# The PedsQL<sup>™</sup> Oral Health Scale in Iranian children: reliability and validity

## AMIR H. PAKPOUR<sup>1</sup>, MIR S. YEKANINEJAD<sup>2</sup>, FATEMEH ZAREI<sup>1</sup>, FARIBA HASHEMI<sup>1</sup>, MICHAEL M. STEELE<sup>3</sup> & JAMES W. VARNI<sup>4,5</sup>

<sup>1</sup>Department of Public Health, Qazvin University of Medical Sciences, Qazvin, Iran, <sup>2</sup>Department of Epidemiology and Biostatistics, School of Public Health, Tehran University of Medical Sciences, Tehran, Iran, <sup>3</sup>Department of Psychology, Auburn University, Auburn, AL, USA, <sup>4</sup>Department of Pediatrics, College of Medicine, Texas A&M University, College Station, TX, USA, and <sup>5</sup>Department of Landscape Architecture and Urban Planning, College of Architecture, Texas A&M University, College Station, TX, USA

International Journal of Paediatric Dentistry 2011; 21: 342– 352

**Objective.** The primary objective of the study was to translate and evaluate the psychometric properties of the Pediatric Quality of Life Inventory<sup>TM</sup> (PedsQL<sup>TM</sup>) Oral Health Scale in over 1000 Iranian children.

**Methods.** A standard forward and backward translation procedure was used to convert the US English dialect version of the PedsQL<sup>TM</sup> Oral Health Scale into the Iranian language (Persian). The Iranian version of the PedsQL<sup>TM</sup> Oral Health Scale, in combination with the PedsQL<sup>TM</sup> 4.0 Generic Core Scales, was then subsequently administered to 1053 Iranian children and 1026 parents. The reliability of the PedsQL<sup>TM</sup> Oral Health Scale was evaluated using internal consistency and test-retest methods. Known-groups discriminant validity, exploratory factor analysis (EFA) of the Oral

Health and the four Generic Core Scales combined, and confirmatory factor analysis (CFA) of the Oral Health Scale alone were conducted. The Benjamini–Hochberg procedure was used to correct *P*-values for multiple comparisons.

**Results.** Good to excellent internal consistency and test-retest reliabilities were demonstrated. The PedsQL<sup>TM</sup> Oral Health Scale demonstrated discriminant validity for subgroups of children across different decayed, missing and filled teeth (DMFT) index categories and gender. The EFA supported the *a priori* factor model of the combined five scales. The CFA analysis confirmed the unidimensional factor structure of the Oral Health Scale.

**Conclusions.** The PedsQL<sup>TM</sup> Oral Health Scale demonstrated excellent psychometric properties in combination with the PedsQL<sup>TM</sup> 4.0 Generic Core Scales. These five scales combined can be utilized to assess the multidimensional oral-health-related quality of life of Iranian children.

#### Introduction

Oral health is an integral part of general health<sup>1</sup> and can affect an individual's life in areas such as language, social, physical and emotional functioning<sup>2,3</sup>. Further, oral diseases can cause serious long-term problems regarding both social (e.g., socializing, self-esteem) and physical (e.g., heart disease) health<sup>4–8</sup>. Despite considerable improvements in the oral health of people worldwide, oral health problems still persist both in developed and in developing countries<sup>9</sup>. Further, the assessment

of oral health status in children and adolescents can be seen as particularly crucial given that poor oral health can cause negative effects on learning abilities, growth, socialization and normal daily activities in children<sup>10</sup>.

It is no surprise that previous research has shown that a child's oral health can have a significant impact on his or her overall quality of life. Quality of life has been defined by the World Health Organization (WHO) as 'an individual's perception of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards, and concerns'<sup>11</sup>. Recently, the WHO has stressed the importance of including oral health in the conceptualization of general health<sup>8</sup>.

*Correspondence to:* A. H. Pakpour, PhD, Department of Public Health, Qazvin University of Medical Sciences, Qazvin, Iran. E-mail: pakpour\_amir@yahoo.com

Based on these recommendations, a large body of literature has emerged that is dedicated exclusively to the quantification of oral health and its impact on health-related quality of life (HRQoL), or oral-health-related quality of life (OHRQoL). Although there are several oral-specific health status measures<sup>12</sup>, there are few measures that are designed specifically to assess OHRQoL among child populations<sup>13</sup>. Furthermore, existing measures focus more on the oral cavity and ignore the impact a child's oral health can have on other health domains. Additionally, such instruments can be seen as being too specific, which makes comparisons between healthy and unhealthy samples difficult. For example, existing measures include mainly questions specifically about the oral cavity<sup>12</sup>. Conversely, more generic instruments ask only questions about physical, psychological and social functioning, and fail to capture the oral health domain entirely. To remedy these issues, the Pediatric Quality of Life Inventory<sup>TM</sup> (PedsQL<sup>TM</sup>) Oral Health Scale was developed to improve the assessment capabilities within the area of OHRQoL<sup>13</sup>. The Peds-OL<sup>TM</sup> Oral Health Scale is not designed to evaluate specific oral health problems; instead, it focuses on the child's general oral health status<sup>13</sup>. The PedsQL<sup>TM</sup> Oral Health Scale is also designed to be used in conjunction with the PedsQL<sup>TM</sup> 4.0 Generic Core Scales or disease-specific modules (e.g., Peds-QL<sup>TM</sup> Diabetes Module). When used with the comprehensive PedsQL<sup>TM</sup> measurement system, the PedsOL<sup>TM</sup> Oral Health Scale has been demonstrated to be a reliable and valid instrument for assessing OHRQoL among children and adolescents in a US sample<sup>13</sup>.

The primary objective of this study was to translate and evaluate the psychometric properties of the PedsQL<sup>TM</sup> Oral Health Scale in a sample of over 1000 Iranian children and their parents.

#### Materials and methods

#### **Participants**

Participants were children ages 8–18 years and their parents. For data collection purposes,

Qazvin (a city near to Tehran, Iran) was divided into three zones, and six schools were randomly selected from each zone. Next, the students were randomly selected by computerbased random generator program from each school. The total number of the students was 1107. In total, 1053 Iranian children and 1026 parents completed the questionnaires.

#### Measurements

The administration process consisted of several parts. The first included an assessment of demographic information such as child age and gender, mother and father's educational level, socioeconomic status, frequency of dental brushing and dental flossing. The second component involved a clinical examination for caries via the decayed, missing and filled teeth (DMFT) index<sup>14</sup>. For the DMFT assessment, subjects were assessed by a single examiner in the school setting on a comfortable chair with a headlamp, a mouth mirror and a WHO probe<sup>14</sup>. Reliability of the examination (intra-examiner reliability) was performed on twenty children. Re-examination was performed after 2 weeks. The intraexaminer reliability for caries status (Kappa statistic) was 0.96.

A third component of the administration process consisted of parents and children completing the Iranian translation of the PedsQL<sup>TM</sup> 4.0 Generic Core Scales<sup>15,16</sup>. The PedsOL<sup>TM</sup> 4.0 Generic Core Scales have 23 items and encompasses (1) Physical Functioning Scale (eight items), (2) Emotional Func-(five items). tioning Scale (3) Social Functioning Scale (five items) and (4) School Functioning Scale (five items). There are two parallel forms for PedsQL<sup>TM</sup> 4.0: a child selfreport form and a parent proxy-report form. All items are scored on a five-point Likert Scale ranging from 'never a problem' = 0, to 'almost always a problem' = 4. The items are reverse scored and transformed into a 0-100point scale with higher scores indicating better quality of life. The PedsQL<sup>TM</sup> 4.0 Generic Core Scales are available in Persian and have been validated in Iranian adolescents<sup>16</sup>.

The final part of the administration included the PedsQL<sup>TM</sup> Oral Health Scale

(e.g., 'I have tooth pain when I eat or drink something hot, cold or sweet'; 'I have blood on my toothbrush after brushing my teeth')<sup>13</sup>. The PedsQL<sup>TM</sup> Oral Health Scale (appendix) has five items and like the PedsQL<sup>TM</sup> 4.0 Generic Core Scales has two parallel forms for child self-report and parent proxy-report. The items include five item response alternatives 0 = never a problem, 1 = almost never a problem, 2 = sometimes a problem, 3 = often a problem, 4 = almost always a problem. Also like the PedsQL<sup>TM</sup> 4.0 Generic Core Scales, the items are reverse scored and linearly transformed into a 0-100-point scale with higher scores representing better OHRQoL.

#### Translation

The original PedsQL<sup>TM</sup> Oral Health Scale was validated among a sample of children and their parents in a US sample<sup>13</sup>. To translate the original measure for use among an Iranian sample, two bilingual Iranian translators independently translated the PedsQL<sup>TM</sup> Oral Health Scale Questionnaire into Persian. The versions were revised by a specialized team including a public health worker, a nurse, a health education specialist and a child psychologist. The team then compared the translations, reconciled discrepancies and arrived at a unified Iranian version suitable for use with children and parents. Next, the Persian version was translated back into US English dialect by two additional translators, both of whom were native English speakers. Discrepancies between the back-translations were resolved. Then, the PedsQL<sup>TM</sup> Oral Health Scale was piloted on 30 children and on their parents, and separate cognitive interviews were conducted among ten children and their parents (8-12 and 13-18 years old). Respondent debriefing was used for this interviewing technique. Results from the interviews indicated that the translated versions were suitable, with no specific items requiring changes for children and/or their parents. Moreover, all of the children and parents found the five questions in the questionnaire were clear, simple and intelligible. All translation procedures were checked and approved by the developer of the PedsQL<sup>TM</sup> Measurement System, Dr. James W. Varni.

#### Procedure

At baseline, the PedsQL<sup>TM</sup> instruments were distributed to children and their parents. Children and parents completed the questionnaires simultaneously in different rooms in schools. One month later, children and their parents were asked to complete the measures again. After the study was described to them, both children and parents gave their written consent to participation in the study, which was approved by the ethics committee of Qazvin University of Medical Sciences.

#### Data analysis

To assess the reliability of the PedsQL<sup>TM</sup> Oral Health Scale, two statistical methods were used. Specifically, internal consistency reliability was assessed by calculating Cronbach's  $\alpha$ , and the reproducibility of the measure was evaluated using test-retest reliability analyses separated by a 1-month interval. Cronbach's  $\alpha$  coefficient ranges from 0 to 1 with values >0.70 being considered acceptable<sup>17</sup>. In terms of the test-retest reliability analysis, intraclass correlation coefficients (ICCs) were calculated. An ICC of <0.40 indicates poor to fair agreement, 0.41-0.60 moderate agreement, 0.61-0.80 good agreement and >0.80 excellent agreement<sup>18</sup>. To control for multiple testing and balance the amount of Type I and Type II errors, the Benjamini and Hochberg false discovery rate (i.e., the expected proportion of rejected true null hypothesis among rejected hypotheses) was used. The false discovery rate level was set at 5%<sup>19,20</sup>.

Range of measurement was based on the percentage of scores at the extremes of the scaling range, that is, the maximum possible score (ceiling effect) and the minimum possible score (floor effect)<sup>21</sup>. Surveys with small floor or ceiling effects (1-15%) are considered to meet acceptable measurement standards, whereas surveys with moderate floor or ceiling effects (>15%) are considered less precise in measuring latent constructs at the extremes of the scale<sup>21</sup>.

To assess the discriminant validity of the PedsQL<sup>TM</sup> Oral Health Scale, a known-groups comparison was conducted among subgroups

of children based on DMFT index scores (DMFT = 0 *versus* DMFT > 0). The knowngroups method compares scale scores across groups known to differ in the health construct being investigated<sup>22,23</sup>. It was hypothesized that children with dental problems as measured by the DMFT index would manifest lower PedsQL<sup>TM</sup> Oral Health Scale scores. Gender subgroups were also tested. It was hypothesized that boys would manifest poorer oral health than girls based on previous studies<sup>4,24–26</sup>.

Construct validity was examined through an analysis of Pearson's product moment correlations among the PedsQL<sup>TM</sup> Oral Health Scale and the PedsQL<sup>TM</sup> 4.0 Generic Core Scales. Computing the intercorrelations among scales provides additional information on the construct validity of an instrument<sup>27</sup>. Based on the conceptualization of diseasespecific symptoms as causal indicators of generic HRQOL and the extant literature on oral health, it was anticipated that more impaired oral health would be associated with more impaired generic HRQOL.

To determine the factor structure of the PedsQL<sup>TM</sup> Oral Health Scale, an exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) were performed. Specifically, the EFA was performed using a principal component analysis on the combined 28 items of the four scales of the PedsQL<sup>TM</sup> 4.0 Generic Core Scales and the PedsQL<sup>TM</sup> Oral Health Scale. It was hypothesized that a 5-factor solution would be determined from the EFA.

To further evaluate the construct validity and the dimensionality of the PedsQL<sup>TM</sup> Oral Health Scale, a CFA was conducted. Model fit was assessed in several ways, including the comparative fit index (CFI), normed fit index (NFI), the root mean square error of approximation (RMSEA), goodness of fit index (GFI) and adjusted goodness of fit index (AGFI). The CFI ranges from 0 to 1, where a CFI close to 1 indicates a very good fit and a value >0.9 indicates an acceptable fit. The NFI specifies the practicality of the model to the collated data, with an assessment being deemed acceptable when it equals or is >0.90. The RMSEA is a measure of the discrepancy of the model to the collated data, expressed per degree of freedom (d.f.), with a typical cut-off point for the RMSEA being 0.05 or less, while an adequate fit is acceptable at 0.08. The GFI measures the relative difference between the data and estimated values obtained from a model, with the adjusted GFI (AGFI) compensating for the degrees of freedom. Previous studies have suggested a cut-off point equal to or >0.90 for GFI and AGFI<sup>28,29</sup>. It hypothesized that the PedsQL<sup>TM</sup> Oral Health Scale would load on 1 factor, supporting unidimensionality.

Parent-child agreement was assessed by intraclass correlations between child self-reports and parent proxy-reports for the PedsQL<sup>TM</sup> 4.0 Generic Core Scales and the PedsQL<sup>TM</sup> Oral Health Scale.

#### Results

#### Sample characteristics

Child and adolescent self-reports were completed by 1053 Iranian children. Parent proxy-reports were completed by 1026 parents including mothers (87%), fathers (8%) and 'others' (e.g., grandmothers; 5%). The average child in the study was 15.0 years old, and 58% of the children were girls (n = 611). Most of the families had a monthly family income of \$500-800. The mean years of education for mothers and fathers were 6.2 and 8.1, respectively. In terms of behaviours related to oral health, most of the children did not use dental floss (47.8%) and about 7% of the children did not report using a tooth brush (Table 1). The mean DMFT index for participating children was 2.4 (SD = 2.6). Additional demographic characteristics of the children are shown in Table 1.

#### Range of measurement

As indicated in Table 2, there were no ceiling or floor effects for the PedsQL<sup>TM</sup> 4.0 Generic Core Scales or the PedsQL<sup>TM</sup> Oral Health Scale. That is, the PedsQL<sup>TM</sup> Oral Health Scale was able to detect a wide range of oral health among the children and adolescents in the current sample.

 
 Table 1. Demographic characteristics of the sample of Iranian children.

	N (%)
Age (mean ± SD)	15.42 (1.1)
Gender	442 (42)
Girls	611 (58)
Father's education (year; mean $\pm$ SD)	8.18 (3.62)
Mother's education (year; mean $\pm$ SD)	6.24 (5.26)
DMFT Index (mean ± SD) Tooth brushing	2.45 (2.66)
Never Once a day Once a week Less than a week Less than a month	78 (7.4) 706 (67) 155 (14.7) 61 (5.8) 53 (5.1)
Dental floss Once a day Once a week Less than once a week Less than once a month Never	179 (17) 148 (14.1) 106 (10.1) 116 (11) 504 (47.8)
Monthly family income 0–500\$ (low) 500–800\$ (moderate) >800\$(high)	200 (19) 516 (49) 337 (32)

## Table 3. Test-retest reliability of the Iranian version of the PedsQL<sup>™</sup> 4.0 Generic Core Scales and PedsQL<sup>™</sup> Oral Health Scale scores.

Scale	ICC (95% CI)
Child self-report Total Generic Core Scales Physical health Emotional functioning Social functioning School functioning Oral health	0.87 (0.83–0.90) 0.80 (0.79–0.83) 0.71 (0.64–0.76) 0.74 (0.66–0.80) 0.80 (0.73–0.85) 0.86 (0.82–0.89)
Parent Proxy-report Total Generic Core Scales Physical health Emotional functioning Social functioning School functioning Oral health	0.90 (0.85–0.94) 0.81 (0.76–0.85) 0.74 (0.68–0.78) 0.77 (0.72–0.81) 0.80 (0.74–0.84) 0.81 (0.77–0.84)

All *P* < 0.05.

ICC, intraclass correlation coefficients.

#### Reliability

In terms of the reliability analyses, Cronbach's  $\alpha$  coefficients for the PedsQL<sup>TM</sup> Oral Health Scale for child self-report and parent proxy-report were 0.81 and 0.89, respectively. Furthermore, internal consistency of the PedsQL<sup>TM</sup> 4.0 Generic Core Scales ranged from 0.71 to 0.92 for both child self-report and parent proxy-report. These results indicate that all of the scales evaluated demonstrated adequate

to excellent internal consistency. As shown in Table 3, ICCs for the PedsQL<sup>TM</sup> Oral Health Scale demonstrated good to excellent test-retest reliability for the scales across a 1-month test-retest interval.

#### Construct validity

Construct validity was supported by the intercorrelations shown in Table 4 between the PedsQL<sup>TM</sup> Oral Health Scale and the Peds-QL<sup>TM</sup> Generic Core Scales. Results from the known-groups comparisons between subgroups of the children showed that the PedsQL<sup>TM</sup> Oral Health Scale effectively

Table 2. Means, standard deviations, percent floor and ceiling effects and Cronbach's α for the Iranian version of PedsQL<sup>™</sup> 4.0 Generic Core Scales and PedsQL<sup>™</sup> Oral Health Scale.

Scale	Number of items	Mean	SD	Percent floor	Percent ceiling	Cronbach's α
Child self-report						
Total Generic Core Scales	23	77.55	13.02	0.6	3	0.86
Physical health	8	80.94	15.92	0.8	12.3	0.78
Emotional functioning	5	71.91	18.60	0.8	7.2	0.77
Social functioning	5	75.50	14.48	0	8.3	0.71
School functioning	5	79.25	17.09	0.94	11	0.83
Oral health	5	79.38	18.02	0	14	0.79
Parent proxy-report						
Total Generic Core Scales	23	75.77	18.42	5.3	0	0.90
Physical health	8	74.19	25.23	5.5	14.7	0.91
Emotional functioning	5	70.83	24.23	6	10.8	0.86
Social functioning	5	63.61	16.07	7.1	0	0.72
School functioning	5	65.74	22.60	0	3	0.71
Oral health	5	74.82	26.1	0	13.5	0.89

discriminated between children with high and low DMFT index scores (Table 5). Children who were classified as 'orally unhealthy' (i.e., DMFT scores >0) had significantly lower PedsQL<sup>TM</sup> Oral Health Scale scores than those who were classified as 'orally healthy' (i.e., DMFT scores = 0) after applying the Benjamini-Hochberg correction. Furthermore, the PedsQL<sup>TM</sup> Oral Health Scale differentiated between the gender subgroups, with girls demonstrating higher PedsQL<sup>TM</sup> Oral Health Scale scores, but this difference was not statis-

Table 4. Intercorrelations among PedsQL<sup>™</sup> 4.0 Generic Core Scales and PedsQL<sup>™</sup> Oral Health Scale for child self-report and parent proxy-report.

Scale	TGC	РН	EF	SF	SchF	ОН
TGC	_	0.85*	0.78*	0.67*	0.77*	0.49*
PH	0.89*	-	0.53*	0.41*	0.51*	0.30*
EF	0.87*	0.73*	-	0.33*	0.48*	0.40*
SF	0.72*	0.51*	0.52*	-	0.49*	0.38*
SchF	0.68*	0.39*	0.47*	0.52*	-	0.49*
ОН	0.75*	0.57*	0.63*	0.56*	0.62*	-

TGC, Total Generic Core Scales; PH, Physical Health Summary Score; EF, Emotional Functioning Scale; SF, Social Functioning Scale; SchF, School Functioning Scale; OH, Oral Health Scale; DMFT, decayed, missing and filled teeth.

Intercorrelations for child self-report are presented above the diagonal, and parent proxy-report correlations are presented below the diagonal. Categories of the correlations are small (0.10), medium (0.30) and large (0.50). \*P < 0.01.

tically significant for self-reported PedsQL<sup>TM</sup> Oral Health Scale scores when it corrected by the Benjamini–Hochberg procedure.

#### Parent-child agreement

Intraclass correlation coefficients were computed to evaluate parent–child agreement. The results showed that two of five the Peds- $QL^{TM}$  4.0 Generic Core Scales had good agreement (0.61–0.80). Moreover, the greatest level of agreement was between child self-report and parent proxy-reports on the Peds $QL^{TM}$  Oral Health Scale (0.70) as shown in Table 6.

Table 6. Intraclass correlations between child self-report and parent proxy-report and for the  $PedsQL^{TM}$  4.0 Generic Core Scales and the  $PedsQL^{TM}$  Oral Health Scale.

Scale	ICC
Total Generic Core Scales	0.59*
Physical health	0.60*
Emotional functioning	0.59*
Social functioning	0.24*
School functioning	0.31*
Oral health	0.70*

ICC, Intraclass correlation coefficients.

ICCs < 0.40 show poor to fair agreement, 0.41–0.60 moderate agreement, 0.61–0.80 good agreement and >0.80 excellent agreement. \*P < 0.01.

Table 5. Comparison of the PedsQL <sup>™</sup> 4	.0 Generic Core Scales and P	'edsQL <sup>™</sup> Oral Health Scale so	ores for DMFT index
categories and gender.			

	DMFT		Gender			
Scale	0 ( <i>n</i> = 308)	>0 ( <i>n</i> = 745)	Girls ( <i>n</i> = 611)	Boys (n = 442)		
Child Self-report						
Total Generic Core Scales	70.0 (19.1)	61.8 (17.5)	77.2 (12.6)	80.2 (12.4)		
Physical health	71.5 (25.4)	66.2 (24.3)	80.5 (15.3)	84.8 (15.7)		
Emotional functioning	72.5 (23.9)	68.1 (23.5)	71.9 (18.5)	73.0 (16.5)		
Social functioning*	61.5 (16.8)	56.3 (15.8)	74.7 (14.4)	80.8 (12.6)		
School functioning	65.6 (24.3)	58.0 (21.9)	79.4 (15.2)	79.2 (17.3)		
Oral health**	79.1 (25.6)	69.8 (26.1)	89.4 (16.6)	74.1 (18.3)		
Parent Proxy-report						
Total Generic Core Scales*	79.8 (16.1)	74.9 (15.3)	64.9 (19.1)	71.1 (11.7)		
Physical health*	80.3 (13.6)	75.1 (11.3)	72.7 (25.7)	83.0 (18.7)		
Emotional functioning*,**	73.6 (17.9)	69.1 (18.9)	69.8 (24.9)	77.1 (17.9)		
Social functioning*	81.3 (17.2)	76.7 (15.7)	50.7 (16.5)	57.6 (10.7)		
School functioning	76.15 (15.29)	66.4 (19.3)	79.2 (17.3)	79.3 (15.2)		
Oral health*,**	84.4 (14.9)	74.5 (18.2)	87.8 (15.6)	78.1 (18.3)		

\*Statistically significant according to Benjamini-Hochberg procedure for gender.

DMFT, decayed, missing and filled teeth.

\*\*Statistically significant according to Benjamini–Hochberg procedure for DMFT.

#### Factor structure

Principal components analysis was conducted on the combined 28 items (The 23-item Peds-QL<sup>TM</sup> 4.0 Generic Core Scales and the 5-item PedsQL<sup>TM</sup> Oral Health Scale) for both child self-reports and parents proxy-reports to assess the factor structure of all five scales together. Results indicated that the Kaiser-Meyer-Olkin measure of sampling adequacy was 0.897 and 0.944 for self-reports and proxy-reports, respectively, which is above the recommended value of 0.60, and the Bartlett's test of sphericity was found to be highly significant for self-reports and proxyreports (P < 0.001). Moreover, the communalities were all found to be above 0.5. Using these aforementioned indicators, a factor analysis was conducted on all 28 items in the form of a principal components analysis. The initial Eigenvalues showed that all 28 items explained 66.12% and 74.87% of the variance in five components for child self-reports and parent proxy-reports, respectively. The five components were further examined using varimax rotations of the factor loading matrix. Results showed that the child selfreports and parent proxy-reports of the 28 items could be summarized into five components including Physical Functioning, Emo-Functioning, Social Functioning. tional School Functioning and Oral Health (Table 7).

Finally, confirmatory factor analyses were performed on the five items for the PedsQL<sup>TM</sup> Oral Health Scale for child self-report and parent proxy-report. These results are shown in Figs 1 and 2. As originally postulated, for

Table 7. Factor analysis results for child self-report and the parent proxy-report for the Iranian version of the PedsQL<sup>™</sup> 4.0 Generic Core Scales and PedsQL<sup>™</sup> Oral Health Scale combined.

	Factor 1		Factor 2		Factor 3		Factor 4		Factor 5	
	Child report	Parent report								
PH1	0.715	0.703	0.199	0.301	0.026	0.320	0.153	0.048	0.026	-0.081
PH2	0.531	0.795	-0.032	0.267	0.060	0.161	0.123	0.049	0.063	-0.039
PH3	0.511	0.756	-0.043	0.250	0.292	0.158	0.020	0.018	0.079	0.168
PH4	0.477	0.585	0.051	0.252	0.157	0.227	0.114	-0.142	-0.017	0.067
PH5	0.368	0.728	-0.057	0.187	0.252	0.127	-0.035	-0.125	-0.059	0.153
PH6	0.390	0.651	0.045	0.147	0.283	0.216	0.111	0.130	0.081	0.128
PH7	0.470	0.532	0.314	0.101	0.124	0.139	0.191	0.041	0.168	0.130
PH8	0.615	0.541	0.143	0.141	0.260	0.241	0.022	0.037	0.226	-0.146
EF1	0.233	0.245	0.472	0.529	0.100	0.122	0.105	0.103	0.054	0.169
EF2	0.266	0.265	0.419	0.724	0.016	0.172	0.171	0.036	0.026	0.382
EF3	0.180	0.196	0.415	0.728	0.208	-0.049	0.212	0.118	0.057	0.129
EF4	0.164	0.222	0.509	0.554	0.283	0.085	0.245	0.044	0.136	-0.215
EF5	0.181	0.271	0.342	0.713	0.109	0.121	0.224	0.067	0.147	0.128
SF1	0.036	0.034	0.001	0.192	0.711	0.228	0.196	0.050	0.491	0.021
SF2	0.111	0.078	0.094	0.107	0.740	0.603	0.106	0.274	0.012	0.034
SF3	0.089	-0.093	0.172	0.008	0.625	0.620	0.157	-0.027	0.121	0.069
SF4	0.112	0.170	0.209	0.151	0.451	0.340	0.112	0.133	0.039	0.148
SF5	0.097	0.082	0.038	0.041	0.237	0.305	0.125	0.207	0.018	0.194
SchF1	0.117	0.161	0.250	-0.010	-0.018	0.016	0.646	0.207	0.044	-0.030
SchF2	0.046	0.183	0.234	0.183	0.274	0.260	0.581	0.699	-0.015	0.122
SchF3	0.080	0.038	0.106	-0.075	0.117	-0.041	0.715	0.138	0.072	-0.085
SchF4	0.223	0.138	0.179	0.240	0.297	0.145	0.641	0.775	0.135	0.111
SchF5	0.224	0.145	0.136	0.266	0.310	0.090	0.471	0.764	0.299	0.043
OH1	0.049	0.176	0.053	0.253	0.014	-0.009	0.059	0.056	0.785	0.742
OH2	0.072	0.152	0.235	0.297	0.030	0.085	0.014	0.087	0.720	0.720
OH3	0.057	0.159	0.083	0.262	0.063	-0.126	0.080	0.102	0.736	0.753
OH4	0.096	0.264	0.118	0.269	0.253	0.163	0.145	0.083	0.494	0.766
OH5	0.059	0.191	-0.009	0.168	0.142	-0.076	0.143	-0.046	0.509	0.659

PH, Physical Health Summary Score; EF, Emotional Functioning Scale; SF, Social Functioning Scale; SchF, School Functioning Scale; OH, Oral Health Scale.

Highest loadings are bolded.



**Fig. 1.** Confirmatory factor analysis on the 5-item PedsQL Oral Health Scale child self report.



**Fig. 2.** Confirmatory factor analysis on the 5-item PedsQL Oral Health Scale parent proxy-report.

both child self-report and parent proxyreport, the PedsQL<sup>TM</sup> Oral Health Scale items loaded on one latent variable. The results showed that the models provided a good fit for the data, as fit indices for child self-report were  $\chi^2 = 6.60$ , d.f. = 5, *P* value = 0.252, GFI = 0.99, AGFI = 0.98, NFI = 0.99, CFI = 0.99 and RMSEA = 0.028 (Fig. 1). For parent proxy-report, when the CFA was run, some of the fit indices did not reach acceptable fit as  $\gamma^2 = 24.79$ , d.f. = 5, *P* value = 0.00015, GFI = 0.98, AGFI = 0.93, NFI = 0.98, CFI = 0.99 and RMSEA = 0.099. The CFA model was improved by adding a covariance structure between having tooth pain (OH1) and having gum pain (OH4). The fit indices for the modified parent proxy-report were  $\chi^2 = 8.36$ , d.f. = 4, *P* value = 0.079, GFI = 0.99, AGFI = 0.97, NFI = 0.99, CFI = 0.99 and RMSEA = 0.052 (Fig. 2).

#### Discussion

This study investigated the psychometric properties of the Iranian version of the Peds-QL<sup>TM</sup> Oral Health Scale among a sample of Iranian children and their parents. Reliable and valid instruments such as the PedsQL<sup>TM</sup> Oral Health Scale, when used in conjunction with the PedsQL<sup>TM</sup> 4.0 Generic Core Scales, may help to assess the effectiveness of specific interventions for treating existing paediatric oral health problems and to plan prevention programmes aimed at improving child and adolescent oral health.

The findings support the reliability and validity of the Iranian version of the Peds-QL<sup>TM</sup> Oral Health Scale among Iranian children. The results from this study are similar to those from the original study of US children<sup>13</sup>, but also include a more comprehensive evaluation of the measure, including conducting a CFA. Anecdotally, most of children and their parents completed the Peds-QL<sup>TM</sup> Oral Health Scale easily, which certainly has important practical implications.

Results indicated that the internal consistency of the PedsQL<sup>TM</sup> Oral Health Scale, as evaluated by examining Cronbach's  $\alpha$  coefficients, was acceptable for both child selfreport and parent proxy-report (i.e., >0.70). The original version of the PedsQL<sup>TM</sup> Oral Health Scale also exceeded the minimum reliability standard of 0.70 and was consistent with the results from the current investigation<sup>13</sup>. In fact, Cronbach's  $\alpha$  in this study was higher than for the PedsOL<sup>TM</sup> Oral Health Scale in comparison with original version in the US sample. One potential explanation for this particular finding could be that the Cronbach's  $\alpha$  coefficient is partly affected by sample size. Because the sample size from the current investigation was significantly larger than that of the validation study for the original version, the reliability coefficients may be more accurate.

According to the findings from this investigation, the PedsQL<sup>TM</sup> Oral Health Scale met the minimal recommended correlation coefficients criteria for test-retest reliability (0.7). Because no previous research exists that examines the reproducibility (i.e., test-retest reliability) of the PedsQL<sup>TM</sup> Oral Health Scale, comparisons with other studies are impossible. The findings of the current investigation however showed that the Iranian version of PedsQL<sup>TM</sup> Oral Health Scale was highly reproducible.

The study showed that there was no floor or ceiling effect for the scales. This suggests that the scales captured the full range of potential responses within the population. This is important to note, because the original version of the PedsQL<sup>TM</sup> Oral Health Scale did not include an analysis of ceiling and floor effects<sup>13</sup>. In fact, this finding can be seen as particularly important given that the initial validation study utilized a relatively homogenous sample in terms of oral health status<sup>13</sup>. This has important clinical implications for the measure as it would be essential to assess children and adolescents with a wide range of oral health at the population health level.

Results indicating that the PedsQL<sup>TM</sup> Oral Health Scale and the PedsQL<sup>TM</sup> 4.0 Generic Core Scales were significantly correlated further supports the construct validity of the PedsQL<sup>TM</sup> Oral Health Scale. That is, children and adolescents who had poorer oral health also evidenced significantly lower levels of HRQoL. This is consistent with other similar studies<sup>13,30,31</sup> and further supports the importance of considering the oral health domain when assessing HRQoL in children and adolescents.

In this study, the known-groups analysis indicated that the PedsQL<sup>TM</sup> Oral Health Scale discriminated between subgroups of children based on the DMFT index categories and gender. These findings are consistent with previous research that indicates that children with caries suffer from worse OHRQoL<sup>4,25,32–34</sup>. Moreover, the analysis showed that boys suffer from worse OHRQoL. These findings are consistent with our *a priori* hypothesis and also other studies<sup>4,24–26</sup>. These findings also have important clinical implications as they suggest that the PedsQL<sup>TM</sup> Oral Health Scale may be a quick and valid screening instrument assessing the general oral health status of children and adolescents.

Also consistent with previous research, the current findings indicated that parent-child agreement ranged from poor to moderate<sup>34,35</sup>. Agreement between parents and children however was at the highest level for the PedsQL<sup>TM</sup> Oral Health Scale (0.70). A possible explanation for this might be that actual disease and perceived need are associated significantly with parents' perceptions of children's oral health<sup>36</sup>. Further, their because most of the items in the PedsOL<sup>TM</sup> Oral Health Scale are related to observable variables, it may be easier to reach agreement on these items. Of course future research will be necessary to fully understand the relationship between parent proxyreports and child self-reports of HROOL and child oral health.

Results from the EFA analysis suggested a five-factor structure for the combined five scales for both child self-report and parent proxy-report. Moreover, the analysis clearly separated the items for the PedsQL<sup>TM</sup> Oral Health Scale from the PedsQL<sup>TM</sup> 4.0 Generic Core Scales. To the best of our knowledge, there is no other study that assesses the factor structure of the PedsQL<sup>TM</sup> 4.0 Generic Core Scales along with the PedsOL<sup>TM</sup> Oral Health Scale. Therefore, comparisons with other studies are not possible. A study by Amiri et al.<sup>16</sup> showed that items of PedsQL<sup>TM</sup> 4.0 Generic Core Scales loaded on five factors in Iranian adolescents. Some possible explanations are that the respondents were different in terms of demographic variables and sample size. Moreover, in this study, we assessed the factor structure of the 28 items of the five scales simultaneously (including the Peds-QL<sup>TM</sup> Oral Health Scale and the PedsQL<sup>TM</sup> 4.0 Generic Core Scales), whereas other studies assessed only the factor structure of the 4 PedsQL<sup>TM</sup> 4.0 Generic Core Scales. Our findings suggest that the PedsQL<sup>TM</sup> Oral Health Scale along with PedsOL<sup>TM</sup> 4.0 Generic Core Scales can be combined to assess the multidimensional oral-health-related quality of life of Iranian children.

Because the PedsQL<sup>TM</sup> Oral Health Scale can also be used as a standalone measure, we additionally conducted a CFA to determine the dimensionality of the Oral Health Scale. The CFA findings support the validity of the *a priori* unidimensionality of the PedsQL Oral Health Scale for both child self-report and parent proxy-report.

#### Conclusions

In summary, the Iranian version of the Peds-QL<sup>TM</sup> Oral Health Scale has demonstrated good to excellent psychometric properties in this relatively large sample of Iranian children. Unlike existing measures, which may be too specific or too generic<sup>12</sup>, the PedsQL<sup>TM</sup> Oral Health Scale can be used in conjunction with the PedsOL<sup>TM</sup> 4.0 Generic Core Scales to reliably and validly understand how a child's oral health is impacting their quality of life. Moreover, the PedsQL<sup>TM</sup> Oral Health Scale can be easily administered along with the PedsQL<sup>TM</sup> 4.0 Generic Core Scales by healthcare workers in Iran to assess children's oralhealth-related quality of life at the population health level. Furthermore, the Iranian version of the PedsQL<sup>TM</sup> Oral Health Scale can serve as a screening instrument for children with unknown oral health status in primary care or dental settings.

#### What this paper adds?

• This study describes the development and psychometric testing of an Iranian version of the PedsQL<sup>TM</sup> Oral Health Scale for assessing oral-health-related quality of life among schoolchildren in Persian-speaking communities.

### Why this paper is important to paediatric dentists?

- The impact of oral health status on children's quality of life is important to consider in assessing oral health needs and outcomes from oral healthcare services/interventions internationally.
- The Iranian version of the PedsQL<sup>TM</sup> Oral Health Scale may be a useful population health level instrument for assessing oral-health-related quality of life of schoolchildren among paediatric dentists working with Persian speaking communities.
- The Iranian version of the PedsQL<sup>TM</sup> Oral Health Scale can serve as a screening instrument for children with unknown oral health status in primary care or dental settings.
- The existence of an Iranian version of the PedsQL<sup>TM</sup> Oral Health Scale will facilitate cross-cultural and cross-national research to enhance paediatric dentists understanding of the impact of oral health on schoolchildren's quality of life internationally.

#### **Competing interests**

Dr Varni holds the copyright and the trademark for the PedsQL<sup>TM</sup> and receives financial compensation from the Mapi Research Trust, which is a nonprofit research institute that charges distribution fees to for-profit companies that use the PedsQL<sup>TM</sup>. The PedsQL<sup>TM</sup> is available at http://www.pedsql.org.

#### References

- 1 Moynihan PJ. The role of diet and nutrition in the etiology and prevention of oral diseases. *Bull World Health Organ* 2005; **83**: 694–699.
- 2 US Department of Health and Human Services. *Oral Health in America: A Report of the Surgeon General.* Rockville, MD: US Department of Health and Human Services, National Institute of Dental and Craniofacial Research, National Institute of Health, 2000.
- 3 Locker D. Measuring oral health; a conceptual framework. *Community Dent Health* 1988; **5**: 3–18.
- 4 Watt GR. Strategies and approaches in oral disease prevention and health promotion. *Bull World Health Organ* 2005; **83**: 711–718.
- 5 Davenport ES, Williams CE, Sterne JA, Sivapathasundram V, Fearne JM, Curtis MA. The East London Study of maternal chronic periodontal disease and preterm low birth weight infants: study design and prevalence data. *Ann Periodontol* 1998; **3**: 213–221.
- 6 Genco R, Offenbacher S, Beck J. Periodontal disease and cardiovascular disease: epidemiology and possible mechanisms. *J Am Dent Assoc* 2002; **133**(Suppl): 14S– 22S.
- 7 Offenbacher S, Katz V, Fertik G *et al.* Periodontal infection as a possible risk factor for preterm low birth weight. *J Periodontol* 1996; **10**(Suppl): 1103–1113.
- 8 Slavkin HC. Does the mouth put the heart at risk? *J Am Dent Assoc* 1999; **130**: 109–113.
- 9 Petersen PE. The World Oral Health Report 2003: continuous improvement of oral health in the 21st century the approach of the WHO Global Oral Health programme. *Community Dent Oral Epidemiol* 2003; **31**(1 Suppl): 3–23.
- 10 Gift HC, Reisine ST, Larach DC. The social impact of dental problems and visits. *Am J Public Health* 1992;
  82: 1663–1668.
- 11 World Health Organization. *Measuring Quality of Life: The Development of the World Health Organization Quality of Life Instrument (WHOQOL)*. Geneva: WHO, 1993.
- 12 Allen PF. Assessment of oral health related quality of life. *Health Qual Life Outcomes* 2003; **8**: 1–40.
- 13 Steele MM, Steele RG, Varni JW. Reliability and validity of the PedsQL<sup>TM</sup> Oral Health Scale:

measuring the relationship between child oral health and health-related quality of life. *Child Health Care* 2009; **38**: 228–244.

- 14 World Health Organization. Oral Health Surveys Basic Methods, 4th edn. Geneva: WHO, 1997.
- 15 Varni JW, Seid M, Kurtin PS. PedsQL<sup>TM</sup> 4.0: reliability and validity of the Pediatric Quality of Life Inventory<sup>TM</sup> 4.0 Generic Core Scales in healthy and patient populations. *Med Care* 2001; **39**: 800–812.
- 16 Amiri P, Ardakani EM, Jalali-Farahani S et al. Reliability and validity of the Iranian version of the Pediatric Quality of Life Inventory<sup>TM</sup> 4.0 Generic Core Scales in adolescents. *Qual Life Res* 2010; 19: 1501–1508.
- 17 Nunnally JC, Bernstein IR. *Psychometric Theory*, 3rd edn. New York: McGraw-Hill, 1994.
- 18 Bartko JJ. Intraclass correlation coefficient as a measure of reliability. *Psychol Rep* 1996; **19**: 3.
- 19 Benjamini Y, Hochberg Y. Controlling the false discovery rate: a practical and powerful approach to multiple testing. *J R Stat Soc Series B Stat Methodol* 1995; **57**: 289–300. Retrieved http://www.jstor.org.
- 20 Benjamini Y, Krieger AM, Yekutieli D. Adaptive linear step-up procedures that control the false discovery rate. *Biometrika* 2006; **93**: 491–507.
- 21 Terwee CB, Bot SD, de Boer MR *et al.* Quality criteria were proposed for measurement properties of health status questionnaires. *J Clin Epidemiol* 2007; **60**: 34–42.
- 22 Cohen J. Statistical Power Analysis for the Behavioral Sciences, 2nd edn. Hillsdale, NJ: Erlbaum, 1998.
- 23 Mulaik S, James L, Van Alstine J, Bennett N, Lind S, Stilwell C. Evaluation of goodness-of-fit indices for structural equation models. *Psychol Bull* 1989; 105: 430–445.
- 24 Calis EM, Geels LM, Prahl-Andersen B, Zentner A. Oral health-related quality of life and dental esthetics in Amsterdam schoolchildren. *J Dent Child (Chic)* 2009; **76**: 130–135.
- 25 Do LG, Spencer AJ. Evaluation of oral healthrelated quality of life questionnaires in a general child population. *Community Dent Health* 2008; **25**: 205–210.
- 26 Ostberg AL, Andersson P, Hakeberg M. Crosscultural adaptation and validation of the oral impacts on daily performances (OIDP) in Swedish. *Swed Dent J* 2008; **32**: 187–195.
- 27 Pedhazur EJ, Schmelkin LP. *Measurement, Design, and Analysis: An Integrated Approach*. Hillsdale, NJ: Erlbaum, 1991.
- 28 Marsh HW, Hau K, Wen Z. In search of golden rules: comment on hypothesis testing approaches to setting cut-off values for fit indexes and dangers in over generalizing Hu and Bentler's findings. *Struct Equ Modeling* 2004; **11**: 320–341.

- 29 Byrne BM. *Structural Equation Modelling*. Mahwah, NJ: Lawrence Erlbaum Associates Publishers, 1998.
- 30 Benyamini Y, Leventhal H, Leventhal EA. Self-rated oral health as an independent predictor of self-rated general health, self-esteem and life satisfaction. *Soc Sci Med* 2004; **59**: 1109–1116.
- 31 Coulter ID, Heslin KC, Marcus M *et al.* Associations of self-reported oral health with physical and mental health in a nationally representative sample of HIV persons receiving medical care. *Qual Life Res* 2002; **11**: 57–70.
- 32 Do LG, Spencer A. Oral health-related quality of life of children by dental caries and fluorosis experience. *J Public Health Dent* 2007; 67: 132–139.
- 33 Robinson PG, Nalweyiso N, Busingye J, Whitworth J. Subjective impacts of dental caries and fluorosis in rural Ugandan children. *Community Dent Health* 2005; **22**: 231–236.
- 34 Sprangers MAG, Aaronson NK. The role of health care providers and significant others in evaluating the quality of life of patients with chronic disease: a review. *J Clin Epidemiol* 1992; **45**: 743–760.
- 35 Achenbach TM, McConaughy SH, Howell CT. Child adolescent behavioral and emotional problems: implications of cross informant correlations for situational specificity. *Psychol Bull* 1987; **101**: 213– 232.
- 36 Talekar BS, Rozier RG, Slade GD, Ennett ST. Parental perceptions of their preschool-aged children's oral health. *J Am Dent Assoc*, 2005; **136**: 364–372.

#### Appendix

### Pediatric Quality of Life Inventory<sup>TM</sup> (PedsQL<sup>TM</sup>) oral health scale items.

- Child self-report item content
- 1. I have tooth pain.
- 2. I have tooth pain when I eat or drink something hot, cold, or sweet.
- 3. I have teeth that are dark in color.
- 4. I have gum pain.
- 5. I have blood on my toothbrush after brushing my teeth.
- Parent-proxy report item content
  - 1. Having tooth pain.
  - 2. Having tooth pain when eating or drinking something hot, cold, or sweet.
  - 3. Having teeth that are dark in color.
  - 4. Having gum pain.
  - 5. Having blood on toothbrush after brushing teeth.

Reproduced with permission from J.W. Varni, Ph.D. Copyright © 1998.

The PedsQL<sup>™</sup> is available at http://www.pedsql.org.

Copyright of International Journal of Paediatric Dentistry is the property of Wiley-Blackwell and its content may not be copied or emailed to multiple sites or posted to a listserv without the copyright holder's express written permission. However, users may print, download, or email articles for individual use.