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Validity and Reliability of the Turkish Version of the KIDSCREEN-27 for Individuals With Cerebral Palsy

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Abstract

Our aims in this study were to examine the construct/concurrent validity and internal/test-re-test reliabilities of both the self-report and parent-report questionnaires of a Turkish version of the KIDSCREEN-27 for adolescents with cerebral palsy (CP). We used a convenience sample of 135 children and adolescents with CP aged 8–18 years (65 males, 70 females; *M* age = 12.39, *SD* = 3.57) and their parents/caregivers (123 mothers, seven fathers, and five grandmothers). We explored structural construct validity via confirmatory factor analysis (CFA). Concurrent validity was examined via Spearman's correlations between the KIDSCREEN-27 questionnaires and the self-report and primary caregiver report forms of the Cerebral Palsy Quality of Life for Children (CP QOL-Child) and adolescents (CP QOL-Teen). We explored test-retest and internal consistency reliabilities utilizing intraclass correlation coefficients (ICC) and Cronbach's alpha (α), respectively. CFA goodness-of fit indices verified that the predefined model of the KIDSCREEN-27 was a good fit for data from the CP population (X^2/df<5, GFI >0.90, AGFI >0.90, RMSEA<0.80). Results showed

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the subdomains of both KIDSCREEN-27 forms to be significantly correlated with the matched subdomains of the CP QOL-Child and CP QOL-Teen questionnaires (ranges of r = 0.62–0.94). Overall, α and ICC coefficients for all subdomains of both KIDSCREEN-27 versions were acceptable (α and ICC >0.70). Both versions of the KIDSCREEN-27 have satisfactory psychometric properties for use in evaluating health-related quality of life (HRQOL) outcomes in children and adolescents with CP.

Keywords
cerebral palsy, KIDSCREEN-27, HRQOL, validity, reliability

Introduction

Health-related quality of life (HRQOL) has recently become an important outcome of health interventions due to dissatisfaction with exclusive biomedical outcomes in health and medical research (Ravens-Sieberer et al., 2006). HRQOL outcomes reflect individual perceptions or thoughts regarding personal physical, social and emotional well-being and self-esteem; they have been considered important potential benefits to treatment (Sakzewski et al., 2012). Particularly since individuals with cerebral palsy (CP) have had relatively lower HRQOL outcomes compared to their healthy peers (Jacobson et al., 2020; Livingston et al., 2007; van der Slot et al., 2010), there is new interest in assessing HRQOL after treatment for children with CP.

Many generic HRQOL questionnaires have been developed, initially for children with a broad range of chronic diseases and, more recently, for individuals with specific diseases (Rajmil et al., 2004). The KIDSCREEN is a useful, generic HRQOL questionnaire (Davis et al., 2010) for assessing the well-being of children and adolescents aged 8–18 years. The KIDSCREEN is available in three different formats: KIDSCREEN-52, KIDSCREEN-27, and KIDSCREEN-10 (Ravens-Sieberer et al., 2014). The KIDSCREEN-27, a shorter version of the KIDSCREEN- 52, has been frequently chosen in clinical and research environments due to its content and easy applicability. It was developed in collaboration with experts from 13 European countries, and its multidimensional structure is based on the World Health Organization's (WHO) definition of HRQOL. These characteristics make the KIDSCREEN-27 questionnaire more applicable in many different cultural contexts (Ravens-Sieberer et al., 2014). Thus, the KIDSCREEN-27 can be used to compare HRQOL outcomes in children from a variety of groups (Bjornson & McLaughlin, 2001). However, because the KIDSCREEN-27 does not have test items tailored to a particular disease or type of disability, its separate suitability for individuals with a specific disability or disease must be established empirically (Davis, Davern, et al., 2013). For example, as a generic tool, the KIDSCREEN-27 does not include specific test items related to factors that may affect the quality of life in individuals with CP, and it cannot provide sensitive and accurate information regarding HRQOL outcomes for this population without adding

condition-specific questionnaires to chart HRQOL outcomes of a given group over time (Bjornson & McLaughlin, 2001). Although the measurement properties of the KIDSCREEN-27 questionnaire for the general population have been previously studied in a variety of cultures (Andersen et al., 2016; Baydur et al., 2016; da Silveira et al., 2021; Nezu et al., 2016; Ng et al., 2015; Pardo-Guijarro et al., 2013; Ravens-Sieberer et al., 2007; Stevanovic & Jafari, 2015; Vélez et al., 2016), to the best of our knowledge, research with this tool for individuals with CP is limited to only one study that reported psychometric properties only for the parent-reported version (Erhart et al., 2009). Several other studies have used the KIDSCREEN questionnaires for children with varied disabilities (Bingol et al., 2021; Davis et al., 2009; Deutz et al., 2018; Korterink et al., 2016; Sakzewski et al., 2012). To date, the quality and precision of HRQOL information from self-report and primary caregiver report for children with CP has relied on the psychometric properties of other HRQOL scales used with other populations.

Research and clinical findings regarding HRQOL outcomes that are based on questionnaires whose measurement properties have not been tested in the target population may be biased or misleading. Although the KIDSCREEN-27 questionnaires have been adapted for Turkish use, and their validity and reliability for healthy children and adolescents were demonstrated by Baydur et al. (2016), there has been no study of their measurement properties when used for Turkish children and adolescents with CP. Accordingly, our purpose in this study was to examine the psychometric properties of both versions of the KIDSCREEN-27 questionnaires when used to assess Turkish children and adolescents with CP.

Method

Participants

Participants in this study were individuals with CP, aged 8–18 years, and their families/primary caregivers. As there is still no definitive scientific method for calculating a sample size for validity and reliability research (Anthoine et al., 2014), we based our estimate of a required sample size on general guidelines of about 5–10 participants needed for each test item (Çankaya et al., 2020), and we determined a need for about 135 participants. Considering that the KIDSCREEN-27 consists of five subdomains and a total of 27 items, the estimate of 135 participants is also compatible with the assumption that the minimum sample size required for confirmatory factor analysis (CFA) is at least five times the number of observed variables, or at least 20 participants per factor (Jackson, 2003). We enrolled children and adolescents with CP who had adequate communication skills and cognitive performance to understand and respond appropriately to items on the KIDSCREEN-27 and Cerebral Palsy Quality of Life (CP QOL) questionnaires. Participants with more than 25% missing values on the KIDSCREEN-27 and those older than 18 years and younger than 8 years were excluded from the study. Before entry to the study, all participants and their families/caregivers

gave written and informed assent and consent, respectively. Finally, all study participants were of Turkish descent and were born in Turkey's city of Ankara. The Non-Interventional Clinical Research Ethics Board of Hacettepe University approved the study with protocol number 16.969.557-2167.

Measures

Classifications. We evaluated participants' manual ability in the collaborative use of both hands for manipulating objects with the Manual Ability Classification System (MACS) (Akpinar et al., 2010), a five-level, ordinal classification system. We defined participants' gross motor functions with the Gross Motor Function Classification System (GMFCS) (Wood & Rosenbaum, 2000), which has five levels with a lower numbered level indicating higher motor function. Finally, we classified the participants' ability to communicate with both familiar and unfamiliar partners with the Communication Function Classification System (CFCS) (Hidecker et al., 2011). We used direct observations and conversations with families/caregivers to determine the functional profile of the participants according to these classification systems.

Outcome Measures

The KIDSCREEN-27, is a short version of the original KIDSCREEN-52 (Ravens-Sieberer et al., 2007). This questionnaire has both a self-reported and parent-reported proxy version. These versions measure the same concept, and they are each composed of five dimensions of HRQOL: physical well-being (5 items); psychological well-being (7 items); autonomy and parent relations (7 items); social support and peers (4 items); and school environment (4 items). Respondents rate the assessment items on a 5-point Likert scale, ranging from "never/not at all" to "always," and mean values for each domain are calculated based on Rasch Person Parameters to obtain standardized T-scores. Before calculating the mean scores for each subdomain, the negatively constructed item one in the *'physical well-being'* subdomain and items 9,10, and 11 in the *'psychological well-being*' subdomain are recoded to provide scores from 1 to 5, such that higher values indicate greater HRQOL (Ravens-Sieberer et al., 2006).

Cerebral Palsy Quality of Life Questionnaire (CP QOL)

The CP QOL questionnaire was developed by an international multidisciplinary team in consultation with researchers, clinicians, health professionals, educators, parents, and children with CP to assess the HRQOL of children and adolescents with CP. The CP QOL for children (CP QOL-Child) and CP QOL for adolescents (CP QOL-Teen) are condition-specific outcome measures for assessing HRQOL outcomes of children (aged 4–12 years) and adolescents (aged 13–18 years) with CP. There are two original versions of the CP QOL-Child questionnaires, including a parent-report proxy version (for parents of children aged 4–12 years) and a child self-report version (for children

aged 9–12 years). These two versions are called CPQOL-Child, and each version assesses the following areas of the child's HRQOL: social well-being and acceptance, participation and physical health, feelings about functioning, emotional well-being and self-esteem, and pain and impact of disability . Also, the CP QOL Questionnaire for adolescents (CP QOL-Teen) (Davis et al., 2013), an extension of the CPQOL-Child, was developed as a reaction to the limitations of existing HRQOL measures for adolescents. The CP QOL-Teen was established for adolescents between the age of 13–18 years and has both a self-report version (for adolescents aged 13–18) and a parent-report proxy version (for parents of adolescents aged 13–18 years). Both versions of the CPQOL-Teen measure the following domains of HRQOL: general well-being and participation, communication and physical health, school well-being, social well-being, access to services, family health, and feelings about functioning (Davis, Davern, et al., 2013). The cross-cultural adaptations of the CP QOL-Child and the CP QOL-Teen for use among Turkish individuals with CP were conducted, respectively, by Atasavun Uysal et al. (2016) and Çelik & Durmaz (2012), and these investigators found both versions to be reliable.

Study Design and Data Collection Procedures

In the first step of this research, we administered all instruments to our 135 participants. To establish the test-retest reliability of the KIDSCREEN-27 questionnaires, we administered these instruments twice after a 14-day interval to a randomly selected subset of our participants (n = 45). We determined the concurrent validity of these questionnaires by correlating the KIDSCREEN-27 subdomain scores with corresponding subdomain scores of the CP QOL-Child and CP QOL-Teen questionnaires. We examined differences between participants at higher (I-III) and lower levels (IV-V) of the functional classification systems (GMFCS-E&R, MACS, and CFCS) in relation to the obtained KIDSCREEN-27 subdomain scores to see whether KIDSCREEN-27 subdomain scores on both versions of the KIDSCREEN-27 differed between participants with higher and lower functional levels. To establish concurrent validity, the participants were placed into two groups based on their ages (9–12, 13–18). Then, as shown in Figure 1, we performed a matching procedure between subdomains to explore relationships between pertinent subdomains of both versions of the KIDSCREEN-27, CP QOL-Child, and CP QOL-Teen questionnaires.

Data Analysis

We examined data for all variables of interest using visual histograms and probability plots, and we used analytical methods to determine whether they were normally distributed. We presented descriptive statistics as means and standard deviations for normally distributed variables and as medians and interquartile range (IQR) for non-normally distributed variables. Except for structural construct validity, descriptive analyses, concurrent validity, test-retest, and internal consistency validities were carried

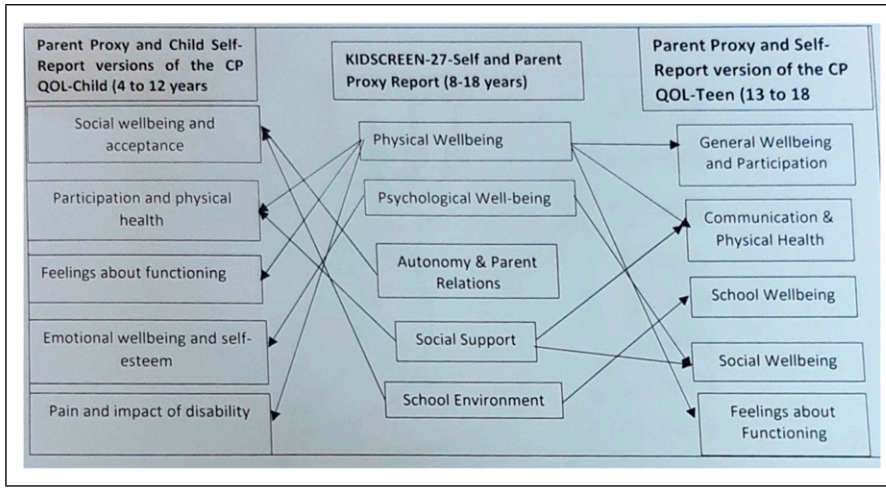

Figure 1. Correlated subdomains of the KIDSCREEN-27 and CPQOL questionnaires.

out using the Statistical Package for the Social Sciences (SPSS 25, version 25.0, IBM Corporation, Armonk, NY). For the CFA associated with construct validity, we used a different version of SPSS (SPSS, Amos v.20).

We examined three main validity types for each version of the KIDSCREEN 27: (a) structural construct validity, (b) concurrent validity, and (c) differences between higher (I-III) and lower (IV-V) functional levels of GMFCS-E&R, MACS, and CFCS classification systems with respect to KIDSCREEN 27 subdomain scores. Regarding structural construct validity, we used CFA to determine whether the predetermined latent structure of the KIDSCREEN-27 questionnaire from its original form in use with other populations would be confirmed by the data we collected from Turkish children and adolescents with CP. In CFA analysis, we used goodness-of-fit indices, including X^2/df, Root Mean Square Error of Approximation (RMSEA), Goodness of Fit Index (GFI), Comparative Fit Index (CFI), Adjusted Goodness of Fit Index (AGFI), and Standardized Root Mean Square Residual (SRMR), to determine whether the measurement model of the KIDSCREEN-27 questionnaire was confirmed by the data collected from Turkish children and adolescents with CP. That is, we used CFA to help determine whether the KIDSCREEN-27, a generic HRQOL questionnaire, behaved as expected in this CP population. If the X^2/df index is less than 3, the goodness of fit is considered good, and a value less than five is considered acceptable; a value of <0.05 for RMSA is considered good, and a value of <0.80 is considered acceptable compliance; values of >0.95 for GFI, CFI, and AGFI is good, and a value of >0.90 is acceptable compliance. A value between 0 and 0.05 is acceptable for SRMR (Gürbüz & Şahin, 2018). We examined concurrent validity via correlations between the subdomains of KIDSCREEN-27 questionnaires and their matched subdomains on CP QOL-Child and CP QOL-Teen, which were used as external references. We used

Spearman correlation coefficients to identify relationships between matched subdomains of the self-reported and parent-reported proxy versions of the KIDSCREEN-27 and CP QOL-Child and Teen questionnaires. Spearman coefficients ranging from 0.75 to 1.00 were deemed good to excellent, $0.50 \leq r < 0.75$ were considered moderate to good, and finally, $0.25 \leq r < 0.50$ were considered weak to moderate. Differences between higher (I-III) and lower functional levels (IV-V) of GMFCS-E&, MACS, and CFCS in relation to mean scores on subdomains of both KIDSCREEN-27 versions were examined using the Mann-Whitney U test. For this purpose, study participants were divided into two groups (levels I-III and levels IV-V) for each classification system.

We examined the reliability of the two versions of the KIDSCREEN-27 through test-retest and internal consistency methods. We used the Cronbach alpha coefficient (α), a test of the average correlation between the items on a scale that recognizes values more than 0.7 as ideal to assess internal consistency or homogeneity. We investigated the consistency of measurement repetition or test-retest reliability using the intraclass correlation coefficient (ICC) with a sub-group of 45 participants who were tested and retested after 14 days with each version of the KIDSCREEN-27. A value of ≥.90 was recognized as excellent for both α and ICC results, whereas a value between .80 and .90 was considered good, and a value between .70 and .80 was considered acceptable (Weir, 2005). Items for which more than 5% of responses were missing were excluded from the analysis (Robitail et al., 2007).

Results

Sociodemographic Properties of the Participants and Their Caregivers

Participant characteristics of interest to these analyses, separately including retest participants, were school status, type of CP, and various classifications for manual ability, gross motor, and communication performance levels (see Table 1). Our sample consisted of 135 children and adolescents with CP (48.1 % males and 51.9 % females; *M* age = 12.39, *SD* = 3.57) and their primary caregivers (123 mothers, seven fathers, and five grandmothers). Parent-proxy versions of the HRQOL outcome measures were mostly completed by the mothers (91.1%), with only a small percent completed by fathers (5.2 %) and grandmothers (3.7%). The educational backgrounds of primary caregivers ranged from illiterate to university degrees. For illiterate caregivers, an experienced physiotherapist read the questionnaire items to the respondents. Most (51.1%) families had a minimum wage monthly income of 5250 TL ($282.49 US) or less. Finally, most families (95%) lived in apartments, with remaining families living in detached homes.

Table 1. Demographic Characteristics of the Participants.

Total Participants (N = 135)			Retest Participants (N = 45)		
Age: max-min; M (SD)	8-18; 12.39 (3.57)		Age: max-min; M (SD)	9-18; 11.6 (3.11)	
Gender	*n*	%	Gender	*n*	%
Male	65	48.1	Male	20	44.4
Female	70	51.9	Female	25	55.6
School status			School status		
Yes	128	94.8	Yes	39	86.7
No	7	5.2	No	6	13.3
Type of CP			Type of CP		
Spastic	110	81.5	Spastic	40	88.9
Monoplegia	4	3.7	Monoplegia	—	—
Hemiplegia	46	42.2	Hemiplegia	21	46.7
Diplegia	35	32.1	Diplegia	19	42.2
Quadriplegia	24	22.0	Quadriplegia	5	11.1
Dyskinetic	15	11.1	Dyskinetic	1	2.2
Ataxic	10	7.4	Ataxic	4	8.9
MACS			MACS		
Level I	36	26.7	Level I	20	44.4
Level II	38	28.1	Level II	9	20
Level III	30	22.2	Level III	10	22
Level IV	22	16.3	Level IV	4	8.9
Level V	9	6.7	Level V	2	4.4
GMFCS E&R			GMFCS E&R		
Level I	39	28.9	Level I	15	33.3
Level II	35	25.9	Level II	12	26.7
Level III	28	20.7	Level III	7	15.6
Level IV	17	12.6	Level IV	9	20
Level V	16	11.9	Level V	2	4.4
CFCS			CFCS		
Level I	58	43.0	Level I	35	77.8
Level II	38	28.1	Level II	6	13.3
Level III	27	20	Level III	3	6.7
Level IV	11	8.1	Level IV	1	2.2
Level V	1	0.7	Level V	—	—
Caregivers			Caregivers		
Mother	123	91.1	Mother	34	75.6
Father	7	5.2	Father	6	13.3
Grandmother	5	3.7	Grandmother	5	11.1

(continued)

Table 1. (continued)

Total Participants (N = 135)			Retest Participants (N = 45)		
Age: max-min; M (SD)	8-18; 12.39 (3.57)		Age: max-min; M (SD)	9-18; 11.6 (3.11)	
Gender	*n*	%	Gender	*n*	%
Caregiver's education			Caregiver's education		
Non literacy	11	8.1	Non literacy	8	17.8
Primary school	36	26.7	Primary school	7	15.6
High school	43	31.9	High school	15	33.3
University	41	30.4	University	15	33.3
Family monthly income			Family monthly income		
≤5250 TL ($282.49 US)	69	51.1	≤5250 TL ($282.49 US)	24	53
>5250 ($282.49 US)	66	48.9	>5250 ($282.49 US)	21	47
Residency type			Residency type		
Apartment	128	95	Apartment	44	98
Detached house	7	5	Detached house	1	2

Note: N = number of participants; CP = Cerebral Palsy; MACS = Manual Ability Classification system; GMFCS-E&R =Gross Motor Function Classification System-Expanded & Revise; CFCS =Communication Function Classification System.

Validity Types

Structural Construct Validity. The CFA performed to determine if the predefined latent structures of the KIDSCREEN-27 questionnaires complied with the data from the CP population revealed acceptable factorial validities of the two versions KIDSCREEN-27 versions. The established model and CFA results are presented in Figures 2 and 3 and in Table 2. For the CFA results of the self-reported version, X^2/df was 3.99, indicating an acceptable difference between expected and observed covariance matrices. GFI, AGFI, and CFI were 0.91, 0.95, and 0.93, respectively, implying an acceptable model fit. Furthermore, RMSEA and SRMR were calculated and found to be 0.74 and 0.034, respectively, showing that the model fit to the data obtained from the CP population was adequate. Regarding item factor loadings, except for item 1 in the *'physical well-being'* subdomain and items 4, 5, 6 and 7 in the *'psychological well-being'* subdomain, all items had significant factor loadings (> 0.60). Correlations between the latent (i.e. factor/subdomain) and the observational (i.e. items) variables were mostly satisfactory. The findings of CFA for the parent proxy version revealed that X^2/df was 3.43, which is acceptable rather than excellent. GFI, AGFI, and CFI were found to have acceptable levels of 0.92, 0.94, and 0.9, respectively. Finally, the RMSEA and SRMR values were also deemed appropriate. As for the item factor loadings, almost all items had sufficient regression weights, apart from items 4, 5, 6, and 7 in the '*psychological well-being'* subdomain. Thus, all items in the respective subdomains had acceptable factor

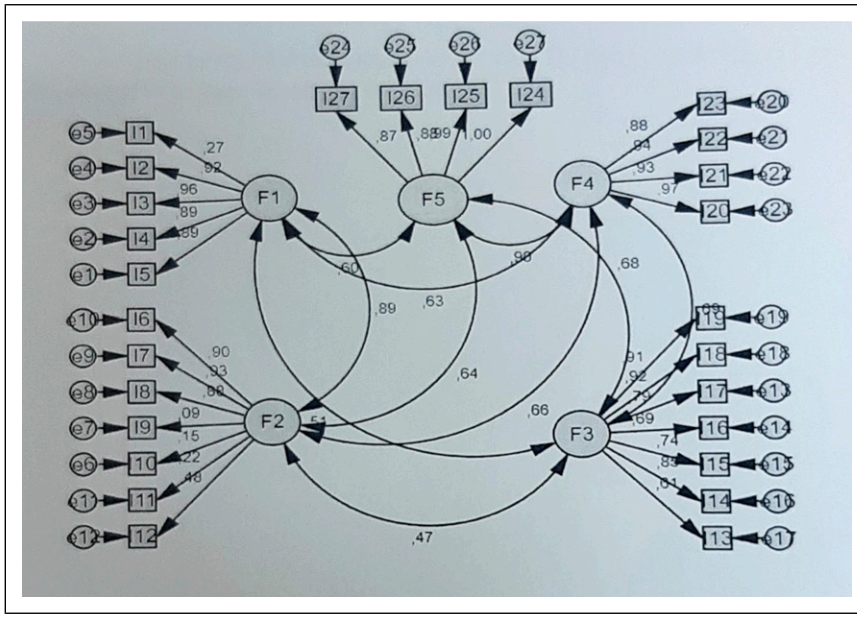

Figure 2. Confirmatory factor analysis model for self-reported version of KIDSCREEN-27 F1, Physical Wellbeing; F2, Psychological Well-being; F3, Autonomy & Parent Relations; F4; Social Support & Peers; F5, School Environment.

loadings, implying that the relevant items converged with their relevant subdomains. Finally, the results presented in Table 3 showed generally significant correlations between the five factors in both versions of the KIDSCREEN-27, with all pairs of factors correlated more than 0.47. For both versions of KIDSCREEN-27 questionnaires, the highest correlation coefficients of 0.89 and 0.90 were between '*physical well-being'* - '*psychological well-being'* and '*social support & peers'* - *'school environment.'*

Concurrent Validity

Both versions of the KIDSCREEN-27 showed adequate concurrent validity through close relationships to their corresponding CP QOL-Child and CP QOL-Teen questionnaires, as shown in Figure 1. Our analysis revealed moderate to good correlations between the *'physical well-being'* subdomain of both versions (self-report and parent-report) of the KIDSCREEN 27 and the corresponding subdomains on both versions of the CP QOL-Child and CPQOL-Teen questionnaires (self-reported version: ranges of r=0.65–0.74 and the parent proxy version: ranges of r=0.62–0.73) (Table 3). Similarly, good correlations were evident between the '*psychological well-being'* subdomain of

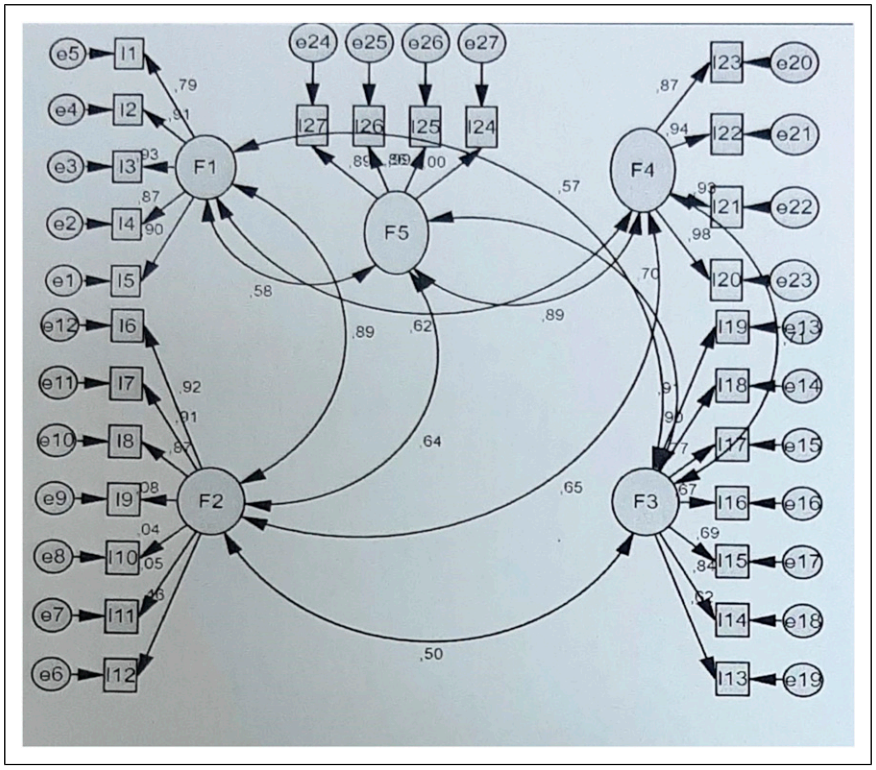

Figure 3. Confirmatory factor analysis model for proxy version of KIDSCREEN-27 F1, Physical Wellbeing; F2, Psychological Well-being; F3, Autonomy & Parent Relations; F4; Social Support & Peers; F5, School Environment.

both versions of the KIDSCREEN-27 and the corresponding subdomains of both CP QOL-Teen versions (13–18 years) (r_1=0.73 and r_2= 0.71), whereas the subdomain correlations for younger children (8–12 years) were relatively low (r_1=0.63 and r_2=0.68). There were excellent to good correlations between the '*autonomy & parent relations'* subdomain of both versions of the KIDSCREEN-27 and the corresponding subdomains of CP QOL-Child and CP QOL-Teen questionnaires (ranges of r= 0.75–0.94). Furthermore, the '*social support & peers'* subdomain of both versions of KIDSCREEN-27 questionnaires were significantly correlated with the corresponding subdomains of CP QOL-Child and CP QOL-Teen questionnaires (ranges of r=0.72–0.82). Finally, correlation coefficients between the *'school environment'* subdomain of both KIDSCREEN-27 versions and the corresponding CP QOL-Child and CP QOL-Teen subdomains were from 0.62 to 0.75

Table 2. Results of Confirmatory Factor Analysis.

KIDSCREEN-27 -Self Report Version					KIDSCREEN-27 -Proxy-Report Version				
Subdomains (T-value)		Results of model fit indices			Subdomains (T-value)		Results of model fit indices		
Physical well-being	Items' factor loading	Indices	Acceptable values	Model value	Physical well-being	Items' factor loading	Indices	Acceptable values	Model value
		X^2/df	<5	3.99			X^2/df	<5	3.43
Item 1	0.27	GFI	>90	0.91	Item 1	0.78	GFI	>0.90	0.92
Item 2	0.92	AGFI	>0.90	0.95	Item 2	0.91	AGFI	>0.90	0.94
Item 3	0.95	CFI	>0.90	0.93	Item 3	0.93	CFI	>0.90	0.91
Item 4	0.88	RMSEA	<0.80	0.74	Item 4	0.87	RMSEA	<0.80	0.96
Item 5	0.88	SRMR	0<α<0.05	0.034	Item 5	0.89	SRMR	0<α<0.05	0.041
Psychological well-being					Psychological well-being				
I6	0.89				I6	0.91			
I7	0.92				I7	0.91			
I8	0.88				I8	0.87			
I9	0.08				I9	0.08			
I10	0.15				I10	0.04			
I11	0.21				I11	0.05			
I12	0.48				I12	0.46			
Autonomy & parent relations					Autonomy & parent relations				
I13	0.61				I13	0.62			
I14	0.84				I14	0.84			
I15	0.73				I15	0.69			
I16	0.69				I16	0.67			
I17	0.79				I17	0.77			

(continued)

Table 2. (continued)

KIDSCREEN-27 -Self Report Version					KIDSCREEN-27 -Proxy-Report Version				
Subdomains (T-value)		Results of model fit indices			Subdomains (T-value)		Results of model fit indices		
Physical well-being	Items' factor loading	Indices	Acceptable values	Model value	Physical well-being	Items' factor loading	Indices	Acceptable values	Model value
I18	0.92				I18	0.89			
I19	0.90				I19	0.90			
Social support & peers					Social support & peers				
I20	0.96				I20	0.98			
I21	0.93				I21	0.93			
I22	0.93				I22	0.94			
I23	0.87				I23	0.87			
School environment					School environment				
I24	0.99				I24	0.99			
I25	0.99				I25	0.99			
I26	0.87				I26	0.86			
I27	0.87				I27	0.89			
Correlation between subdomains					Correlation between subdomains				
Correlated subdomains	r*	Correlated subdomains	r*		Correlated subdomains	r*	Correlated subdomains	r*	
F1-F2	0.89	F2-F4	0.66		F1-F2	0.89	F2-F4	0.65	
F1-F3	0.50	F5-F2	0.64		F1-F3	0.51	F5-F2	0.64	
F1-F4	0.64	F3-F4	0.68		F1-F4	0.62	F3-F4	0.71	
F1-F5	0.59	F5-F3	0.67		F1-F5	0.58	F5-F3	0.70	
F2-F3	0.47	F5-F4	0.89		F2-F3	0.50	F5-F4	0.90	

F1, Physical Well-being; F2, Psychological Well-being; F3, Autonomy & Parent Relations; F4; Social Support & Peers; F5, School Environment; * Spearman correlation coefficient.

Table 3. Correlations Between Matched Subdomains of Self-Report and Proxy Versions of KIDSCREEN-27 and CPQOL-Child and CP QOL-Teen.

	CP QOL-Child version (8–12 years) (*n*=88)					CP QOL- Teen version (9–13 years) (*n*=47)				
KIDSCREEN-27 (8–18 years)(T-Value)	Social Well-being and Acceptance	Feelings About Functioning	Participation And Physical Health	Emotional Well-being and Self Esteem	Pain and Impact of Disability	General Wellbeing and Participation	Communication & Physical Health	School Wellbeing	Social Wellbeing	Feelings About Functioning
Physical well-being	—	r_1=0.74 r_2=0,67	r_1=0.65 r_2=0,62		r_1=0.73 r_2=0,68	r_1=0.67 r_2=0,63	r_1=0.69 r_2=0,73	—	—	r_1=0.71 r_2=0,65
Psychological Well-being	—	—	—	r_1=0.63 r_2=0,68	—	—	—	—	r_1=0.73 r_2=0,71	—
Autonomy & Parent relations	r_1=0.94 r_2=0,83	—	—	—	—	r_1=0.79 r_2=0,75	—	—	r_1=0.76 r_2=0,79	—
Social support & peers	—	—	r_1=0.72 r_2=0,78	—	—	—	r_1=0.75 r_2=0,82	—	r_1=0.76 r_2=0,78	—
School Environment	r_1=0.72 r_2=0,62	—	—	—	—	—	—	—	r_1=0.73 r_2=0,75	—

Note: CP QOL = Cerebral Palsy Quality of Life; r_1; Spearman correlations between the self-report versions of KIDSCREEN-27 and CPQOL-Child and CP QOL-Teen, r_2; Spearman correlations between proxy versions of KIDSCREEN-27 and CPQOL-Child and CP QOL-Teen.

Concurrent Validity

Differences Between the Higher (I-III) and Lower (IV-V) Functional Levels of the GMFCS-E&R, MACS, and CFCS According to Each Subdomain of the KIDSCREEN-27

For both versions of the KIDSCREEN- 27, the results of the Mann-Whitney U-test showed that children and adolescents with higher functioning levels had significantly better scores on all HRQOL subdomains than those with lower functioning levels ($p < .05$) (Table 4). Regarding communication performance, the subdomain scores of both versions were comparable to both higher and lower functional levels ($p > .05$). That is, factor scores of both KIDSCREEN-27 versions showed non-significant correlations with the participants' communication performance levels.

Reliability

For the self-reported version of the KIDSCREEN-27, internal consistency (Cronbach's a) ranged from 0.77 to 0.97; for the parent-proxy version, the range was 0.71–0.96. More specifically, apart from the *'psychological well-being'* subdomain, internal consistency reliability for each subdomain of both versions was good to excellent ($\alpha>0.90$), and Cronbach's alpha coefficient for the *'psychological well-being'* subdomain of both versions was satisfactory ($\alpha=0.77$ and 0.71, respectively). The test-retest reliability of both versions of KIDSCREEN-27 was found to be acceptable for all subdomains (ranges of ICC 0.71–0.97; $p < .001$) (Table 5).

Missing Values

In the current study, there were no items with more than 5% missing values in either version of the KIDSCREEN-27 questionnaires. Missing values were 1.2% for the item *'Has your child felt fit and well?'* and 2.1% for item *'Has your child been physically active (e.g., running, climbing, biking)?'* in the primary caregiver proxy report version; 4.2% for item '*Have you had enough money to do the same things as your friends?',* 3.1 % for '*Have you had enough money for your expenses?',* and 4.6 % for '*Have you been able to run well?'* in the self-reported version.

Discussion

In this study we found that both self-report and primary caregiver proxy report versions of the KIDSCREEN-27 had adequate psychometric properties among children and adolescents with CP. Both KIDSCREEN-27 versions were successful in measuring the construct they were intended to measure—namely, HRQOL—in CP children and adolescents. In other words, CFA indices showed that the predefined and confirmed factor structure of both KIDSCREEN-27 versions, a generic HRQOL instrument, fitted the data from our CP sample. Satisfactory correlations between matched subdomains of

Table 4. Differences between GMFCS-E&R, MACS, and CFCS Levels According to Subdomains of Self-Report and Proxy Versions of KIDSCREEN-27.

Self-Report version										Proxy version								
	MACS group			GMFCS group		P[a]	CFCS group			MACS group			GMFCS group		P[a]	CFCS group		
Kidscreen-27 Subdomains (T-value)	I-II-III (*n* = 103)	IV-V (*n* = 32)	P[a]	I-II-III (*n* = 102)	IV-V (*n* = 33)		I-II-III (*n* = 103)	IV-V (*n* = 32)	P[a]	I-II-III (*n* = 103)	IV-V (*n* = 32)	P[a]	I-II-III (*n* = 102)	IV-V (*n* = 33)		I-II-III (*n* = 103)	IV-V (*n* = 32)	P[a]
Physical well-being Median (IQR)	55.89 (13.72)	35.89 (10.27)	0.000	54.21 (15.72)	35.89 (14.16)	0.000	52.67 (20.00)	41.19 (21.79)	0.227	52.67 (15.72)	36.49 (14.31)	0.000	50.91 (15.72)	36.60 (16.05)	0.000	48.37 (20.00)	38.86 (24.01)	0.152
Psychological Well-being Median (IQR)	48.06 (7.08)	33.82 (11.87)	0.000	46.64 (9.36)	34.65 (20.23)	0.016	46.61 (14.62)	40.06 (13.04)	0.025	44.26 (7.40)	36.37 (13.88)	0.000	44.26 (5.31)	38.07 (14.09)	0.000	44.26 (6.61)	40.06 (7.61)	0.023
Autonomy & Parent relations Median (IQR)	42.08 (15.92)	37.48 (9.73)	0.011	42.08 (12.69)	37.48 (15.34)	0.005	40.60 (15.92)	38.27 (11.62)	0.706	43.79 (14.36)	37.48 (9.77)	0.002	43.79 (11.56)	37.48 (11.10)	0.018	42.18 (11.62)	38.26 (11.64)	0.507
Social support & peers Median (IQR)	49.14 (12.62)	39.96 (21.6)	0.005	47.54 (16.16)	39.96 (23.37)	0.001	45.94 (12.62)	39.96 (18.45)	0.483	49.14 (12.62)	39.96 (18.45)	0.021	49.14 (12.62)	39.96 (21.60)	0.003	45.94 (12.62)	39.96 (18.45)	0.442
School Environment Median (IQR)	44.38 (13.28)	38.14 (15.27)	0.030	44.38 (13.28)	38.14 (15.81)	0.002	41.24 (16.07)	38.14 (13.53)	0.348	44.38 (13.28)	38.14 (15.81)	0.017	44.38 (13.28)	38.14 (14.25)	0.001	41.24 (16.07)	38.14 (13.53)	0.348

[a]Mann-Whitney U Test; MACS, Manual Ability Classification system; GMFCS, Gross Motor Function Classification System; CFCS, Communication Function Classification System, IQR, Interquartile Range.

Table 5. Test–Retest Reliability and Internal Consistency of Self-Report and Proxy Report of KIDSCREEN-27.

Self-Report Version				Proxy version			
Subdomains (T-Value)	Cronbach alpha(α)[a]	ICC (95% CI)	P**	Subdomains (T-Value)	Cronbach alpha (α)	ICC (95% CI)	P**
Physical well-being	0.90	0.78 (0.70–0.85)	0.000	Physical well-being	0.93	0.97 (0.95–0.98)	0.000
Psychological Well-being	0.77	0.93 (0.89–0.95)	0.000	Psychological Well-being	0.71	0.92 (0.88–0.95)	0.000
Autonomy & Parent relations	0.88	0.78 (0.71–0.85	0.000	Autonomy & Parent relations	0.91	0.77 (0.69–0.84)	0.000
Social support & peers	0.96	0.95 (0.93–0.97	0.000	Social support & peers	0.96	0.95 (0.93–0.97)	0.000
School Environment	0.97	0.97 (0.96–0.98)	0.000	School Environment	0.96	0.97 (0.96–0.98)	0.000

[a]A value more than 0.70 is acceptable; ICC, Interclass Correlation Coefficient; CI, Confidence Interval; ** Significance.

KIDSCREEN-27 and CP QOL questionnaires showed that the items (observed variables) on the KIDSCREEN-27 and latent structure (i.e., subdomains) were understood similarly by children and adolescents and their parents. The concurrent validity analysis revealed that the KIDSCREEN-27 questionnaires can be utilized to assess HRQOL in children and adolescents with CP. Additionally, subdomain scores in both versions varied with functional motor levels but not with levels of communication performance. Subdomains of both versions revealed satisfactory internal consistency and test-retest reliabilities with appropriate Cronbach's alpha coefficients and ICC values.

Validity

The use of self-administered or proxy-reported HRQOL questionnaires in a new culture/country or population requires appropriate cross-cultural validation and equivalence between the original structure and target version (Beaton et al., 2000). Validation represents the means of determining that a questionnaire evaluates what it is supposed to measure. We examined the three most common validity types: structural construct validity (factorial validity), concurrent validity, and differences between higher and lower functional levels of classification systems. Construct validity is the degree to which a set of variables accurately describe the construct to be evaluated (Souza et al., 2017). In this study, the construct validity of both versions of the KIDSCREEN-27 was confirmed by CFA, which examined the relationship between the observed variables/items and their underlying latent variables or factors (i.e., domains). CFA results demonstrated the adequacy of the model fit to data from Turkish children and adolescents with CP, confirming the predefined latent construct of the KIDSCREEN-27, which was originally developed as a generic HRQOL questionnaire. With the above results, the item '*In general, how would you say your health is?*' under the '*physical well-being'* subdomain of the self-reported version and the items '*have you felt sad?'*, '*have you felt so bad that you didn't want to do anything?', 'have you felt lonely?',* and *'have you been happy with the way you are?*' under the '*psychological well-being'* subdomains of both versions were found to have unacceptable regression weights (factor loading) of less than 0.05, suggesting that these items could not sufficiently explain their relevant factors. However, because CFA yielded adequate goodness-of-fit indexes, the research authors and statistical experts did not need to remove these items from the relevant subdomains. The KIDSCREEN-27 is a general HRQOL life instrument; on the other hand, the CP QOL self-report and primary caregiver proxy report versions are condition-specific HRQOL questionnaires for children and adolescents with CP. (Davis, Davern, et al., 2013). Moderate to excellent correlations between the matched subdomains of both versions of the KIDSCREEN-27 and CP QOL questionnaires demonstrated that KIDSCREEN-27 could be utilized to measure HRQOL outcomes in children and adolescents with CP. In other words, both versions of KIDSCREEN-27 had satisfactory concurrent validity. HRQOL is closely related to gross and fine motor function in children with CP (Kim & Park, 2011; Tonmukayakul et al., 2020); however, to the best of our knowledge, there is no

evidence to date that it is related to communication performance. We found that children and adolescents with higher functional motor levels had greater HRQOL scores than those with lower functional motor levels, showing that both KIDSCREEN-27 versions can measure the intended concepts. On the other hand, the KIDSCREEN-27 subdomain scores did not differ based on communication performance levels, as expected, implying that both versions of KIDSCREEN-27 can measure the impact of CP on children and adolescents.

Reliability

Both versions of the KIDSCREEN-27 had adequate internal consistency for each subdomain, indicating that all items/questions in a particular factor or subdomain measure the same construct. Moreover, the internal consistency reliability coefficients suggested that the homogeneity of factor items to the underlying factor was sufficient. This finding is in line with the preliminary study that explored the structural and cross-cultural validity of the KIDSCREEN-27 questionnaire among healthy children and adolescents aged 8–18 years from 13 European countries (Robitail et al., 2007). In terms of test-retest reliability, each subdomain of both versions of the KIDSCREEN-27 had acceptable to excellent test-retest reliability. More specifically, the '*physical well-being'* domain of the self-reported version and the *'autonomy & parent relations'* subdomains of both versions produced acceptable ICC coefficients, while the remaining subdomains in either version produced excellent ICC coefficients. These results are consistent with the previous psychometric studies for Spanish, Norwegian and Brazilian versions of KIDSCREEN-27 conducted in the healthy population aged 8–18 years.

Limitations and Directions for Further Research

Our sample size was estimated by a general rule of thumb of 5–10 participants needed for each item and 10-20 participants per factor in CFA., and our sample was relatively small, compared to psychometric studies conducted in healthy populations where prospective participants are more readily available than was the case for our participants with CP. The functional profile of these participants was biased towards MACS and GMFCS Levels I-II-III. Finally, there was a disparity between the number of children and adolescents (59.3% children and 40.7% adolescents), with children outnumbering adolescents. These limitations suggest a need for cross validations of these findings.

Conclusion

Predefined latent structures of both versions of KIDSCREEN fit the data from adolescents and children with CP, indicating that both self-report and parent versions of KIDSCREEN-27 questionnaires can be confidently used to evaluate HRQOL outcomes in children and adolescents with CP. Furthermore, we determined that both

versions of the KIDSCREEN-27 had adequate internal consistency and test-retest reliability. Further work is needed to cross-validate these findings with a larger sample and to investigate whether both versions are sensitive to changes over time.

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Ethics Approval

This study was performed in line with the principles of the Declaration of Helsinki. Approval was granted by the Ethics Committee of Hacettepe University with protocol number 16,969,557-2167 and a date of 2021/19/19

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