfortable about the way their body is developing	0 (0.0)	10 (4.9)	75 (36.6)
Social functioning				
Item 28*	Believing that people like to be with them	0 (0.0)	1 (0.5)	42 (20.5)
Item 29*	Have many close friends	0 (0.0)	2 (1.0)	47 (22.9)
Item 30*	Getting along well with people their age	1 (0.5)	3 (1.5)	96 (46.8)
Item 31*	Having a lot in common with their friends	0 (0.0)	7 (3.4)	92 (44.9)
Item 32*	Having similar hobbies and interests to people their age	0 (0.0)	4 (2.0)	78 (38.1)
Item 33*	Being together with other people gives them a good feeling	0 (0.0)	4 (2.0)	104 (50.7)
Outlook on life				
Item 45*	Happy with the way things are	0 (0.0)	18 (8.8)	51 (24.8)
Item 46*	Happy with life in general	0 (0.0)	6 (2.9)	69 (33.7)
Item 47*	Satisfied with their current life situation	0 (0.0)	22 (10.7)	61 (29.8)
Intimate relations				
Item 26	Difficulty in making friends	0 (0.0)	9 (4.4)	82 (40.0)
Item 27	Feel left out in groups of people their age	0 (0.0)	10 (4.9)	89 (43.4)
Item 43*	Find it easy to have an intimate relationship	0 (0.0)	5 (2.4)	54 (26.3)
Item 44*	Feel confident when they are with people of opposite sex	0 (0.0)	11 (5.4)	26 (12.7)

*Reversed item; †The highest scores of item reversed items 20, 21, and 22 are 4.

ever, items in the "physical functioning" domain showed relatively low item-own scale correlations.

Exploratory factor analyses

The original version of the MMQL-AF has 46 items in 7 domains. They are as follows: "physical functioning" (items 2-8, 11, and 15); "cognitive functioning" (items 34-42); "psychological functioning" (items 9, 10, 12-19); "body image" (items 20-25); "social functioning" (items 28-33); "outlook on life" (items 45-47); and "intimate relations" (items 26, 27, 43, and 44).

When exploratory factor analysis with principal-component factor extraction was performed using our data, 7 factors were

Table 3. Internal consistency and multi-trait scaling analysis of KMMQL-AF

Domains	No. of items	Cronbach's α*	Cronbach's α, if item deleted*	Item-own scale correlation†		Item-other scale correlation	
				Range of correlation	Success/Total	Range of correlation	Success/Total
Physical functioning	9	0.78	0.73-0.79	0.20-0.65	6/9	0.01-0.39	54/54
Cognitive functioning	9	0.85	0.82-0.85	0.35-0.76	8/9	0.10-0.40	54/54
Psychological functioning	9	0.82	0.79-0.82	0.41-0.67	9/9	0.11-0.57	53/54
Body image	6	0.83	0.77-0.83	0.42-0.75	6/6	0.06-0.69	35/36
Social functioning	6	0.88	0.85-0.87	0.61-0.75	6/6	0.16-0.70	36/36
Outlook on life	3	0.92	0.88-0.92	0.80-0.88	3/3	0.24-0.56	18/18
Intimate relation	4	0.81	0.73-0.81	0.69-0.85	4/4	0.22-0.66	24/24

*Cronbach's α values ≥ 0.7 indicate adequate scale reliability; †Corrected for overlap.

Table 4. Result of exploratory factor analysis of KMMQL-AF

Domains	Variables	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7
Physical functioning	Item 2	0.10	0.16	-0.03	0.66	-0.09	0.03	0.10
	Item 3	0.24	0.19	0.08	0.60	0.18	0.09	0.03
	Item 4*	0.00	0.01	0.20	0.18	0.13	-0.05	-0.01
	Item 5	0.12	0.11	0.08	0.77	0.17	0.08	-0.07
	Item 6	0.11	0.19	0.08	0.59	-0.01	-0.09	0.19
	Item 7	0.04	0.20	0.10	0.62	-0.06	0.04	0.05
	Item 8*	0.20	0.08	0.04	0.29	0.19	0.06	-0.20
	Item 11*	0.08	0.09	0.17	0.23	0.30	-0.13	0.16
	Item 15	0.07	0.29	0.04	0.46	0.07	0.09	0.18
Cognitive functioning	Item 34	0.14	0.23	0.75	-0.10	0.09	0.10	0.13
	Item 35	0.13	0.06	0.48	0.07	0.16	-0.03	0.24
	Item 36	0.12	0.05	0.72	0.11	-0.02	0.14	0.12
	Item 37	0.04	0.01	0.62	0.19	-0.16	0.19	-0.03
	Item 38	0.27	0.00	0.43	0.10	0.26	-0.03	-0.16
	Item 39	0.09	0.13	0.70	-0.01	0.15	0.06	-0.15
	Item 40*	0.17	0.00	0.35	0.24	0.06	-0.06	-0.23
	Item 41	0.19	-0.05	0.41	0.19	0.16	0.13	-0.10
	Item 42	0.29	0.19	0.61	0.14	0.03	0.14	-0.06
Psychological functioning	Item 9	0.13	0.21	0.04	0.11	0.65	0.16	0.04
	Item 10	0.11	0.14	0.10	0.02	0.69	0.14	-0.05
	Item 12	0.32	0.20	-0.05	0.04	0.47	-0.07	0.12
	Item 13	0.23	0.27	0.00	0.21	0.37	-0.09	0.30
	Item 14	0.26	0.19	0.16	0.00	0.57	0.18	0.29
	Item 16*	0.05	0.15	0.13	0.10	0.38	-0.12	0.23
	Item 17	0.12	0.15	0.02	0.17	0.20	-0.05	0.56
	Item 18	0.28	0.15	0.10	0.12	0.44	0.08	0.48
	Item 19*	0.33	0.07	0.37	0.24	0.21	0.31	0.20
Body image	Item 20*	0.00	0.35	0.17	-0.14	0.09	0.25	0.20
	Item 21	0.14	0.71	0.06	0.02	-0.01	0.27	0.30
	Item 22	0.23	0.43	0.09	0.00	0.11	0.58	0.09
	Item 23	0.16	0.80	0.11	0.09	0.08	0.20	0.19
	Item 24	0.16	0.10	0.18	0.07	0.11	0.74	-0.02
	Item 25	0.19	0.19	0.16	0.06	0.07	0.75	-0.02
Social functioning	Item 28	0.63	0.22	0.11	0.09	0.01	0.01	-0.06
	Item 29	0.66	0.19	0.25	0.06	0.07	0.20	-0.08
	Item 30	0.83	0.13	0.13	0.01	0.14	0.08	0.09
	Item 31	0.82	0.13	0.07	0.08	0.04	0.15	0.07
	Item 32	0.69	0.16	0.09	0.07	0.04	0.06	-0.18
	Item 33	0.56	0.35	0.14	0.03	-0.12	-0.02	-0.11
Outlook on Life	Item 45	0.16	0.82	0.09	0.14	0.14	0.00	-0.09
	Item 46	0.18	0.75	0.13	0.12	0.12	-0.01	-0.04
	Item 47	0.24	0.84	0.05	0.16	0.11	0.06	-0.05
Intimate relations	Item 26	0.66	0.12	0.11	0.14	0.20	0.03	0.11
	Item 27	0.72	0.21	0.09	0.17	0.06	0.08	0.23
	Item 43	0.67	0.15	-0.01	0.05	0.23	0.10	0.02
	Item 44	0.48	0.20	0.05	0.09	0.16	0.03	0.06
Eigenvalue		11.1	2.8	2.7	2.2	1.9	1.2	1.0
Explained variance (84.5%)		20.9	16.7	14.3	10.1	9.2	7.3	5.9

*Item with factor loading under 0.4.

http://dx.doi.org/10.3346/jkms.2013.28.12.1788

Table 5. Concurrent validity of KMMQL-AF

Domains	Karnofsky score	Physiological anxiety*	Worry/oversensitivity*	Social concerns/concentration*
Physical functioning	0.45	0.37	0.37	0.32
Cognitive functioning	0.22	0.34	0.28	0.45
Psychological functioning	0.54	0.43	0.64	0.49
Body image	0.17	0.19	0.32	0.39
Social functioning	0.15	0.16	0.27	0.39
Outlook on life	0.40	0.21	0.33	0.39
Intimate relations	0.33	0.26	0.40	0.51

< 0.40 (weak correlation), 0.40-0.60 (moderate correlation), > 0.60 (high correlation). *Domain measured by Revised Children's Manifest Anxiety Scale (RCMAS).

Table 6. Known group validity of KMMQL-AF

Domains	On treatment (n = 107)		Off treatment (n = 98)		*P* value*
	Mean	SD	Mean	SD	
Physical functioning	3.1	2.9-3.2	3.6	3.4-3.7	< 0.001
Cognitive functioning	4.0	3.8-4.1	4.1	3.9-4.2	0.35
Psychological functioning	4.0	3.9-4.1	4.2	4.1-4.3	0.01
Body image	3.3	3.1-3.4	3.5	3.3-3.6	0.13
Social functioning	9.6	9.0-10.3	11.8	11.1-12.4	< 0.001
Outlook on life	3.2	3.0-3.4	3.9	3.7-4.1	< 0.001
Intimate relations	3.5	3.3-3.7	3.8	3.6-4.0	0.04

**P* values are calculated by Student's t-tests.

extracted from the data, explaining 84.5% of the total variance (Table 4). Factor 1 was composed of all the items in the "social functioning" and "intimate relations" domains. Factor 2 was composed of all the items in the "outlook on life" domain and some items from the "body image" domain. Other items from the "body image" domain were combined into Factor 6. Factor 3 was similar to the "cognitive functioning" domain, and Factor 4 shared most items with the "physical functioning" domain. Items in the "psychological functioning" domain were included in Factors 5 and 7.

Items 4 ("Need time to rest during the day"), 8 ("Prefer to watch rather than to take part in games and sports"), and 11 ("Feeling tired during the day") had no significant factor loadings on their own domain, i.e., the "physical functioning" domain. Items 16 ("Worried about dying"), 19 ("Feeling inferior to most people"), 20 ("Being satisfied with their weight"), and 40 ("Difficulty with reading or writing") also had no significant factor loadings on their own domain. Item 18 ("Worried about things in general") showed significant overlapping factor loadings between Factors 5 and 7. Item 22 ("Feeling about their body development") also showed significant overlapping factor loadings between Factors 2 and 6 (Table 4).

Concurrent validity

Table 5 shows the concurrent validity of the KMMQL-AF. The "physical functioning" domain showed moderate correlation with the Karnofsky scores. The "psychological functioning" and "outlook on life" domains also demonstrated moderate correlation with the Karnofsky scores. The "psychological functioning" domain showed moderate-to-high correlations with all domains of the RCMAS (0.43-0.64). Furthermore, the "cognitive functioning" domain showed moderate and positive correlations with the "social concerns/concentration" domain (0.45) of the RCMAS, and the "intimate relations" domain showed moderate and positive correlations with the "worry/oversensitivity" (0.40) and "social concerns/concentration" (0.51) domains of the RCMAS.

Known group validity

We used Student's t-test to assess known group validity (Table 6). According to the KMMQL-AF, 'off treatment' group had significantly higher scores in the "physical functioning" (3.1 vs 3.6; $P < 0.001$), "psychological functioning" (4.0 vs 4.2; $P = 0.01$), "outlook on life" (3.2 vs 3.9; $P < 0.001$), and "intimate relations" (3.5 vs 3.8; $P = 0.04$) domains than did the 'on treatment' group. However, the MMQL-AF could not discriminate between the 2 groups when considering the cognitive functioning, body image, and social functioning domains.

DISCUSSION

To our knowledge, this is the first study that has cross-culturally adapted the MMQL-AF to the diverse childhood cancer survivors in Asia. We validated the KMMQL-AF in Korean children and adolescents with various cancer types. The KMMQL-AF had sufficient reliability and demonstrated correlation with other inventories, as we predicted. Furthermore, it distinguished between 'on treatment' cancer patients and 'off treatment' cancer survivors. Most of the participants completed the questionnaires with the missing rates below 2%. This low missing rate reveals that the KMMQL-AF is a feasible tool. Therefore, we were able to confirm that the KMMQL-AF is valid and reliable.

The factor structure of the KMMQL-AF was similar to that of the original version, although some differences were observed. In multi-trait scaling analyses, the KMMQL-AF had few scaling errors (6/322 = 1.9%; items 4, 8, 11, 19, 23, and 40). However, exploratory factor analysis revealed some potential differences in the underlying factor structure of the KMMQL-AF from that of the original version of the MMQL-AF. Although the "cognitive functioning," "social functioning," "outlook on life," and "intimate relations" domains demonstrated similar internal structure as the original version, the others had some differences. Seven of the 46 items in the KMMQL-AF (items 4, 8, 11, 16, 19, 20, and 40) had factor loadings under 0.4, which means that these items do not strongly belong to one specific domain. For example, items 4 ("Need time to rest during the day") and 8 ("Prefer to watch rather than to take part in games and sports")

could not be strong indicators of poor physical functioning, although factor loading was the strongest for this domain than for any other domain. In another example, the factor loading for item 19 ("Feeling inferior to most people") was shared by Factor 1 (corresponding to the "social functioning" domain) and Factor 3 (corresponding to the "cognitive functioning" domain), indicating that this item is not just related to psychological functioning in our population.

The "social functioning" and "intimate relations" domains were combined into 1 factor. This result suggests that both the "social functioning" and "intimate relations" domains ask similar issues on interpersonal relationships; therefore, in exploratory factor analysis, they were combined into 1 factor. The "body image" domain was divided into 2 factors, namely, satisfaction with their own body (items 21 "Being happy about the way they look" and 23 "Liking their body the way it is") and cognition about development status (items 22 "Feeling about their body development," 24 "Feeling that others think that their body is poorly developed," and 25 "Feeling uncomfortable about the way their body is developing"). The "psychological functioning" domain was also divided into 2 factors, grouped as emotional status (items 9 "feeling sad," 10 "Feeling angry," 12 "Feeling lonely," 13 "Feeling frightened," and 14 "Feeling nervous or anxious") and worry (items 17 "Worried about their health" and 18 "Worried about things in general"). While it may be possible to modify the MMQL-AF to reflect the potential differences in factor structure revealed by the exploratory factor analysis, we decided to retain the original factor structure based on acceptable multi-trait scaling analysis results and to ensure international comparison.

In concurrent validation, the "physical functioning" domain showed moderate correlation with the Karnofsky performance scale scores, as expected. This result suggests that the "physical functioning" domain reveals the performance status of cancer survivors. The "psychosocial functioning" domain also showed moderate-to-high correlation with all the domains in the RCMAS. Therefore, we can expect that the KMMQL-AF can simultaneously measure physical and psychological aspects of HRQL in childhood cancer patients. The "cognitive functioning" and "intimate relations" domains also showed moderate correlation with the "social concerns/concentration" domain in the RCMAS. The "social concerns/concentration" domain in the RCMAS suggests that the child is likely to feel that he or she is unable to meet the expectations of other important people and is inadequate and unable to concentrate on tasks.

In known-group validity analysis of the KMMQL-AF, the "physical functioning," "psychological functioning," "outlook on life," and "intimate relations" domains could discriminate between 'on treatment' and 'off treatment' groups. 'Off treatment' cancer survivors showed significantly higher scores than 'on treatment' cancer patients. This suggests that various physical and socio-psychological consequences of childhood cancer in childhood cancer survivors during the course of cancer treatments generally improve after cancer treatment. However, there were no significant differences in the "cognitive functioning," "body image," and "social functioning" domains between the 2 groups, indicating that the experience of appearance change and social isolation during cancer treatment lasts even after cancer treatment.

Our study has some limitations. First, we could not compare the KMMQL-AF with other instruments assessing QOL in childhood cancer survivors. At the beginning of our study, there was no validated tool for QOL assessment in adolescent cancer patients in Korea. Instead, we used various instruments for assessing concurrent validity of physical performance and anxiety in adolescent cancer patients. Second, because our study population had no control children without cancer, we could not compare childhood cancer survivors with children without cancer history. However, Bhatia et al. (5) reported that the MMQL-AF discriminated between the 2 groups, and cancer patients showed a significantly increased risk of poor QOL.

In conclusion, the KMMQL-AF appears to be a reliable and valid instrument for HRQoL assessment in childhood cancer patients aged between 13 and 20 yr. We believe that studies on HRQoL assessment by KMMQL-AF will help to develop interventional strategies for improving the HRQoL of childhood cancer survivors in the Republic of Korea.

ACKNOWLEDGMENTS

We would like to thank all the patients and caregivers who participated in our study; we would also like to thank all the physicians and coworkers in the cooperating cancer center for the recruitment of study participants.

DISCLOSURE

The authors declare no conflicts of interest.

REFERENCES

1. Howlader N, Noone AM, Krapcho M, Neyman N, Aminou R, Altekruse SF, Kosary CL, Ruhl J, Tatalovich Z, Cho H, et al. *SEER cancer statistics review, 1975-2009 (vintage 2009 populations). Bethesda: National Cancer Institute, 2012.*
2. The Korea Central Cancer Registry, National Cancer Center. *Annual report of cancer statistics in Korea in 2010: Ministry of Health and Welfare 2012. Available at http://ncc.re.kr/english/infor/kccr.isp [accessed on 29 October 2013].*
3. Varni JW, Burwinkle TM, Katz ER, Meeske K, Dickinson P. *The PedsQL in pediatric cancer: reliability and validity of the Pediatric Quality of Life Inventory Generic Core Scales, Multidimensional Fatigue Scale, and Cancer Module. Cancer 2002; 94: 2090-106.*

 http://dx.doi.org/10.3346/jkms.2013.28.12.1788

4. Raat H, Bonsel GJ, Essink-Bot ML, Landgraf JM, Gemke RJ. *Reliability and validity of comprehensive health status measures in children: the Child Health Questionnaire in relation to the Health Utilities Index. J Clin Epidemiol 2002; 55: 67-76.*
5. Bhatia S, Jenney ME, Bogue MK, Rockwood TH, Feusner JH, Friedman DL, Robison LL, Kane RL. *The Minneapolis-Manchester Quality of Life instrument: reliability and validity of the adolescent form. J Clin Oncol 2002; 20: 4692-8.*
6. Ward-Smith P, Hamlin J, Bartholomew J, Stegenga K. *Quality of life among adolescents with cancer. J Pediatr Oncol Nurs 2007; 24: 166-71.*
7. Phipps S, Dunavant M, Jayawardene D, Srivastiva DK. *Assessment of health-related quality of life in acute in-patient settings: use of the BASES instrument in children undergoing bone marrow transplantation. Int J Cancer Suppl 1999; 12: 18-24.*
8. Goodwin DA, Boggs SR, Graham-Pole J. *Development and validation of the pediatric oncology quality of life scale. Psychol Assess 1994; 6: 321-8.*
9. Calaminus G, Weinspach S, Teske C, Göbel U. *Quality of survival in children and adolescents after treatment for childhood cancer: the influence of reported late effects on health related quality of life. Klin Padiatr 2007; 219: 152-7.*
10. Yeh CH, Hung LC. *Construct validity of newly developed quality of life assessment instrument for child and adolescent cancer patients in Taiwan. Psychooncology 2003; 12: 345-56.*
11. Kook SH, Varni JW. *Validation of the Korean version of the pediatric quality of life inventory 4.0 (PedsQL) generic core scales in school children and adolescents using the Rasch model. Health Qual Life Outcomes 2008; 6: 41.*
12. Yoo HJ, Ra YS, Park HJ, Lai JS, Cella D, Shin HY, Kim DS. *Agreement between pediatric brain tumor patients and parent proxy reports regarding the Pediatric Functional Assessment of Cancer Therapy-Childhood Brain Tumor Survivors questionnaire, version 2. Cancer 2010; 116: 3674-82.*
13. Armstrong FD, Toledano SR, Miloslavich K, Lackman-Zeman L, Levy JD, Gay CL, Schuman WB, Fishkin PE. *The Miami pediatric quality of life questionnaire: parent scale. Int J Cancer Suppl 1999; 12: 11-7.*
14. Eiser C, Jenney M. *Measuring quality of life. Arch Dis Child 2007; 92: 348-50.*
15. Puhan MA, Behnke M, Devereaux PJ, Montori VM, Braendli O, Frey M, Schünemann HJ. *Measurement of agreement on health-related quality of life changes in response to respiratory rehabilitation by patients and physicians: a prospective study. Respir Med 2004; 98: 1195-202.*
16. Bhatia S, Jenney ME, Wu E, Bogue MK, Rockwood TH, Feusner JH, Friedman DL, Robison LL, Kane RL. *The Minneapolis-Manchester Quality of Life Instrument: reliability and validity of the Youth Form. J Pediatr 2004; 145: 39-46.*
17. Wu E, Robison LL, Jenney ME, Rockwood TH, Feusner J, Friedman D, Kane RL, Bhatia S. *Assessment of health-related quality of life of adolescent cancer patients using the Minneapolis-Manchester Quality of Life Adolescent Questionnaire. Pediatr Blood Cancer 2007; 48: 678-86.*
18. Hutchings HA, Upton P, Cheung WY, Maddocks A, Eiser C, Williams JG, Russell IT, Jackson S, Jenney ME. *Development of a parent version of the Manchester-Minneapolis quality of life survey for use by parents and carers of UK children: MMQL-UK (PF). Health Qual Life Outcomes 2008; 6: 19.*
19. Hutchings HA, Upton P, Cheung WY, Maddocks A, Eiser C, Williams JG, Russell IT, Jackson S, Jenney ME. *Adaptation of the Manchester-Minneapolis Quality of Life instrument for use in the UK population. Arch Dis Child 2007; 92: 855-60.*
20. Einberg EL, Kadrija I, Brunt D, Nygren JN, Svedberg P. *Psychometric evaluation of a Swedish version of Minneapolis-Manchester quality of life-youth form and adolescent form. Health Qual Life Outcomes 2013; 11: 79.*
21. Taylor RM, Gibson F, Franck LS. *A concept analysis of health-related quality of life in young people with chronic illness. J Clin Nurs 2008; 17: 1823-33.*
22. Karnofsky DA, Burchenal, JH. *The clinical evaluation of chemotherapeutic agents in cancer. In: MacLeod CM, editor. Evaluation of chemotherapeutic agents. New York: Columbia University Press, 1949, p191-205.*
23. Reynolds CR, Richmond BO. *What I think and feel: a revised measure of children's manifest anxiety. J Abnorm Child Psychol 1978; 6: 271-80.*
24. Choi JS, Cho SC. *Assessment of anxiety in children-reliability and validity of revised children's manifest anxiety scale. J Korean Neuropsychiatr Assoc 1990; 29: 691-702.*
25. Fayers PM, Machin D. *Quality of life: the assessment, analysis and interpretation of patient-reported outcomes. Chichester: Jhon Wiley, 2007, p66-71.*