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Factor Analysis of SF-36 Persian Version Health-Related Quality of Life Questionnaire in Iran

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Abstract: Short Form 36 (SF-36) questionnaire is an important instrument for health related quality of life study. It is used in many studies in the world. The purpose of this paper is evaluation of validity and reliability of a Persian translation of the SF-36 questionnaire as a tool for use in the general population in Iran. The SF-36 data were collected in a cross-sectional study on 1214 Iranian older people (over 40 years old) randomly selected from the general population in Mazandaran province in north of Iran. For internal consistency, Chronbach's alpha was calculated. Factor analysis with 2 and 3 principal components analysis extraction method was used. Internal consistency for 8 scales using Chronbach's alpha was 0.86. Construct validity was acceptable the same as significant correlation between scales. The correlation coefficient between 8 scales and two related principal components was also acceptable, but was not high for some scales. Two principal factor structure of the SF-36 scales in general population in the north of Iran were not equivalent with two principal component in U.S. population, and factor loadings were not similar to those found in the U.S. population. The Persian version of SF-36 is an appropriate tool for assessing the health perceptions of the population, but the eight Persian SF-36 scales scores can be summarized into three summary scores.

Key words: Validity · Reliability · SF-36 · Health-Related Quality of Life · Factor Analysis · Iran

INTRODUCTION

Short Form 36 (SF-36) questionnaire is an important instrument for health related quality of life study [1]. It is a completed version of SF-12 and SF-20 and it is used in many studies in the world [2]. A 36-item short form (SF-36) questionnaire was constructed to survey health status in the Medical Outcomes Study [1] and it was designed for use in clinical practice and research, health policy evaluations and general population surveys [3]. SF-36 has been translated into different languages and adapted to different cultures to obtain comparable data on health status internationally [4-7]. SF-36 was validated and studied in Iran for different groups [8, 9]. It is necessary to study validity and reliability of SF-36 Persian version in a general population.

Factor analysis provides one empirical test of the construct validity of the SF-36 in relation to its hypothesized structure. This method can be used in other countries to test the generalization ability of the two-dimensional (physical and mental) model of health observed in both general and patient populations in the United States [1]. Principal component analysis, a type of factor analysis, was used in the IQOLA project to estimate the congruence between hypothesized physical and mental health constructs and the SF-36 scales used to measure these constructs [10]. When prior information on expected factor/scale structure is available, they can be validated using confirmatory factor analysis (CFA). In exploratory factor analysis (EFA), a choice is required for the number of factors. The choice of number of factors can be made in a number of ways [12]. This is sometimes based on conventions like eigenvalues greater than 1 or eigenvalues accounting for over 5% or 10% individually, or over 70% or 80% jointly, of the total [13]. Scree plots with factors plotted in decreasing eigenvalue order are also sometimes used, selecting the number of factors appearing to separate factors with large versus small eigenvalues. It can also be based on penalized likelihood criteria like the Akaike information criterion (AIC) and the Schwartz Basyeian information criteria (BIC) [13]. A variety of informal conventions and penalized likelihood criteria have been recommended for choosing the number of factors. Those factors may be extracted using a variety of procedures. Johnson and Wichern consider maximum-likelihood and principal component extraction as the

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procedures having the 'most to recommend them [14]. They also discuss the principal factor procedure. Exploratory factor analysis is widely used to evaluate whether questionnaire items can be grouped into clusters representing different dimensions of the construct under study [15].

The aim of this study is to confirm factor analysis with principal component for structure validation of Persian SF-36 in Mazandaran population in Iran. The purpose of this study is to assess the validity and reliability of a Persian translation of the SF-36 questionnaire as a tool for use in the general population in Iran.

MATERIALS AND METHODS

In order to evaluate of HRQOL, this cross-sectional study was designed, SF-36 Persian version data and socioeconomic data were collected. Statistical population was elderly Mazandaran population aged 40 years old and over. The SF-36 was administered by self administration or face to face interviews were carried out with a sample of households (for poor literacy level people). The SF-36 includes one multi-item scale that assesses eight health concepts: (1) limitation in physical functions because of health problems (PF); (2) limitation in social activities because of physical or emotional problems (SF); (3) limitations in usual role activities because of physical health problems (RP); (4) Bodily pain (BP); (5) General mental health (MH) (Psychological distress and well-being); (6) limitations in usual role activities because of emotional (RE); (7) Vitality (energy and fatigue) (VT) and (8) General health perceptions (GH). Each scale consists of 2 to 10 items, and each item is rated to a two- to six-point Likert scale. The scale score is calculated by summation of all the scores of items belonging to the same scale from 0 to 100 with higher scores indicating higher levels of function and/or better health.

The SF-36 data were collected in a cross-sectional study on 1214 Iranian older people (over 40 years old) randomly selected from the general population in Mazandaran province in north of Iran. For internal consistency, Chronbach's alpha was calculated.

Factor analysis with principal component extraction method for items and scales SF-36 was used. The Iranian population means and SD can be used for the Z-score transformation in the calculation of the standard SF-36 PCS and MCS scores in local studies, which will make interpretation easier by adjusting the population mean and SD to 50 and 10, respectively.

Norm-based scoring with Z-score transformation, calculated as (observed score- population mean) / population standard deviation, and standardization of the population mean and standard deviation (SD) to 50 and 10, respectively, are recommended for easier interpretation [16].

The SF-36 PCS and MCS scoring algorithm is summarized below:

SF-36 PCS = (Z-score of each scale × respective physical factor coefficient) × 10 + 50

SF-36 MCS = (Z-score of each scale × respective mental factor coefficient) × 10 + 50

The statistical package used was SPSS, version 15.

RESULTS AND DISCUSSION

The participants had an average of 51.5 years of age with a standard deviation of 10.3 years of age. Among the respondents, there were male 52.1% and female 47.9%. The majority of the respondents were married (87.2%). About 62.4% of the respondents had an education level equal to or less than middle school. 603 subjects (49.3%) were resident on urban areas and 611 persons (49.1%) resident rural areas.

By answers the first and second question of SF-36, 563 persons (47.8%) have said that their health status were very good or excellent and 104 (8.5%) fair or poor. Compared to one year ago, 411 (34.1%) participants have said that their health now were better than one year ago (vs. 303 (25.2%) worse). The SF-36 health profiles are contained in Table 1.

Scale reliability: The internal consistency of subscales is shown on the Table 2. Cronbach's $\propto$ exceeded 0.7 for all subscales except GH, SF and RE of the SF-36. Alpha for SF-36 subscales is ranged from 0.56 (SF) to 0.92 (PF). Internal consistency for 8 scales using Chronbach's alpha was 0.86.

Correlations and Construction validity: In multivariate analysis of the SF-36, subscales measuring similar constructs were moderately to strongly correlated ($r=0.40$), while domains measuring heterogeneous constructs were weakly correlated ($r<0.40$). For example the correlation between PF and BP was 0.49, but about PF and MH was 0.36.

Table 1: Mean (SD) of 8 scales SF-36 scores on study participants in Mazandaran province in north of Iran 2005

Component	Mean (SD) Female	Mean (SD) Male	Total Mean (SD)
GH	60.5 (18.4)	65.1 (17.4)	63.2 (17.9)
PF	61.6 (17.9)	75.7 (24.0)	70.7 (25.5)
RP	56.2 (37.7)	64.1 (33.8)	60.7 (36.1)
RE	55.7 (37.7)	63.9 (36.3)	60.3 (38.3)
SF	61.7 (23.0)	66.8 (22.7)	64.6 (23.1)
BP	59.1 (25.4)	68.3 (23.3)	64.1 (24.8)
VT	55.1 (19.4)	62.9 (16.9)	59.3 (19.6)
MH	61.7 (17.9)	66.9 (16.9)	64.5 (17.7)

Table 2: Internal consistency (reliability estimates)

Component	Number of items	Chronbach's Alpha
GH	5	0.65
PF	10	0.91
RP	4	0.72
RE	3	0.69
SF	2	0.59
BP	2	0.84
VT	4	0.73
MH	5	0.73
SF-36	36	0.93

Construction validity was acceptable as correlation between scales was significant. The correlation coefficient between 8 scales and two related principal components was also acceptable, but was not high for some scales. Correlation coefficient between PF, RF and RE with PCS were higher than coefficients between those with MCS and Correlation coefficients between MH, VT, SF and GH with MCS were higher than coefficients between those with PCS. Correlation between PCS and MCS was high (93%).

First-order factor structure: Table 4 summarizes the results of first-order factor loadings and SF-36 items. On the basis of factor analysis, items were included in a scale when they weighted most heavily on that scale, with item loadings exceeding 0.4.

We used iterated principal factor analysis to determine the structure of all of the SF-36 items. There were eight distinct factors with eigenvalues greater than 1.0. The total variability explained by the eight factors was 61%. All of first-order factors were clearly associated with SF-36 scales except BP and SF that were clustered in one factor. Factor analysis didn't show discrimination between BP and SF by their items.

The "vigorous activities" item from the PF scale had a moderate loading on the 7th factor. Other secondary loadings such as "sick easier than", "expect health to get worse" from the GH scale were more highly related to MH. The "health is excellent" from GH and items from the MH factor that express positive affect (i.e., "happy person" and "calm and peaceful") tended to load more highly on the VT factor (.778 and .681) than on their own factor. The items from the VT scale that express fatigue (i.e., "worn out" and "tired") tended to load more highly on to MH factor.

Second-order factor structure: We used iterated principal factor analysis to determine the structure of all of the SF-36 subscales. There were two distinct factors with eigenvalues greater than 1.0 (Table 5).

The total variability explained by the two factors was 63%. Factor one (MCS) was clearly associated with MH, VT and GH and SF were clustered in factor 1 and RP, RE and PF were clustered in factor 2 (PCS). There were statistically significant correlation for both PCS and MCS scores obtained by use of algorithms ($p<0.01$).

To explore the SF-36 scales and their hypothesized groupings, 3 principal components factor analysis used.

On the basis of factor analysis, Evaluation of (SF-36), three component factor analysis emerged as a separation which explained about 10% of the variance in the data. Although RE and RP emerged as a separate dimension within the analysis which explained 72.3% of the variance

Table 3: Correlations (r) between the Persian version SF-36 scales

Scale	MH	VT	BP	SF	RE	RP	PF	GH
GH	0.445	0.521	0.501	0.409	0.301	0.349	0.392	1
PF	0.363	0.479	0.497	0.383	0.354	0.437	1	
RP	0.336	0.397	0.458	0.378	0.527	1		
RE	0.431	0.381	0.381	0.407	1			
SF	0.508	0.456	0.590	1				
BP	0.465	0.510	1					
VT	0.687	1						
MH	1							

Table 4: Varimax rotated first-order factor loadings (>0.3) and item-scale allocations for

		Components							
SF-36	SF-36 Items(question number)	(1)-PF	(2)-VT	(3)-MH	(4)-BP-SF	(5)-RF	(6)-RE	(7)*	(8)-GH
PH	1 (3a) Vigorous activities	0.300						0.663	
	2 (3b) Moderate activities	0.685							
	3 (3c) Lifting/carrying groceries	0.731							
	4 (3d) Climbing several flight	0.614						0.483	
	5 (3e) Climbing one flight	0.825							
	6 (3f) Bend/kneeling or stooping	0.597						0.378	
	7 (3g) Walking more than 1 km	0.672							
	8 (3h) Walking several blocks	0.847							
	9 (3i) Walking one block	0.861							
	10 (3j) Bathing or dressing	0.671							
RP	1 (4a) Cut down time on work					0.390	0.476	0.313	
	2 (4b) Accomplished less					0.658	0.315		
	3 (4c) Limited in kind of work					0.679			
	4 (4d) Difficulty performing work					0.690			
RE	1 (5a) Cut down time on work						0.762		
	2 (5b) Accomplished less						0.621		
	3 (5c) Didn't do work as carefully						0.594		
BP	1 (7) Intensity of bodily pain				0.674				
	2 (8) Extent pain interfered work				0.677				
VT	1 (9a) Feel full of pep		0.775						
	2 (9e) Have a lot of energy		0.705						
	3 (9g) Feel worn out			0.599					
	4 (9i) Feel tired		0.336	0.440					
SF	1 (6) Social extent				0.762				
	2 (10) Social-time interfered				0.496				
MH	1 (9b) Been very nervous			0.528					
	2 (9c) Felt down in the dumps			0.517					
	3 (9d) Felt calm and peaceful		0.681						
	4 (9f) Felt downhearted and blue			0.629					
	5 (9h) Been a happy person		0.778						
GH	1 (1) Health is: excellent … poor		0.454						0.326
	2 (11a) Sick easier			0.463					
	3 (11b) As healthy as anybody								0.780
	4 (11c) Expect health to get worse			0.61					
	5 (11d) Health is excellent		0.551						
									0.454

* Items related this factor allocated to PF

in the data, but eigenvalues for second and third factors were >0.8.

This study has showed that reliability coefficient equals 93%. This finding was similar to results of others studies in Iran [8, 9, 17]. GH, SF and RE had the lowest rate of coefficients. This is consistent with the US [1, 14], Italy [18] and Chinese [19-20] surveys. Ware and his colleagues in IQOLA project were explained that SF, GH and RE had the lowest coefficients. The update article by Ware [5] reports details of reliability with ∝ values that exceed than .80 for all scales except Social Functioning (∝=.68). This means that questions related to these scales were not understood by respondents.

The results of our study showed that the first-order factor loadings SF-36 items were included in 8 scales except with a little difference. Some studies reported results similar to our findings [21-23]. The first-order factor loadings for the most of items, were in range of loadings in ten countries [24] but some of items such as: "vigorous activities" item from the PF, "sick easier than",

Table 5: Two principal component second-order factor coefficients of Persian version SF-36 scale scores

Scale	Factor I	Factor II
GH	0.742	0.314
PF	0.454	0.524
RP	0.189	0.853
RE	0.235	0.766
SF	0.617	0.38
BP	0.608	0.466
VT	0.839	0.203
MH	0.736	0.155

Table 6: Three principal component second-order factor coefficients of Iranians SF-36 scale scores

Scale	Factor I (MCS)	Factor II (PCS)	Factor III
GH	0.656	0.423	0.199
PF	0.192	0.826	0.176
RP	0.110	0.442	0.746
RE	0.311	0.074	0.864
SF	0.524	0.433	0.255
BP	0.411	0.691	0.204
VT	0.796	0.316	0.144
MH	0.883	0.095	0.216

"expect health to get worse" and "health is excellent" from the GH scale were not redundant with loadings in their scales. The items from the MH and VT factors that express positive affect or fatigue didn't tended to load on to their own factors. These findings are consistent to those have been found in ten countries in IQOLA project [24]. Consequently, this study results support to 8 scales factor structure in Persian SF-36 similar to original version.

Table 5 shows the PF, RP and RE scales loading most on the physical component and least on the mental component. Also, the MH, VT, SF and BP scale had the higher loading on the "mental" component than the physical component of health. 63% of the total variance was accounted for by the first two rotated principal components. Factorial analysis of the scales yielded results identical to the original version except for the RE Scale. The GH appears to measure mental health and the BP appears to measure both physical and mental health. This discordance is probably explained by the nature of the elderly population and not by a structural defect since the items and scales are satisfactory such as those Ware et al was reported by validation criteria [5].

These two dimensions (summary scales) physical and mental explain 63% of the total variability; and even though it is less than obtained in the U.S. (68%), it is nevertheless acceptable (> 60%) [1,4]. The hypothesized summary scores for mental and physical health accounted for 56% to 85% of variance in health-related quality of life in the United States, Sweden [25], and the United Kingdom [26-27, 5]. Fukuhara and his colleges [28] reported that, in Japanese version 1.1 in the first phase in IQOLA Project; factor analysis, could not clearly distinguish the scales designed to measure the "physical" component of quality of life from those designed to measure the "mental" component.

However, factor analysis results can be influenced by many conditions other than the relationship between underlying concepts including the skew ness of scores and sample size [29-34]. Conventional approaches are based on changing strong factor loadings, for example, in excess of 0.3 or 0.35 or 0.4, to unit loadings and others to zero loadings. If an item loads strongly on more than one factor, the usual convention is to discard it. Knafl and Grey [13] indicated that the same informal convention applied with a different factor extraction procedure can produce quite different choices for the number of factors.

When we had selected 3 hypothetical factors for analysis, evaluation of data emerged as a separate dimension which explained 72.3% of the variance in the data and this time the RF and RE did load onto the 3rd dimension. The obtained results indicate that these two subscales are different in structure or the number of items or their large standard deviations from other scales of SF-36. Extreme values of the scale (the ceiling and floor effect), to be the most 'coarse' of all the eight, and having non-normal distribution for these two scales explained by other authors [22, 30, 31]. About 62.4% of the respondents had an education level equal to or less than middle school. It is possible that low education attainment among this people may also influence their understanding of some portions of the Persian SF-36, especially those RE, RF and GH questions.

Two principal factor structure of the SF-36 scales in general population in north of Iran was not equivalent with two principal component in U.S. population, and factor loadings were not similar to those found in the U.S. population [1].

CONCLUSIONS

The hypothesized two-factor structure of the SF-36 scales was replicated from the SF-36 data of the Iranian general population, and the two factors explained 63% of the total variance of the SF-36 scale scores. This is an acceptable structure validity for Persian version of SF-36 and the standard SF-36 PCS and MCS scales

scoring algorithm is therefore recommended for the Iranians population for better international comparability. The Iranian population means and SD can be used for the Z-score transformation in the calculation of the standard SF-36 PCS and MCS scores in local studies, which will make interpretation easier by adjusting the population mean and SD to 50 and 10, respectively.

The Persian version of SF-36 is an appropriate tool for assessing health perceptions of the population, but the eight Persian SF-36 scales scores can be summarized into three summary scores with 3rd dimension for limitation scales RE and RF for elderly population.

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