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ORIGINAL ARTICLE

Reliability and validity of the Turkish version of the Rapid Estimate of Adult Literacy in Dentistry (TREALD-30)

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ABSTRACT

Objective: To culturally adapt the Turkish version of Rapid Estimate of Adult Literacy in Dentistry (TREALD-30) for Turkish-speaking adult dental patients and to evaluate its psychometric properties.

Material and methods: After translation and cross-cultural adaptation, TREALD-30 was tested in a sample of 127 adult patients who attended a dental school clinic in Istanbul. Data were collected through clinical examinations and self-completed questionnaires, including TREALD-30, the Oral Health Impact Profile (OHIP), the Rapid Estimate of Adult Literacy in Medicine (REALM), two health literacy screening questions, and socio-behavioral characteristics. Psychometric properties were examined using Classical Test Theory (CTT) and Rasch analysis.

Results: Internal consistency (Cronbach's Alpha = 0.91) and test-retest reliability (Intraclass correlation coefficient = 0.99) were satisfactory for TREALD-30. It exhibited good convergent and predictive validity. Monthly family income, years of education, dental flossing, health literacy, and health literacy skills were found as stronger predictors of patients'oral health literacy (OHL). Confirmatory factor analysis (CFA) confirmed a two-factor model. The Rasch model explained 37.9% of the total variance in this dataset. In addition, TREALD-30 had eleven misfitting items, which indicated evidence of multidimensionality. The reliability indeces provided in Rasch analysis (person separation reliability = 0.91 and expected-a-posteriori/plausible reliability = 0.94) indicated that TREALD-30 had acceptable reliability.

Conclusion: TREALD-30 showed satisfactory psychometric properties. It may be used to identify patients with low OHL. Socio-demographic factors, oral health behaviors and health literacy skills should be taken into account when planning future studies to assess the OHL in both clinical and community settings.

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Oral health literacy; REALD-30; psychometric evaluation; Turkish dental patients; literacy in dentistry

Introduction

In the last several years, there has been an increasing emphasis on oral health literacy (OHL), which represents the cognitive and social skills that determine the ability of individuals to obtain, process, and understand basic oral health information and services needed to make appropriate oral health decisions [1]. OHL is recognized as an important determinant of oral health as well as a causal factor that contributes to oral health disparities [2–4]. As an empowerment strategy [5], OHL also has a critical role in empowering people's motivation and ability to promote their awareness of the importance of oral health and its link to general knowledge about disease and health management [4,6,7]. Individuals' health literacy level is the product of a complex set of skills and interactions on the part of the individual, the health care system, and the cultural and societal context [5,8,9]. Due to a mismatch between the skills of individuals and the demands of the health care system, including dental team members, patients face many difficulties in sharing personal health information with providers, understanding and using oral health information, and managing oral diseases. For these reasons, effective communication between dentists and their patients is essential for quality dental care and to improve patient's OHL. Recognizing its importance in dentistry, a growing movement has begun to create a user-friendly physical environment and patient-centered strategies have been used to develop and maintain health literacy-based practice in all settings of dentistry [5,7–9].

Studies showed that low OHL is associated with adverse oral health outcomes such as worse oral health status [3,10–13], inadequate oral health behaviors [10,14,15], poor ability to understand oral health information [15,16], and lower oral health knowledge [10,14,17].

In the last few years, some initiatives have begun to improve and assess the health literacy of both the community and health providers in Turkey. To date, there are few validated instruments to assess health literacy in Turkish adults. A recent study that used the European Health Literacy Survey Questionnaire reported that approximately 65% of Turkish adults had limited health literacy [18]. Unfortunately, the assessment of OHL still remains a

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neglected area in Turkey. Community-based oral health promotion programs are needed urgently for the promotion of oral health in Turkey [19]. In countries with developing health care systems, an assessment of OHL is crucial for designing effective health educational materials for individuals, as well as designing intervention programs to successfully achieve oral health promotion at a community level [4,10,20–23].

To date, there is currently no valid and reliable instrument for measuring OHL in Turkish adults. For this reason, educational level is used as a proxy measure for OHL in the field of dentistry. It is known that this proxy measure is often limited and may overestimate an individual's OHL level, because literacy is usually several grades lower than the attained educational level [20]. Several instruments have been developed to measure OHL, which vary in their approach and design, as well as in terms of their purpose, such as word recognition, conceptual knowledge, numeracy, and reading comprehension [21–23]. As a screening instrument, we *chose to use* the Rapid Estimate of Adult Literacy in Dentistry (REALD-30), a word recognition test designed to assess OHL [20]. This instrument is more user-friendly and faster to use in a clinical setting to identify patients with low health literacy level [22–26]. It has been translated and validated in Indian [25], Chinese [26], Spanish [27], Arabic [28], and Portuguese [24]. This measure was developed in English and cannot be used directly in Turkish-speaking groups because language and culture have significant impacts on the reliability and validity of OHL instruments [6,7,22]. Therefore, the aims of this study were to develop a Turkish version of Rapid Estimate of Adult Literacy in Dentistry-30 (TREALD-30) and to evaluate its psychometric properties among adults patients who attended a dental school clinic in Istanbul.

Material and methods

The study was performed in two stages. First, REALD-30 was translated from English into Turkish and adapted to Turkish culture, after obtaining permission from the developer, Prof. Lee. In the second stage, its psychometric properties were assessed using both classical test theory (CTT) and Rasch analysis in a sample of 127 adult patients who attended a dental school clinic in Istanbul.

REALD-30 was developed and validated to measure OHL. It is a word recognition test that includes 30 words of dental context arranged in order of increasing difficulty, based both on average word length, number of syllables, and difficult sound combinations. The study participant is asked to read each word out loud with one point given for each word that is pronounced correctly, resulting in a 0–30 cumulative score where 0 = lowest and 30 = highest literacy [20].

Turkish adaptation process of the REALD-30

Based on standard recommendations [29], the process of cross-cultural adaptation involves five steps, as follows:

Stage 1 – initial translation: Two independent native Turkish-speaking translators translated the original REALD-30 into Turkish. One of the translators was a physician and therefore aware of the concepts being measured with REALD-30, and the second translator was a language specialist without a medical background. Each translator produced a written report of their translation and additional comments, highlighting uncertainties along with the rationale for their final choices.

Stage 2 – synthesis of these translations: The two translators and a member from the research team as a mediator met to compare the two translations, and to produce one common consensus translation (T-12). In this stage, dictionary definitions, comprehensiveness, and grammar were checked. After all discrepancies were resolved by consensus discussion among the team members, the T-12 was produced together with a report that documented the process.

Stage 3 – Back-translation: The T-12 version was backward translated by two bilingual 'back-translators' whose mother tongue was English and who were completely blind to the original version of REALD-30, producing translations BT1 and BT2. This stage is a process of validity checking to ensure the translated version accurately reflects the item content of the original version. To avoid information bias and to elicit unexpected meanings of the items in the translated questionnaire, the translators had no medical background. These translations were compared with the original English version. Some discrepancies related to wording were resolved by consensus between the two translators.

Stage 4 – expert committee review: An expert committee consisting of a biostatistician, six oral health professionals (public dental health, pediatric dentistry, oral surgery, oral radiology), one linguist, and four translators consolidated all translated versions, discussing discrepancies raised in previous stages, and a consensus was reached on all items.

Considering semantic, experiential, and conceptual equivalence, this committee developed the 'pre-final version' of TREALD-30. This was then reviewed to ensure that the final translation was fully comprehensible and to verify the cross-cultural equivalence of the source and final version. In addition, the face and content validity of TREALD-30 were examined by the expert panel in order to assess the clarity of the dental terms. During this stage, Item-level Content Validity Index (I-CVI) was used to assess the equivalence of each word between the Turkish and English versions of REALD-30. The panel of experts rated the equivalence of each word using a 4-point rating scale (from 1 = not equivalent to 4 = most equivalent). I-CVI was calculated as the number of experts who provided a rank of 3 or 4, divided by the total number of experts [30]. The experts were asked to assess the item regarding difficulty with reading the words on a 3-point Likert scale (1 = easy; 2 = moderate, 3 = difficult). Consensus on an item difficulty was defined as agreement by at least 80% of the experts [31].

Stage 5 – pretesting: To guarantee sensitivity to local culture and to determine whether the operational characteristics of TREALD-30 (instructions, items, response choices, and administration) was pilot-tested on a convenience sample of 35 adult patients who attended a dental school clinic in Istanbul.

Psychometric testing of the scale

Participants

This cross-sectional study for psychometric testing of TREALD-30 was performed on a series of consecutive adult patients who attended the Department of Oral Medicine and Radiology, Istanbul University, between January and March 2014.

Sample size for internal consistency was calculated using an online sample size calculator (https://www.statstodo.com/SSiz1Alpha_Pgm.php) with the following parameters: probability of Type I error (α) was 0.05, power ($1-\beta$) was 0.8, number of items = 30, the expected level for Cronbach alpha = 0.80; for the required level for Cronbach's alpha = 0.70, a sample size of 101 subjects was required for this study.

To be eligible for participation in this study, the subjects had to meet the following criteria: (a) able to read and write Turkish, (b) aged over 18 years, (c) willing to participate, (d) without obvious signs of cognitive impairment, and (e) without vision or hearing problems.

Procedure

The study was approved by the ethics committee of Istanbul Faculty of Medicine and conducted in accordance with the principles of the Helsinki declaration. All subjects were informed about the nature of the study by a clinical assistant. Informed consent was obtained from each subject who agreed to participate in the study prior to clinical examination.

Clinical oral examination was conducted by a trained dentist on dental chairs under unit light using a dental mirror and periodontal probe. The decayed, missing due to caries, and filled teeth (DMFT) index and its components was calculated to assess patient's dental status. After clinical examinations, all interviews were conducted by two interviewers. The principal author (K.P) conducted the three-day training (theoretical and practical) and calibration course for interviewers. Each session lasted 2 h. In the theoretical training, the interviewers were trained on how to administer and score the REALD-30 and on the criteria for selecting pronunciation errors. For practical training, two interviewers and the principal author watched videos of six patients and scored the patients independently. After that, their scores were compared and discussed to resolve scoring/coding discrepancies. In the calibration training, interviewers watched videos of 12 patients and recorded scores. The examiners evaluated the videos individually and repeated the evaluation after two weeks in order to analyze the intra-rater agreement. Intra-rater and inter-rater reliability for each item was assessed using the Kappa coefficient, in which values above 0.81 indicated excellent reproducibility [31]. Intra-rater reliability coefficients ranged from 0.91 to 1.00, whereas the inter-rater reliability coefficients ranged from 0.83 to 0.92.

Each participant was given a laminated copy of TREALD-30 by the trained interviewer and asked to read each word aloud. If participants could not read a word, they instructed to say 'blank' and move to the next word.

Measures

Data were collected using a two-part questionnaire instrument. The first part comprised *socio-demographic* information (sex, age, marital status, educational level, and family monthly income), self-rated oral health, oral health behaviors, and dental caries experience. The second part consisted of TREALD-30, the Rapid Estimate of Adult Literacy in Medicine (REALM), the Oral Health Impact Profile (OHIP-14), and the two health literacy screening questions.

Health literacy was measured using REALM, which is a 66-item word recognition and pronunciation test. This scale had been previously validated with Turkish patients at a family medicine clinic [32]. REALM scores range from 0 to 66 based on the total number of correctly pronounced words, with higher scores indicating greater health literacy.

To identify patients with inadequate health literacy, two health literacy screening questions were included: 'How often do you have someone help you read hospital materials?' and 'How confident are you with completing forms by yourself?' [33]. The first item is scored on a 4-point scale (1 = always, 2 = sometimes, 3 = rarely, and 4 = never), with higher scores indicating higher reading ability. The item on perceived confidence is scored on a 3-point scale (1 = not at all confident, 2 = somewhat confident, and 3 = extremely confident), with higher scores indicating greater perceived confidence.

Oral health-related quality of life was measured using the Turkish version of OHIP-14, which consists of fourteen items organized in seven subscales [34]. Each item is scored as: 0 = never, 1 = hardly ever, 2 = sometimes, 3 = fairly often, and 4 = very often. The OHIP-14 scale ranged from 0 to 56, with higher scores indicating poorer oral health-related quality of life.

Self-rated oral health was based on responses to a single item ('How do you consider your oral health in general?'). This item was rated on a 5-point Likert-type scale that ranged from 1 (very poor) to 5 (excellent), with higher scores indicating better self-rated oral health.

In this study, oral health-related behaviors including tooth brushing frequency, dental attendance pattern, use of dental floss, and daily consumption of sugar-added food and beverages were assessed. These particular oral health behaviors and their categorization were chosen based on recommendations of the latest Delivering Better Oral Health guidance and published studies [35–37]. Oral health behaviors were dichotomized as follows: tooth brushing frequency ($\geq$ twice a day versus $\leq$ once a day) [35], use of dental floss (use versus do not use) [36], dental attendance pattern (regular dental check-up at least once a year versus symptom-oriented) [37], and daily consumption of sugar-added food and beverages ($\leq$ three a day versus $\geq$ four a day) [35].

Data analysis

Classical test theory (CTT)

The reliability and validity of TREALD-30 were firstly assessed using the traditional CTT. Face and content validity of the questionnaire were examined by the expert panel in order to assess the clarity of the dental terms prior to the main study.

Reliability was assessed in two ways: internal consistency and test-retest reliability [38]. Internal consistency was evaluated using Cronbach's alpha. Cronbach's alpha values >0.70 and item-total correlation coefficients >0.20 were regarded as acceptable. An item was considered for removal if its deletion resulted in a > 0.1 increase in the Cronbach's alpha coefficient. The percent-correct item responses were used to estimate the item difficulty parameters. The test–retest reliability of the TREALD-30 total score was estimated using the intra-class correlation coefficient (ICC) calculated for 46 out of 127 subjects who were re-tested two weeks after the first set. The sample size for the test–retest reliability was calculated according to Walter et al. [39], setting $\alpha = 0.05$, $\beta = 0.20$, and assuming an acceptable ICC of 0.80 with an expected ICC of 0.90. An ICC = 0.8 was defined as the minimal acceptable level of reliability and we hypothesized that our findings would be consistent with a minimum coefficient of 0.9. Following these assumptions, 46 stable subjects were required. We considered an ICC less than 0.4 as poor, an ICC of 0.4–0.75 as fair or good, and an ICC greater than 0.75 as excellent [40].

To examine construct validity, we performed a principal component analysis (PCA) with varimax rotation. The adequacy of the data for factor analysis was investigated using the Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy and Bartlett's test of sphericity. The KMO value for the TREALD-30 was 0.847 and the Bartlett's test for sphericity was significant ($p < 0.001$), which suggested that TREALD-30 was suitable for PCA. Factors were extracted using Kaiser's criterion of retaining factors with eigenvalues of >1, the characteristics of the screen plot of eigenvalues, at least three items substantially loading on a factor; a simple structure with distinctive factors with its items highly loading (> 0.50) on single factor, and meaningful interpretability [41,42].

To test the convergent validity of TREALD-30, the associations between TREALD-30 and REALM, and between TREALD-30 and two single-item indicators of health literacy were assessed. We hypothesized that the TREALD-30 would be related to a participant's reading ability and perceived confidence, as well as REALM.

We evaluated the predictive validity of TREALD-30 by relating scores to five variables: (a) self-rated oral health, (b) clinical oral health status, (c) oral health behaviors, (d) oral health-related quality of life, and (e) socio-demographic factors. We hypothized that higher OHL would be positively associated with higher levels of education, better oral health behavior, better oral health-related quality of life, good oral health status, and better self-rated oral health. To explore the relationship between TREALD-30 and other variables, the Mann–Whitney *U* test was used for dichotomous variables, and Spearman's rank correlation coefficient was used for continuous variables. Interpretation of correlation coefficients was as follows: $r \leq 0.49$ weak relationship, $0.50 \leq r \leq 0.74$ moderate relationship, and $r \geq 0.75$ strong relationship [43]. Hierarchical multiple linear regression with enter method was used to determine factors related to the participants' OHL. TREALD-30 scores were used as dependent variables. The independent variables were entered in the following steps: the socio-demographic variables were entered into the first block, the clinical indexes in block 2, and the oral health behaviors in block 3. Finally, subjective oral health measures (OHIP-14 and self-rated oral health) and health literacy measures (REALM-66, two health literacy screening questions) were sequentially and separately entered in blocks 4 and 5. Tabachnick and Fidell [44] suggested that sample size should be at least 104 events plus the number of independent variables, in the case of this study, at least 122 [104 + 18]. The number of participants met these requirements. The magnitude of R2 change at each step was used to determine the variance explained by each set of variables. Collinearity among the independent variables was tested based on variance inflation factors and tolerances for individual variables. A tolerance of less than 0.10 and/or a variance inflation factor of more than 10 indicated a multicollinearity problem [45]. Statistical significance was achieved when $p < 0.05$. Statistical analysis was performed using IBM SPSS Statistics version 19 for Windows (SPSS Inc., Chicago, IL, USA).

Rasch analysis

Rasch analysis using the Partial Credit Model was employed to further assess the psychometric properties of TREALD-30 because it provided information regarding the extent to which each item was difficult to endorse. Before we proceeded with the Rasch analysis, we first needed to evaluate the dimensionality of TREALD-30 items because unidimensionality is considered the most critical and basic assumption of Rasch models. The new factor structures obtained by PCA were compared with the one factor structure based on a conceptual model by performing confirmatory factor analysis (CFA) using Lisrel 9.1 (Scientific Software International, Skokie, IL) with the maximum likelihood model. We evaluated the goodness of fit of the model using the following multiple indices [46]: Chi-square degree of freedom (Chi-square/df <5), comparative fit index (CFI, > 0.9), incremental fit index (IFI >0.9), Tucker–Lewis index (TLI >0.9) and root mean square error of approximation (RMSEA, < 0.08). The reliability and validity of TREALD-30 were evaluated using person and item reliability coefficients, item fit statistics, and item parameter difficulty estimates. Item fit was assessed using information-weighted fit statistic (infit) and outlier-sensitive fit statistic (outfit) mean square index (MNSQ). These statistics are more informative to explore the fit of the items to the Rasch model because they give relatively more weight to unexpected responses among persons who are well targeted to the item calibrations. An item with an infit and outfit statistic >1.3 or <0.7 was considered 'lack of fit' according to the Rasch model for binary items [47]. Reliability was assessed using person separation and the expected a posteriori/plausible value (EAP/PV) reliability. The person reliability coefficient is an indication of the precision of the scale by showing how well the scale can distinguish individuals, and the EAP/PV reliability (similar to Cronbach's alpha) is an estimate of how reliably the items can be used to distinguish individuals' underlying abilities. Reliability coefficients greater than 0.81 and a variance of 60% or greater explained by measure are considered good [48]. The sample size for Rasch analysis of dichotomous data was based on recommendations by Linacre

[49]. These authors recommended a target sample size of 64–144 to provide 95% confidence ±0.5 logits.

Rasch analysis was performed using Construct Map software version 4.6 (UC Berkeley, CA. Available at: http://bearcenter.berkeley.edu/software/constructmap) and the R package eRm (R package version 0.15-4. Available at: http://cran.r-project.org/web/packages/eRm/).

For the CFA, LISREL 9.1 for Windows (Scientific Software International, Skokie, IL) was used [50].

Results

Adaptation into Turkish

Even though English and Turkish belong to different language families, similarities exist between these languages along with many common words (cognates). Eighteen of the 30 words (pulp, fluoride, braces, genetics, restoration, bruxism, abscess, plaque, dentition, malocclusion, periodontal, hypoplasia, halitosis, analgesia, cellulitis, fistula, temporomandibular, and hyperemia) are common words used frequently by Turkish oral health professionals in dental practice. Thus, we decided to use these common words that have the same meaning but minor pronunciation changes. Following a discussion and consensus between both translators and the expert committee, a few small changes were made to increase conceptual and semantic equivalence. In this context, the words *gingiva, incipient, sealant*, and *apicoectomy* were replaced with *gum, incipient caries, fissure sealant,* and *apical resection*, because their translation into Turkish generated compound words, which are commonly used dental terms by oral health professionals in the Turkish language. All items had an excellent content validity (I-CVI ≥0.78). The range of I-CVI was 0.833 to 1.0, which indicated that each item of the two versions was equivalent. Based on the level of agreement among the experts (agreement percentage ≥80%), 10 items were classified as 'easy' (items 1–4, 11–14, 16, and 20), 9 as 'moderate' (items 5, 7, 9, 15, 19, 22, 26, 27, 29), and 11 as 'difficult' (items 6, 10, 17, 18, 21, 23–25, 28, and 30).

The pretest revealed that there were no problems in understanding the instructions and items, or in its administration.

Psychometric testing

Characteristics of the study participants

The study sample consisted of 127 patients (52% females, 48% males) with a mean age of 37.04 years (SD = 13.2). Table 1 presents the sample distribution according to sociodemographic, behavioral and clinical factors, as well as the distribution of scaled study scores. Only 32% of patients were receiving assistance to read hospital materials, 34% reported being somewhat or less confident with forms. The mean completion time for TREALD-30 was 2.75 (SD = 1.09) minutes.

Table 1. Sample characteristics ($n = 127$).

Characteristics	*N* (%)
Gender	
Female	66 (52)
Male	61 (48)
Marital status	
Married	74 (58.3)
Single, divorced, or widowed	53 (41.7)
Employment status	
Employed full or part-time	51 (40.2)
Unemployed	76 (59.8)
Family monthly income, TL, Mean (SD)	1855.59 ± 1071.82
Education, Mean (SD)	9.59 ± 4.24
Age (years), Mean (SD)	37.04 ± 13.12
Dental attendance	
Regular dental check-up	55 (43.3)
Symptoms-oriented	72 (56.7)
Tooth brushing	
≥Twice a day	42 (33.1)
≤Once a day	85 (66.9)
Dental flossing	
Use	28 (22)
Do not use	99 (78)
Daily consumption of sugar added food and beverages	
≤Three a day	75 (59.1)
≥Four a day	52 (40.9)
DMFT, Mean (SD)	8.90 ± 5.62
DT, Mean (SD)	2.11 ± 2.22
MT, Mean (SD)	3.98 ± 5.05
FT, Mean (SD)	2.79 ± 3.37
REALM, Mean (SD)	46.52 ± 6.90
OHIP, Mean (SD)	15.70 ± 8.81
SROH, Mean (SD)	2.81 ± 1.02
TREALD-30, Mean (SD)	17.93 ± 6.02
Reading ability of hospital materials, Mean (SD)	3.36 ± 1.06
Perceived confidence in completing medical forms, Mean (SD)	2.51 ± 0.73

SD: standard deviation; TL: Turkish Lira; SROH: self - rated oral health; REALM: Rapid Estimate of Adult Literacy in Medicine; OHIP: Oral Health Impact Profile; TREALD-30: the Turkish version of the Rapid Estimate of Adult Literacy in Dentistry.

CTT analysis

Internal consistency reliability, as measured by Cronbach's alpha, was 0.91, which indicated acceptable internal consistency. Cronbach's alpha coefficients did not increase by deleting any items. The corrected item-total correlation coefficients were from 0.26 to 0.66. None of these items were pronounced correctly by all the participants. Temporomandibular (96.9%), malocclusion (89%), fluoride (88.6%), periodontal (75.6%), bruxism (72.4%), apicoectomy (71.7%), halitosis (70.9%), hypoplasia (68.5%), gingiva (54.3%), and sealant (52%) were the most mispronounced dental terms. The ICC used to examine the test-retest reliability was 0.99 for all instruments, which indicated good reliability.

The PCA with varimax rotation initially revealed nine factors with eigenvalues greater than 1, accounting for 64.25% of the total variance. This solution was not further investigated because seven of the nine factors comprised fewer than three items. Additionally, 10 items were eliminated due to low factor loadings (<0.50) and cross loading issues. An inspection of the scree plot suggested the retention of two factors. Therefore, we extracted two factors that accounted for 35.26% of the total variance. The first factor accounted for 27.72% of the total variance (items 4, 5, 7, 8, 9, 11, 12, 13, 15, 16, 19, 26, 27; Alpha = 0.87; eigenvalue = 8.31) and was interpreted as dental terms used by patients in daily life. The second factor made up 7.53% of the total variance and was interpreted as specific dental terms used by oral health professionals in dental practice (items 10, 18, 21, 23, 24, 28, 30;

Table 2. Findings for convergent and predictive validity of TREALD-30.

Variables	REALD-30 Mean (SD)	*p* value
Gender[a]		
Female ($n = 66$)	17.96 ± 5.79	0.977
Male ($n = 61$)	17.90 ± 6.30	
Marital status[a]		
Married ($n = 74$)	17.00 ± 5.89	0.04
Single, divorced, or widowed ($n = 53$)	19.24 ± 6.01	
Employment status[a]		
Employed full-time or part-time ($n = 51$)	18.52 ± 6.03	0.405
Unemployed ($n = 76$)	17.53 ± 6.02	
Dental attendance[a]		
Regular dental check-up ($n = 55$)	18.67 ± 5.78	0.231
Symptoms-oriented ($n = 72$)	17.37 ± 6.17	
Tooth brushing[a]		
≥Twice a day ($n = 42$)	19.00 ± 6.35	0.113
≤Once a day ($n = 85$)	17.41 ± 5.82	
Dental flossing[a]		
Use ($n = 28$)	19.85 ± 6.75	0.029
Do not use ($n = 99$)	17.39 ± 5.72	
Daily consumption of sugar added food and beverages[a]		
≤Three a day ($n = 75$)	18.93 ± 5.62	0.043
≥Four a day ($n = 52$)	16.50 ± 6.34	
Family monthly income (*r*)	0.39**	
Education (*r*)	0.78**	
Age (*r*)	−0.28**	
DT (*r*)	0.02	
MT (*r*)	−0.26**	
FT (*r*)	0.04	
REALM	0.73**	
OHIP (*r*)	−0.28**	
SROH (*r*)	0.34**	
Reading ability of hospital materials (*r*)	0.69**	
Perceived confidence in completing medical forms (*r*)	0.59**	

*$p < 0.05$.
**$p < 0.01$.
SD: standard deviation; *r*: spearman's rank correlation coefficient; SROH: self-rated oral health; REALM: Rapid Estimate of Adult Literacy in Medicine; OHIP: Oral Health Impact Profile.
[a]Statistical evaluation by Mann–Whitney *U*-test.

Alpha = 0.78; eigenvalue = 2.26). According to the criterion of a ratio greater than 4.0 for evidence of unidimensionality, the ratio of the first to the second eigenvalue was 3.67 (8.31/2.26), which showed that TREALD-30 was multidimensional [51].

As shown in Table 2, the total TREALD-30 score was significantly weakly correlated with age ($r = -0.28$, $p < 0.01$), monthly family income ($r = 0.39$, $p < 0.01$), the number of missing teeth ($r = -0.26$, $p < 0.01$), the OHIP-14 ($r = -0.28$, $p < 0.01$), and self-rated oral health ($r = 0.34$, $p < 0.01$). TREALD-30 was positively and moderately correlated with REALM ($r = 0.73$, $p < 0.01$), and two single-item indicators of health literacy ($r = 0.69$, $p < 0.01$ for reading ability of hospital materials; $r = 0.59$, $p < 0.01$ for perceived confidence in completing medical forms). A strong positive correlation was found between TREALD-30 and education ($r = 0.78$; $p < 0.01$). Further, we found that participants who reported using dental floss had higher scores on the TREALD-30 than those who reported never using dental floss ($p = 0.029$). Participants who consumed sugar-added food and beverages less than four times/day had higher scores on TREALD-30 than those who consumed them ≥ four times/day ($p = 0.043$). Single participants scored higher than married participants ($p = 0.04$). These significant associations supported both the convergent and predictive validity of TREALD-30.

Table 3 shows the results of the multiple linear regression analysis. In the first block, the years of education was significantly related to the dependent variable. Pattern of dental attendance and years of education were a significant predictor when the model was tested for clinical indices (step 3), and subjective oral health measures (step 4) were significant predictors of OHL. Monthly family income, years of education, dental flossing, health literacy, health literacy skills related to both reading hospital materials and confidence completing medical forms were the strongest individual predictors in the final model, which accounted for 79.9% of the variance in adult patients' OHL. All tolerance values were higher than 0.47 and the VIF values were no higher than 2.12, which indicated absence of any significant multicollinearity in the model.

The R^2 change showed that socio-demographic variables accounted for 56.8% of the variance; oral health behaviors added 3.6% to the explained variance, clinical indices added 0.4%, and subjective oral health measures added 2.2%. The last step, which included health literacy measures, added another 19.7% to the explained variance. The results of CFA indicated that the two-factor model demonstrated a better fit than did the one-factor model ($\chi^2/df = 1.34$, CFI = 0.89, IFI = 0.90, TLI = 0.89, and RMSEA = 0.052).

Rasch analysis

Rasch analysis of TREALD-30 is presented in Table 4. Nineteen out of 30 items (63.3%) had INFIT/OUTFIT statistics between 0.7 and 1.3, reflecting that these items contributed to a single underlying construct. Eleven items (Bruxism, Malocclusion, Incipient, Caries, Periodontal, Sealant, Halitosis, Analgesia, Cellulitis, Temporomandibular, and Apicoectomy) had the extreme OUTFIT values, indicated that these items did not fit the model well and were not closely related to the overall construct.

Table 4 shows that the range of difficulty in TREALD-30 was from −5.51 to 5.90 in which the 'caries' item was the easiest task, and 'temporamandibular' was the most difficult.

The Rasch model explained 37.9% of the total variance in this dataset, which indicated that multidimensionality was present in this scale. Person separation and the EAP/PV reliability were above the criterion of 0.80. In this study, the separation reliability was 0.91, which showed a high level of reliability across the test items. The EAP/PV reliability was 0.94, which indicates a high level of precision. No floor or ceiling effects were found for TREALD-30.

Discussion

The development of TREALD-30 to assess the OHL of Turkish adults has been described in this study and evidence has been provided for its validity and reliability. To the best of our knowledge, this study is the first attempt at providing novel insights into OHL competences among Turkish adult patients. The term 'oral health education' has been used for many years instead of the concept of 'health literacy' as an

Table 3. Hierarchical models of the factors associated with OHL in adult dental patients ($n = 127$).

	Model 1 Socio-demographic variables only	Model 2 Add oral health behaviors	Model 3 Add clinical indices to Model 2	Model 4 Add subjective oral health measures to Model 3	Model 5 Add health literacy measures to Model 4
Socio-demographic variables					
Gender (men/women)	−0.053	−0.058	−0.057	−0.052	0.010
Age (years)	−0.044	−0.058	−0.022	−0.011	−0.050
Monthly family income, TL	0.090	0.090	0.093	0.096	0.107*
Years of education	0.696***	0.624***	0.629***	0.567***	0.252***
Marital status	0.043	0.062	0.065	0.096	0.022
Employment status (Employed/unemployed)	0.040	0.022	0.037	0.013	0.024
Oral health behaviors					
Dental attendance		−0.153*	−0.154*	−0.155*	−0.068
Tooth brushing		0.054	0.051	0.047	0.028
Dental flossing		−0.119	−0.116	−0.094	−0.101*
Daily frequency of sugar intake		−0.051	−0.065	−0.074	−0.047
Clinical indexes					
DT			0.068	0.077	0.092
MT			−0.017	0.025	−0.019
FT			0.010	0.032	0.001
Subjective oral health measures					
OHIP				−0.081	−0.052
SROH				0.134*	0.042
Health literacy measures					
REALM					−0.182***
Reading ability of hospital materials					0.368***
Perceived confidence in completing medical forms					0.201***
R^2	0.568	0.605	0.609	0.630	0.828
Adjusted R-square	0.547	0.571	0.564	0.580	0.799
R-square change	0.568	0.036	0.004	0.022	0.197
F change	26.346***	2.676*	0.351	3.264*	41.271***

Standardized beta coefficients are presented.
SROH: self-rated oral health; REALM: Rapid Estimate of Adult Literacy in Medicine; OHIP: Oral Health Impact Profile.
*$p < 0.05$.
**$p = 0.01$.
***$p < 0.001$.

Table 4. Rasch analysis of TREALD-30.

Item	Estimate	Standard error	Infit MNSQ	Outfit MNSQ
1	−4.766	0.230	0.79	0.72
2	−2.498	0.200	0.89	0.84
3	−2.498	0.200	0.88	0.85
4	−3.259	0.211	0.75	0.71
5	−1.253	0.182	0.93	0.88
6	4.213	0.195	1.00	0.89
7	0.102	0.169	0.92	0.86
8	−2.149	0.194	0.82	0.79
9	0.912	0.165	0.94	0.74
10	2.591	0.171	0.85	0.59
11	−1.252	0.182	0.75	0.71
12	−2.044	0.193	0.89	0.84
13	−2.765	0.204	0.83	0.75
14	−2.914	0.206	0.82	0.78
15	0.596	0.166	0.90	0.77
16	−2.258	0.196	0.75	0.72
17	1.330	0.165	1.02	0.90
18	4.214	0.195	0.76	0.54
19	−1.101	0.180	0.72	0.68
20	−5.511	0.235	0.77	0.63
21	2.840	0.174	0.98	0.65
22	1.172	0.165	0.77	0.69
23	2.297	0.168	0.91	0.73
24	2.471	0.170	0.78	0.63
25	2.905	0.174	0.95	0.66
26	0.701	0.166	0.71	0.58
27	−0.889	0.178	0.77	0.78
28	5.904	0.222	0.74	0.52
29	0.378	0.167	0.87	0.85
30	2.531	0.153	1.19	1.37

important component of oral health promotion initiatives in Turkey. It is known that health literacy differs from health education because it focuses on gaining knowledge and enhancing an individual's communication skills and empowerment to become co-producers of their health [5].

Language and culture have significant impacts on the reliability and validity of OHL instruments [6,7,22]. Thus, culturally-relevant evidence-based screening tools are needed for more accurate assessment of patients' OHL in practice-based applications [8]. To develop the new version of an OHL instrument, some researchers used different methods, including the Delphi process [27], corpus database [26], and checking newspapers/audiovisual media [24]. After a careful process of translation and cultural adaptation, the original English-language REALD-30 was translated into Turkish, and resulted in a back-translated version that was very similar to the original although dental word modifications were made to take into account both the cultural differences, the dictionary definition and the frequency of use in dental practice. There were some differences in spelling and pronunciation of words because Turkish orthography is to a large extent phonemic, employing a one-to-one letter-sound correspondence. In Turkish, the spelling of words is changed when the pronunciation changes. These types of changes are only concerned with consonants that have voiced and unvoiced equivalents. In contrast to the original version, TREALD-30 consisted of some compound words. The I-CVI of each item was higher than 0.80, which indicated the equivalance of

each word between the Turkish and English version of REALD-30. We investigated whether reading difficulty could be related to these compound words. The results of both CTT and Rasch analysis supported the experts' classification of 'difficult.'

In contrast to the original validation study [20], a combination of CTT and Rasch analysis has been used in the development of new language versions of REALD-30 [26–28]. We used a similar method to evaluate the psychometric properties of TREALD-30, because Rash analysis may provide additional information to the CTT and allow for the examination of an individual item's difficulty level and discriminatory ability.

An initial assessment of the scale based on the CTT showed that the Cronbach alpha obtained for this study was 0.91, which indicated excellent internal consistency. The Cronbach's alpha value was higher than those reported in previous validation studies conducted in the United States of America (USA) [20] and Saudi Arabia [28], and lower than in the Indian study [25]. The ICC used to examine the test–retest reliability was 0.99 for all instruments, which indicated good reliability. The ICC for TREALD-30 was similar to the validation studies in Saudi Arabia [28] and Brazil [24], but higher than reported in a previous validation study conducted in Bangalore [25].

The results of both CTT and Rasch analysis used in this study support the multidimensionality of OHL. The CFA showed the presence of two factors in agreement with previous validation studies [20,28,34]. The dental terms loaded with the second factor are more difficult. These terms are used by oral health professionals for specific dental problems. The first factor consisted of commonly used dental terms by patients in daily life. As stated in previous studies [20,24–28], the two domains underlying the OHL may be related to differences in reading ability and the difficulty of the words. The Rasch analysis showed that 19 out of 30 items demonstrated a good fit to the Rasch model with regard to the criteria mentioned above, which reflected that these items contributed to a single underlying construct. The remaining 11 items (bruxism, malocclusion, incipient, caries, periodontal, sealant, halitosis, analgesia, cellulitis, temporomandibular, and apicoectomy) were misfits due to extreme OUTFIT values, which indicated a lack of the expected probabilistic relationship between the item and other items in the TREALD-30. According to rules for improving the instrument's quality, misfitting items are removed until there are no further improvement-in-fit requirements. For identifying misfitting items, more emphasis should be placed on infit values than on outfit values [52]. No item was deleted in TREALD-30 based on the results of an item analysis because their infit mean-square statistics were acceptable.

Evidence of misfit for some items was found in the Saudi Arabian validation study [28]. Across these studies, there is considerable variation in misfitting items. It may be that differences in culture, and sample characteristics and sizes contributed to this lack of consistency in the fit of REALD-30 data in adult patients from Saudi Arabia and Turkey. In addition, the amount of variance explained by Rasch measures in this study was found lower than those in the Arabic validation study [28], suggesting that an additional construct could exist. When compared with this study, the difficulty level of the items was very similar. The results of the Rasch analysis for the TREALD-30 indicated satisfactory readability for this instrument, which is consistent with a previous study in Saudi Arabia. [28]. Similar to our results, the authors also found that all items correlated positively with the estimated measure. Our findings may provide valuable information for future studies aiming to explore the construct validity of TREALD-30. However, future studies with a larger and representative sample are needed to confirm the assumed multidimensional structure of OHL.

Bivariate analysis showed that TREALD-30 was positively correlated with REALM, as well as with the participants' reading ability of hospital materials, thus indicating its convergent validity.

TREALD-30 scores were significantly correlated with the number of missing teeth, age, OHIP-14 score, years of schooling, self-rated oral health, and family monthly income and significantly associated with two oral health behaviors (use of dental floss and daily consumption of sugar-added food and beverages). These findings provide support for the predictive validity of TREALD-30.

Multivariate analyses showed that monthly family income, years of education, dental flossing, health literacy, health literacy skills related to both reading hospital materials and confidence completing medical forms were the strongest individual predictors of OHL, accounting for 79.9% of the variance. A larger proportion of variance in OHL was explained by socio-demographic factors (56.8%). However, previous validation studies have reported conflicting results regarding the associations between OHL and socio-demographic factors. Similar to previous validation studies [20,24,27,28], we found that participants with a higher education had higher TREALD-30 scores. In contrast to previous studies [20,26–28], we found that TREALD-30 scores were significantly correlated with participants' age and income.

Like previous validation studies [20,26,28,53,54], we found no association between dental attendance patterns and REALD-30. This result was not surprising, because Turkish adults were more likely to have problem-oriented visiting patterns. Of all oral health behaviors, only dental floss use was found as a predictor of OHL. Previous validation studies suggested that the clinical oral status of participants could be helpful in assessing the predictive validity of REALD-30 [20,26,28]. Consistent with prior studies [12,13], a significant negative correlation between TREALD-30 scores and the number of missing teeth was found in bivariate analysis, but not in the multivariate analysis. Clinical indices and oral health behaviors explained only a small portion of the variance (4%) in OHL. Future studies are needed to confirm the association of socio-demographic, clinical, and behavioral factors with OHL.

Consistent with previous validation studies [20,27], we found that TREALD-30 scores were significantly related to self-rated oral health and the OHIP-14 in the bivariate analysis. However, multivariate analyses showed no association between OHL and subjective oral health measures. Subjective measures independently explained only a small proportion of variance of OHL (2.2%). A possible explanation for these results may be the lack of of communicative and critical

health literacy components in REALD-30, which also can influence health outcomes.

Consistent with previous validation studies in the USA [20] and Spain [27], we found a significant positive correlation between REALD-30 and REALM in both bivariate and multivariate analyses. These findings support the importance of integration of oral health into health promoting programs. There are some mass media campaigns and national projects to increase health literacy in our community. To date, oral health care is not integrated into national health programmes. Thus, there is a need to give more attention to mass media campaigns to heighten public awareness of oral health. In line with previous studies [26,27], we found that TREALD-30 scores were correlated with participants' reading ability of hospital materials and perceived confidence in completing medical forms in both univariate and multivariate analyses. Health literacy measures explained alone 19.7% of the variance in OHL. TREALD-30 appears to be useful for measuring the reading ability of patients as well as for detecting limited medical/dental health literacy in patients attending in dental clinics.

It is noteworthy but not surprising that with the exception of India, the mean TREALD-30 score among dental patients in this study was lower than reported from previous validation studies performed in other countries [20,24–28]. There are two potential explanations for these reported differences. First, socio-economically disadvantaged Turkish adults tend to use public or university dental hospitals more than socio-economically advantaged adults because of dental health care costs. Secondly, the mean number schooling years of Turkish adults is 7.6 years [55]. This value is lower than all countries where validated versions of REALD 30 were available, but higher than India. As mentioned above, the lower OHL scores observed in this study were associated with having low monthly family income and education levels. Our study confirms findings from a previous study [2] that OHL may contribute to oral health disparities because adults with low OHL are more likely to be poor and not well educated.

There are several limitations to this cross-sectional study that should be taken into account when considering these findings. The study was conducted in only one large dental training hospital in Istanbul, which limits the generalizability of the results and conclusions because these patients are probably not representative of the entire Turkish adult population. Future studies should be conducted using TREALD-30 to fully evaluate its psychometric properties in both clinical and population-based studies. The cross-sectional design did not allow causation or changes over time in participants' OHL to be studied. Recent studies have shown that REALD-30 was correlated with oral health knowledge [10,14,17]. The REALD-30 does not assess understanding or comprehension. To measure OHL, some researchers enhanced REALD-30 by adding a comprehension component [27,56]. Recent reviews of existing OHL tools suggested that more comprehensive and culturally sensitive tools, including communicative/interactional and critical levels could be used in both clinical and research settings to improve OHL skills and dentist–patient communication [21–23]. No cut-off points have yet been established for REALD-30 to determine what score would indicate inadequate OHL [12,20,23,24]. Future research will be necessary to examine the association of OHL with oral health knowledge, and to determine its cut-off points.

Despite these limitations, this study has some strengths. First, minimum sample sizes were calculated for Cronbach's alpha, the test–retest reliability, and Rasch analysis before conducting this study. Secondly, clinical dental status and oral health behaviors were used to assess the predictive validity of TREALD-30. Lastly, using Rasch analysis along with CTT provides additional support to the factor structure of TREALD-30.

Conclusions

TREALD-30 appears to be a valid and reliable tool for assessing OHL in adult patients of the studied community. This measure may be used to identify patients with low OHL, who have difficulty communicating with their dentist and following up with oral care instructions due to poor understanding of basic oral health vocabulary. Socio-demographic factors, oral health behaviors, and health literacy skills should be taken into account when planning future studies to assess OHL in clinical setting.

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Notes on contributors

Kadriye Peker, conceptualized and designed the study, acquired, interpreted the data, drafted the manuscript, and revised the paper. TEK and BG contributed to the data collection. ÖU contributed to the data analysis and interpretation of the results. TLE contributed to the study management.

References

[1] USDHHS (United States Department of Health and Human Services). Healthy people 2010: understanding and improving health. 2nd ed. Washington (DC): United States Government Printing Office; 2000.

[2] Horowitz AM, Kleinman DV. Oral health literacy: a pathway to reducing oral health disparities in Maryland. J Public Health Dent. 2012;72:26–30.

[3] Naghibi Sistani MM, Yazdani R, Virtanen J, et al. Determinants of oral health: does oral health literacy matter? ISRN Dent. 2013;2013:249591.

[4] Hongal S, Torwane NA, Goel P, et al. Assessing the oral health literacy: a review. Int J Med Public Health. 2013;3:219–224.

[5] Nutbeam D. Health literacy as a public goal: a challenge for contemporary health education and communication strategies into the 21st century. Health Promot Int. 2000;15:259–267.

[6] National Institute of Dental and Craniofacial Research. The invisible barrier: literacy and its relationship with oral health. A report of a workgroup sponsored by NIDCR, USPHS, DHHS. J Public Health Dent. 2005;65:174–182.
[7] Horowitz AM, Kleinman DV. Oral health literacy: the new imperative to better oral health. Dent Clin North Am. 2008;52:333–344.
[8] Horowitz AM, Kleinman DV. Creating a health literacy-based practice. J Calif Dent Assoc. 2012;40:331–340.
[9] Reardon GT. Low oral health literacy: An elusive dream or dentistry's target for advocacy? Compendium. 2010;31:184–189.
[10] Ueno M, Takeuchi S, Oshiro A, et al. Relationship between oral health literacy and oral health behaviors and clinical status in Japanese adults. JDS. 2013; 8:170–176.
[11] Lee JY, Divaris K, Baker AD, et al. The relationship of oral health literacy and self-efficacy with oral health status and dental neglect. Am J Public Health. 2012;102:923–929.
[12] Haridas R, Supreetha S, Ajagannanavar SL, et al. Oral health literacy and oral health status among adults attending dental college hospital in India. J Int Oral Health. 2014;6:61–66.
[13] Blizniuk A, Ueno M, Zaitsu T, et al. Association of oral health literacy with oral health behaviour and oral health status in Belarus. Community Dent Health. 2015;32:148–152.
[14] Parker EJ, Jamieson LM. Associations between indigenous Australian oral health literacy and self-reported oral health outcomes. BMC Oral Health. 2010;10:3
[15] Holtzman JS, Atchison KA, Gironda MW, et al. The association between oral health literacy and failed appointments in adults attending a university-based general dental clinic. Community Dent Oral Epidemiol. 2014;42:263–270.
[16] D'Cruz AM, Shankar Aradhya MR. Health literacy among Indian adults seeking dental care. Dent Res J (Isfahan). 2013;10:20–24.
[17] Jones M, Lee JY, Rozier RG. Oral health literacy among adult patients seeking dental care. J Am Dent Assoc. 2007;138: 1199–1208.
[18] Durusu-Tanrıöver M, Yıldırım HH, Demiray-Ready FN, et al. The study of health literacy in Turkey. Ankara: The Union of Health and Social Workers Press; 2014.
[19] Gökalp SG, Doğan BG, Tekçiçek MT, et al. National survey of oral health status of children and adults in Turkey. Community Dent Health. 2010;27:12–17.
[20] Lee JY, Rozier RG, Lee SY, et al. Development of a word recognition instrument to test health literacy in dentistry: the READ-30 – a brief communication. J Public Health Dent. 2007;67:94–98.
[21] Dickson-Swift V, Kenny A, Farmer J, et al. Measuring oral health literacy: a scoping review of existing tools. BMC Oral Health. 2014;14:148
[22] Parthasarathy DS, McGrath CP, Bridges SM, et al. Efficacy of instruments measuring oral health literacy: a systematic review. Oral Health Prev Dent. 2014;12:201–207.
[23] Kaur N, Kandelman D, Nimmon L, et al. Oral health literacy: findings of a scoping review. EC Dental Sci. 2015;2:293–306.
[24] Junkes MC, Fraiz FC, Sardenberg F, et al. Validity and reliability of the Brazilian version of the rapid estimate of adult literacy in dentistry-BREALD-30. PLoS One. 2015;10:e0131600
[25] Devi MA, Soni S, Radha G, et al. Reliability and validity of a questionnaire to assess oral health literacy among college students in Bangalore city. Int J Contemp Dent. 2011;2:43–46.
[26] Wong HM, Bridges SM, Yiu CK, et al. Development and validation of Hong Kong rapid estimate of adult literacy in dentistry. J Investig Clin Dent. 2012;3:118–127.
[27] Lee J, Stucky B, Rozier G, et al. Oral health literacy assessment: development of an oral health literacy instrument for Spanish speakers. J Public Health Dent. 2013;73:1–8.
[28] Tadakamadla SK, Quadri MF, Pakpour AH, et al. Reliability and validity of arabic rapid estimate of adult literacy in dentistry (AREALD-30) in Saudi Arabia. BMC Oral Health. 2014;14:120
[29] Beaton DE, Bombardier C, Guillemin F, et al. Guidelines for the process of cross-cultural adaptation of self-report measures. Spine (Phila Pa 1976). 2000;25:3186–3191.
[30] Polit DF, Beck CT, Owen SV. Focus on research methods: Is the CVI an acceptable indicator of content validity? Appraisal and recommendations. Res Nurs Health. 2007;30:459–467.
[31] Landis JR, Koch GC. The measurement of observer agreement for categorical data. Biometrics. 1977;33:159–174.
[32] Ozdemir H, Alper Z, Uncu Y, et al. Health literacy among adults: a study from Turkey. Health Educ Res. 2010;25:464–477.
[33] Chew LD, Bradley KA, Boyko EJ. Brief questions to identify patients with inadequate health literacy. Fam Med. 2004;36:588–594.
[34] Mumcu G, Inanc N, Ergun T, et al. Oral health related quality of life is affected by disease activity in Behçet's disease. Oral Dis. 2006;12:145–151.
[35] Public Health England (PHE). Delivering better oral health: an evidence-based toolkit for prevention. 3rd ed. London: PHE; 2014.
[36] Honkala S, Honkala E, Al-Sahli N. Do life- or school-satisfaction and self-esteem indicators explain the oral hygiene habits of schoolchildren? Commun Dent Oral Epidemiol. 2007;35:337–347.
[37] Montero J, Albaladejo A, Zalba JI. Influence of the usual motivation for dental attendance on dental status and oral health-related quality of life. Med Oral Patol Oral Cir Bucal. 2014;19:e225–e231.
[38] 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.
[39] Walter SD, Eliasziw M, Donner A. Sample size and optimal designs for reliability studies. Stat Med. 1998;17:101–110.
[40] Shrout PE, Fleiss JL. Intraclass correlations: uses in assessing rater reliability. Psychol Bull. 1979;86:420–428.
[41] Cattell RB. The screen test for the number of factors. Multivar Behav Res. 1966;1:245–276.
[42] MacCallum R, Widaman KF. Sample size in factor analysis. Psychol Methods. 1999;4:184–199.
[43] Portney LG, Watkins MP. Foundations of clinical research. Applications to practice. 2nd ed. Upper Saddle River (NJ): Prentice Hall; 2000.
[44] Tabachnick BG, Fidell LS. Using multivariate statistics. 4th ed. Boston: Allyn and Bacon; 2001.
[45] O'Brien RM. A caution regarding rule of thumb for variance inflation factors. Qual Quant. 2007;41:673–690.
[46] Hu L, Bentler PM. Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. Struct Equ Model. 1999;6:1–55.
[47] Wright B, Linacre JM, Gustafsson JE, et al. Reasonable mean-square fit values. Rasch Meas Trans. 1994;8:370.
[48] Fisher WP Jr. Rating scale instrument quality criteria. Rasch Meas Trans. 2007;21:1095.
[49] Linacre JM. Sample size and item calibration stability. Rasch Meas Trans. 1994;7:328.
[50] Jöreskog KG, Sörbom D. LISREL 9.1 for windows. Skokie, IL: Scientific Software International, Inc.; 2013.
[51] Hattie J. Methodology review: assessing unidimensionality of tests and items. Appl Psychol Meas.1985;9:139–164.
[52] Bond TG, Fox CM, Applying the Rasch model: fundamental measurement in the human sciences. Mahwah (NJ): L. Erlbaum; 2001.
[53] Burgette JM, Lee JY, Baker AD, et al. Is dental utilization associated with oral health literacy? J Dent Res. 2016;95:160–166.
[54] Macek MD, Atchison KA, Watson MR, et al. Assessing health literacy and oral health: preliminary results of a multi-site investigation. J Public Health Dent. 2016;76:303–313.
[55] United Nations Development Programme (UNDP). Work for human development. Briefing note for countries on the 2015 Human Development Report Turkey, 2015. [Internet]. Available from: http://hdr.undp.org/sites/all/themes/hdr_theme/country-notes/TUR.pdf UNDP.
[56] Khan K, Ruby B, Goldblatt RS, et al. A pilot study to assess oral health literacy by comparing a word recognition and comprehension tool. BMC Oral Health. 2014;14:135