



## Psychometric Properties of the Revised Osteoporosis Knowledge Test in Iranian Adolescent

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### Abstract

**Background:** Osteoporosis knowledge test is a comprehensive questionnaire that evaluates risk factors, nutrition and exercise recommendations, as well as general subjects such as bone evolution, diagnosis, and osteoporosis treatment. The aim of this study was to determine the psychometric characteristics of the revised version of osteoporosis knowledge test (OKT) in Iranian adolescent population.

**Materials and Methods:** This is a cross-sectional methodological study that studied 330 high school students. Sampling was conducted in public and private schools in Saveh, Iran. Schools and students in each school were randomly selected. The translation validity was examined using Forward and Backward translation. Content validity was examined in two qualitative (assessment of experts' opinions) and quantitative (using the content validity ratio (CVR) and Content Validity Index [CVI]) parts. Face validity was determined on 30 high school students. The generalized factor analysis (GFA) was used to evaluate the construct validity of the instrument. The reliability was determined in terms of reproducibility via intra-class correlation coefficient (ICC) by test-retest and internal consistency (Cronbach's alpha) on 20 participants.

**Results:** Content validity indices, CVI and CVR, for OKT were 0.97 and 0.99, respectively. Reliability was confirmed in two dimensions of intra-class correlation coefficient (ICC = 0.69), and internal consistency ( $\alpha = 0.81$ ). Construct validity was confirmed using the generalized factor analysis.

**Conclusion:** Findings support the validity and reliability of osteoporosis knowledge test. Therefore, it is recommended that the instrument can be used in both clinical practice and research in Iranian adolescent population.

**Key Words:** Adolescent, Knowledge, Osteoporosis, Psychometric, Reliability, Validity.

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## 1- INTRODUCTION

Osteoporosis is defined as loss of bone mass and quality, where bones are prone to fractures after weak and low-impact blows (1). Osteoporosis is a major health concern, with around two million fractures occurring annually in the United States (2). The cost of osteoporosis fractures in the United States was estimated at more than \$19,000 million (3). According to the International Osteoporosis Foundation, osteoporosis is a serious problem in the Middle East (4). About 4.9% of men and 32.4% of women are affected by spinal osteoporosis in Tehran-Iran (5). This disease is an important cause of fractures in the elderly, resulting in pain, costly rehabilitation courses and premature death (6). The disease leads to the profound psychosocial complications, loss of ability to perform social roles due to pain and organ deformity (7). Although genetics is the main determinant of bone density, unsuitable living environments and lifestyle, such as inadequate intake of calcium and vitamin D, smoking and sedentary lifestyle are other risk factors of osteoporosis (8).

Today, women are more prone to bone mass loss than the past decades, due to reduced physical activity and dietary calcium intake and cigarette smoking. The number of femoral fractures is expected to increase six-fold between 1990 and 2050 (9). Stabilized osteoporosis cannot be reversed. However, measures can prevent it or its progression (10). Osteoporosis is not a part of the normal aging process (11). It is affected by nutrition and physical activity (12, 13). Insufficient osteoporosis knowledge and the lack of relevant training are among the most important causes of osteoporosis (14). Health care providers must design appropriate interventions to prevent and treat the disease and encourage preventive treatment (15). The first step in adopting preventive treatments for osteoporosis is to

know these behaviors and gain enough knowledge about these behaviors (2). Some studies have reported a positive association between knowledge of osteoporosis and adoption of osteoporosis prevention behaviors (13, 16-19). Several questionnaires have been designed to examine osteoporosis knowledge including prevention, risk factors, characteristics, outcomes and treatments (2, 15). These researcher-made tools are designed to measure osteoporosis knowledge in adults, such as FOOQ (Facts on Osteoporosis Quiz), OPQ (Osteoporosis Questionnaire) and OKAT (Osteoporosis Knowledge Assessment Tool) (15). The original OKT questionnaire has been used more extensively (2). The OKT questionnaire was first developed by Gendler et al. in 1991 (20). It is a comprehensive questionnaire designed based on research on risk factors, nutrition exercise recommendations, bone evolution, diagnosis and treatment of osteoporosis.

In this questionnaire, the different dimensions of osteoporosis knowledge are assessed, which adds to its validity and reliability. There are also no right and wrong answers in this questionnaire, and instead, the "I do not know" option is included to reduce the degree of speculation about the correct answer. In addition to the United States, the questionnaire has been used in other English-speaking countries such as Australia, England and New Zealand and has been translated into non-English languages, including Chinese and Spanish. Its validity and reliability have been investigated in both women and men with a wide range of age, recommending its use for research in different cultures. For this questionnaire changes should be made to its content based on different cultures and translations, and the effectiveness of the components affecting different populations should be examined. It may also be necessary to change nutrition-related

questions based on a specific region and culture (15). The validity and reliability of the original OKT questionnaire have been confirmed in several studies in Iranian women residents in Sydney, Australia (19) and other countries (15, 21). Baheiraei et al. conducted a psychometric examination on the previous version of the OKT questionnaire among 120 Iranian women living in Sydney. They showed that the internal consistency, shown with Cronbach's alpha, was moderate (0.58 and 0.66, for the diet and exercise sub-scales, respectively). The intra-group correlation coefficient was 0.75. Overall, the validity and reliability of the questionnaire were reported suitable for use in research (19). Qi et al. reviewed the previous version of OKT and reported high validity and reliability for the questionnaire (2). Gendler et al. (2012) designed a 32-item version of the questionnaire based on the latest scientific literature available on the subject and examined its validity. The internal consistency of the questionnaire that was obtained using the Kuder-Richardson-20 test was 0.83, 0.81 and 0.85 for subscales of nutrition, exercise and the total scale, respectively. Pearson's correlation coefficient was 0.87.

The validity of the questionnaire was assessed through content validity, and the revised version of the OKT questionnaire was introduced as a comprehensive questionnaire reflecting new research on osteoporosis, which can examine the various aspects of osteoporosis knowledge (15). Literature shows that, despite the existence of a standard version of the osteoporosis knowledge test, most studies in Iran have used researcher-made questionnaires (22-24). Considering that the latest version of the osteoporosis knowledge test was introduced by the designers of this questionnaire as a comprehensive and complete questionnaire, and due to the different culture in Iran and the high incidence of

osteoporosis, it was necessary to examine the psychometric factors of the questionnaire. Therefore, this study aimed to investigate the psychometric characteristics of the revised version of the osteoporosis knowledge test (OKT 2011, 2012).

## 2- MATERIALS AND METHODS

### 2-1. Type of study and participants

This is a cross-sectional and a methodological (25, 26) study designed to translate and validate the revised version of OKT (2011, 2012). This instrument measures people's knowledge of osteoporosis and its prevention. The new edition (2011) of the test includes 32 multiple choice items and has been designed by Gendler et al. (15). Here, it was used with the formal and written consent of Professor Gendler. The OKT consists of two subscales: the nutrition subscale that includes 26 items (items 1-11 and 18-32); and the exercise subscale that includes 20 items (items 1-17 and 30-32).

In this test, items 1-11 are related to risk factors for osteoporosis. Since 11 items are related to the risk factors for osteoporosis, the subscale of osteoporosis risk factors is also calculated in statistical analysis, in addition to the subscales of diet and exercise. Each of the 32 items has only one right answer/best answer. The fourth option in all 32 items is "I do not know". Each right answer has 1 point; while wrong answer or the "I do not know" answer is scored as zero. The total score of the test ranged between 0 and 32 (2, 15). The score of the exercise subscale ranges between 0 and 20, the score of the nutrition subscale ranges between 0 and 26, and the score of the risk factors for osteoporosis subscale ranges between 0 and 11 (2, 15). The participants included 330 female high school students in Saveh, Iran. The inclusion criteria were Iranian nationality, having phone contact, and willingness to participate in the study.

## 2-2. Sampling

Sampling was conducted using the two-stage randomized method. First, among the public and private schools in Saveh, three schools were randomly selected using random computer numbers. Then, the students in each high school were selected proportional, randomly. After reviewing the eligibility criteria and a providing brief explanation of the objectives and confidentiality of the study, the individuals were asked to participate. Informed written consent was obtained from the participants. Sample size that was 5 times the number of items in the questionnaire (Role of thumb) was used for factor analysis (27). Thus, because OKT had 32 items, a sample size of 160 was calculated. In this study, 330 adolescent girls were studied.

## 2-3. English to Persian Translation (Direct Translation) and Reverse Translation

After correspondence with the designer of the questionnaire, and obtaining the permission, the translation was carried out using the Forward and Backward method, whereby the items were first translated into Persian by two experts fluent in both English and Persian. After combining and translating the initial translations into a single translation, the text was translated from Persian to English by two expert translators. The translated English text was matched to the original questionnaire, and the translation validity was confirmed.

## 2-4. Reliability and Validity of the OKT (2011, 2012)

After matching the English translation with the original text of the questionnaire, 10 faculty members (2 gynecologists, 2 epidemiologists, 2 PhDs of health education, 3 MScs of midwifery and 1 orthopedic specialist) were provided with the questionnaire to assess its content validity, and their comments on the rules of grammar and correct words were

obtained. Content Validity Index (CVI) was calculated based on three indices of clarity, simplicity and relevancy and Content Validity Ratio (CVR) was calculated based on the items necessity. According to the Lawshe table, CVR was considered favorable if it was higher than 0.62. Also, If CVI quantity was  $\geq 0.79$ , the question was acceptable. The initial Persian version was then tested on 10 individuals in the general population, and face validity and the concepts of the items from their point of view were examined.

The final version included the necessary revisions. The final version of questionnaire was completed by 10 adolescent girls in the general population and the reliability was determined using test-retest (Intra-class Correlation Coefficient [ICC]), and internal consistency (Cronbach's alpha coefficient) for the two dimensions of OKT. To assess the questionnaire resolution, the ceiling and floor effects were investigated in order to determine the percentage of people who obtained the maximum and minimum score, respectively.

## 2-5. Statistical Analysis

Statistical analysis was performed using STATA 14.0. The generalized factor analysis (GFA) was used. Because of the binary nature of the indicators of the latent variables, we used this procedure. In this analysis, each item was entered in the model in a binary mode using the Bernoulli distribution and Logit's link function to introduce the corresponding latent variables. Mean and Variance Adaptive Gauss-Hermite Quadrature Integration Method was used to estimate the model. This model allows for consideration of the relationship between each item and the studied construct as latent variables. The paths are introduced from the exogenous binary variables to endogenous latent variables. P-value less than 0.05 was considered significant.



### 3- RESULTS

#### 3-1. Sample Characteristics

The mean (standard deviation [SD]) age of the participants was 16.7 (0.9). The mean (SD) Body Mass Index (BMI), and menarche age were 21.3 (3.4), and 13.0 (1.27) years, respectively. One-third of the students' fathers (32.1%), and one-fifth of their mothers (28.2%) had secondary school educations. The majority of the mothers (91.8%) were housewives and about one third (32.1%) of the fathers were self-employed. More than half of the

participants (57.6%) reported that their income was sufficient (**Table.1**). The mean (SD) of the total OKT score was 11.08 (4.08) (within a possible score range of 0 to 32), with minimum and maximum scores of 0 and 26. The mean (SD) of the exercise, nutrition and osteoporosis risk factors subscales scores were 6.46 (2.85), 9.81 (3.57) and 5.20 (2.28), respectively. Based on the results, 41.2% of students had poor levels of knowledge, 57.6% had moderate levels of knowledge and only 1.2% of them had good levels of knowledge of osteoporosis (**Table.2**).

**Table-1:** Baseline characteristics of osteoporosis in participant students

Characteristic	Number (%)	Characteristic	Number (%)
Age (years)		Father's Job	
Mean (SD)	16.7 (0.90)	unemployed	13 (3.9)
Body mass index (kg/m <sup>2</sup> )		Worker	88 (2.7)
Mean (SD)	21.3 (3.41)	Clerk	33 (10.0)
Menarche age		Retired	90 (27.3)
Mean (SD)	13.0 (1.27)	Self-employed	106 (32.1)
Student's education level (year)		Family history of osteoporosis	
Second	117 (35.5)	Yes	61 (18.5)
Third	138 (41.8)	No	269 (81.5)
Fourth	75 (22.7)	Mother's education level	
Father's education level		Elementary	133 (40.3)
Elementary	75 (22.7)	Secondary	93 (28.2)
Secondary	106 (32.1)	High school	21 (6.4)
High school	27 (8.2)	Diploma	66 (20.0)
Diploma	97 (29.4)	University	17 (5.2)
University	25 (7.6)	Economy status	
Mother's job		Perfect	16 (4.8)
Housewife	303 (91.8)	Sufficient	108 (32.7)
Worker	4 (1.2)	Fairly Sufficient	190 (57.6)
Clerk	15 (4.5)	Insufficient	16 (4.8)
Others	8 (2.4)	Number of family members	
Previous information about osteoporosis		Mean (SD)	2.4 (1.05)
Yes	77 (23.3)		
No	253 (76.7)		

SD: Standard Deviation.

**Table-2:** Status of osteoporosis knowledge and subscales in the participant students (n = 330)

Characteristic	Mean (standard deviation)	Attainable Score Range	Maximum scores	Minimum scores
Exercise	6.46 (2.85)	0-20	16	0
Nutrition	9.81 (3.57)	0-26	22	0
OKT Total	11.08 (4.08)	0-32	26	0

### 3-2. Content Validity

In the qualitative evaluation of the measurement instrument, experts provided their feedback in writing about the clarity and relevance of the content of the OKT scale for Iranian culture. The content of the questionnaire was generally confirmed through this step. It is also worth noting that some items were improved based on the comments of the expert panel members. CVI and CVR scores for OKT were 0.97 and 0.99, respectively (**Table.3**).

### 3-3. Reliability

Cronbach's alpha coefficient for this scale was  $\alpha=0.81$ , which evaluates the existence of internal correlation. Also, ICC (95% confidence interval) was 0.69 (0.22 to 0.87), indicating stability of the result if the test was to be repeated (**Table.4**).

### 3-4. Construct Validity

The results of the GFA were as follows:

Results showed that, items OKT1, OKT2, OKT5, OKT6, OKT7, OKT9, OKT13, OKT14, OKT16 and OKT17, were loaded

significantly in the exercise subscale. In other words, the exercise subscale was significantly composed of these items. On the other hand, items OKT3, OKT4, OKT8, OKT10, OKT18, OKT20, OKT21, OKT30, OKT31, and OKT32, were not significantly loaded in this subscale.

Results showed that, items OKT1, OKT7, OKT9, OKT10, OKT18, OKT20, OKT21, OKT22, OKT23, OKT25, OKT26, OKT27 and OKT32, were significantly loaded in the nutrition subscale. In other words, nutrition subscale was significantly composed of these items. On the other hand, items OKT3, OKT4, OKT5, OKT6, OKT8, OKT11, OKT19, OKT24, OKT28, OKT30 and OKT31 were not significantly loaded in this subscale (**Table.4**).

As a result, convergence and differentiation in two subscales of exercise and nutrition, and therefore, the construct validity of the two subscales were relatively confirmed. Results also showed that predictive power of exercise and nutrition subscales based on the relevant items were 63% and 29%, respectively.

**Table-3:** The CVI, and CVR for Items of the OKT

OKT	CVI	CVR	OKT	CVI	CVR
OKT1	0.93	1	OKT17	0.83	1
OKT2	1	0.9	OKT18	0.83	1
OKT3	1	1	OKT19	1	1
OKT4	1	1	OKT20	1	1
OKT5	1	1	OKT21	1	1
OKT6	1	1	OKT22	1	1
OKT7	1	1	OKT23	1	1
OKT8	1	1	OKT24	1	1
OKT9	0.93	1	OKT25	1	1
OKT10	1	1	OKT26	1	1
OKT11	0.93	1	OKT27	1	1
OKT12	1	1	OKT28	1	1
OKT13	1	1	OKT29	1	1
OKT14	1	1	OKT30	1	1
OKT15	1	1	OKT31	1	1
OKT16	0.86	1	OKT32	1	1
OKT Total	0.97	0.99			

OKT: Osteoporosis Knowledge Test; CVI: Content Validity Index; CVR: Content Validity Ratio.

**Table-4:** The Cronbach's alpha and ICC for the OKT

Variables	Cornbrash's alpha	ICC (95% CI)
Exercise	0.75	0.66 (0.16 to 0.87)
Nutrition	0.77	0.71 (0.27 to 0.88)
Total OKT	0.81	0.69 (0.22 to 0.87)

ICC: Intraclass Correlation Coefficient; 95% CI: 95% Confidence Interval; OKT: Osteoporosis Knowledge Test.

#### 4- DISCUSSION

The present study aimed to evaluate the reliability and validity of OKT (2011, 2012) questionnaire in Iranian female adolescents, which consisted of two subscales of exercise and nutrition. Findings showed that the Persian version of OKT is an appropriate tool for evaluating osteoporosis knowledge. This study was the first to conduct a psychometric evaluation on the OKT (2011, 2012) questionnaire among Iranian adolescents.

##### 4-1. Content Validity

Test validity is its effectiveness in measuring the attribute for which the test is designed to measure (28). The content validity of the OKT questionnaire was determined by both the qualitative results (expert opinions), and the quantitative results (by determining CVR and CVI) (29). The study used expert judgments, as a panel of experts, to determine the content validity, and the relevance, simplicity and clarity of each item, as well as their necessity, were asked from the panel of experts in the form a checklist. In the original version of the instrument, the CVI and CVR values are not used to represent simplicity, relevance, clarity, and necessity (30). Although other similar studies have confirmed the validity of the osteoporosis knowledge test, the values have not been reported for comparison with the results of the present study (2, 15).

##### 4-2. Reliability

Reliability is defined as the degree of independence of a scale from measurement errors (32). In this study, the reliability was determined using the internal consistency method through Cronbach's alpha and Intra-class Correlation Coefficient (ICC). The values of  $\alpha > 0.7$  indicate symmetric and acceptable reliability (29). In the present study, it was higher than 0.7 for both subscales of OKT, as well as its overall score, indicating the desirable reliability of the questionnaire, which is consistent with the study by Gendler et al. (2014) (15), and Chen et al. (31) that showed that the questionnaire had acceptable reliability. In addition, the ICC (95% confidence interval) was also equal to 0.69 (0.29 to 0.87), which indicates the stability of the result and repeatability if the test is repeated, which is consistent with the results reported by Baheiraei et al. (2005) (19), who conducted a psychometric evaluation on the original version of the questionnaire and confirmed its reliability. In the original version of the questionnaire, ICC values have not been reported, and other statistical methods have been used to examine reliability, where, finally, the reliability of the questionnaire has been reported to be acceptable (15), which is consistent with the results of this study.

##### 4-3. Construct (Factorial) Validity

Construct validity of a test is its degree of accuracy in measuring the target theoretical construct or characteristic (33). A confirmatory factorial analysis was used in this study. In the confirmatory factorial analysis, the researcher's goal is to

confirm a specific factorial structure, expressing the hypothesis about the number of factors, and the fit of the desired factor in the hypothesis is tested with the covariance of the measured variables (34). In this study, a generalized factorial analysis was used considering the binary state of the items studied. In this analysis, each item was entered in the model in a binary mode using the Bernoulli distribution and Logit's link function. Mean and Variance Adaptive Gauss-Hermite Quadrature Integration Method was used to estimate the model. It allows for examining the significance of the relationship between each item and the studied construct. The factorial validity of the two subscales was then confirmed. The factorial validity for each of the 32 items of the questionnaire has been confirmed in the main article about the psychometric evaluation of the revised version of the OKT, which is consistent with our results (15). Our results are also consistent with those reported by Qi et al. (2014) (2).

#### 4-4. Limitations and suggestions

One of the limitations of this study was that the questionnaire was validated on the adolescents' age group and its validity for adults and the wider community might be limited. Also, its predictive and concurrent validity was not determined. Therefore, it is suggested that in later studies, this questionnaire be used in different age groups and other psychometric methods be considered as well. The present study was conducted on high school and Persian-speaking students. Therefore, in order to make this questionnaire acceptable, useful and practical for other populations among Iranian populations, it is suggested to conduct future research among different groups or from different social classes and in other regions of Iran. Further psychometric testing is needed to determine if the revised OKT is psychometrically sound and clinically

useful across a more divergent group of individuals regarding race and ethnicity.

#### 5- CONCLUSION

The results of this study indicate the Persian version of the OKT (2011, 2012) as an appropriate instrument for assessing osteoporosis knowledge is comparable to other English versions of measuring instrument for osteoporosis knowledge and it has acceptable validity and reliability.

**6- CONFLICT OF INTEREST:** None.

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