

Exploratory and Confirmatory Factor Analyses for Testing Validity and Reliability of the Malay Language Questionnaire for Urinary Incontinence Diagnosis (QUID)

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Abstract

This study examines the construct validity and reliability of the Malay language questionnaire for urinary incontinence diagnosis (QUID) in women. Study Design: Random sampling design was used in this cross-sectional survey. Materials and Methods: The Americanized English language questionnaire was translated to the Malay language and distributed to community-dwelling Malaysian women living in various locations in Selangor. The construct validity was tested using exploratory factor analysis (EFA) followed by confirmatory factor analysis (CFA). The reliability was determined using Cronbach's α . Results: A total of 111 women completed the Malay language QUID in this pilot study. The Keiser-Meyer-Olkin (KMO) measure of sampling adequacy of 0.675 and Bartlett's test of sphericity ($\chi^2 = 284.633$, $df = 15$, $p = 0.001$) indicated that the EFA was possible. The total variance and the scree plot identified two factors above the initial eigenvalue of 1 while a third factor was just below it (0.758). The CFA output showed a recursive model with the solution being not admissible because two unobserved and exogenous variables had negative variance estimates. The following values of absolute fit indices showed an acceptable level of fit: 1) Chi-square test with $\chi^2 = 4.997$, $df = 5$, $p = 0.416$, indicated a smaller difference between the expected and observed covariance matrices; 2) GFI = 0.986, AGFI = 0.939, RMR = 0.021 and CMIN/DF = 1.0 indicated acceptable level of fit; 3) The baseline comparison values of NFI = 0.983 and CFI = 1.0 also

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indicated a good fit to the data; 4) RMSEA = 0.000 was considered a perfect fit indicating that the hypothesized model was a good fit to the observed data. Under the hypothesis of “close fit”, the probability of getting a sample RMSEA as large as 0.000 was 0.567. The Cronbach’s α coefficient of 0.823 indicated good reliability. Conclusion: The Malay language QUID is a valid and reliable instrument for diagnosing female urinary incontinence in the Malaysian population.

Keywords

Confirmatory Factor Analysis, Exploratory Factor Analysis, Malay Language, Questionnaire for Urinary Incontinence Diagnosis, Reliability

1. Introduction

The exact prevalence of urinary incontinence (UI) in a population seems to vary from population to population and from study to study. This might be related to the numerous different types of questionnaires and language versions used to ascertain its prevalence. Despite several local surveys, the exact prevalence and diagnosis of different types of UI in Malaysian women remains poorly established. The reported prevalence in local studies has ranged from 9% to 40% [1]-[4]. Most local studies were cross-sectional, observational studies conducted either in the community or in clinics using English language questionnaires mainly from Britain or America. Some had been translated to Malay, Mandarin or Tamil languages, as these languages are the three major languages used in the multiracial society of Malaysia. Using the English, Malay and Mandarin language versions of the International Prostate Symptoms Score (IPPS), Low *et al.* [5] reported a prevalence of 19% of female lower urinary tract symptoms (FLUTS). The same researchers when using questions extracted from the Bristol Female Lower Urinary Tract Symptoms Questionnaire (BFLUTS-Q), on the other hand, reported the prevalence of stress urinary incontinence (SUI) and urge urinary incontinence (UUI) at 44.7% and 55.3%, respectively [5]. Whether these translated versions of the stated questionnaires are validated remains unclear.

Zalina *et al.* [6], using the English language version of the International Consultation on Incontinence Questionnaire (ICIQ)-FLUTS reported an overall UI prevalence of 34.9%. Mohd Sidik [7], using a modified Malay version of the Barthel’s Index (BI) reported a prevalence of 9.9% among the elderly in a rural community in Sepang, Selangor. This was similar to two other studies on the Malaysian elderly [8] [9]. Dhillon *et al.* [10] reported a UI prevalence of 40% in menopausal women living in Kelantan. A cross-sectional survey of 5506 in 11 Asian countries documented a prevalence of UI of 13.1% in the Malaysian women [3].

Similar observations have also been reported in other populations. In a review of seven studies investigating the prevalence of UI in Australia, Botlero *et al.* [11] reported the prevalence ranging from 12.8% to 46%. Although the exact reason for this wide variation in the reported prevalence is uncertain, it might result from differences in the definitions used, duration of the reference period, or even the design of the questionnaire used. In a more recent prevalence study, the same authors had used the QUID developed by Bradley *et al.* [12] and reported an overall prevalence of UI of 41.7% [13] in women in Australia.

The wide ranging prevalence of UI together with incomplete validated information on the type of UI and the associated risk factors in Malaysian women has significant implications on the diagnosis and management of UI. There is, therefore, a need to ascertain the exact prevalence and types of UI and the associated risk factors in Malaysian women using a standardized diagnostic tool. It is important that the tool to be used must be both sensitive and reliable. For this, QUID with its predictive values of 90% for SUI and 95% for UUI [11] appears to have a potential in helping ascertain more accurately the exact prevalence of UI in the Malaysian female. Its usability in the Malaysian population has, however, not been assessed before, particularly in the Malay language, which is now the major vehicular language of the population. But before it can be used in the Malay language, its sensitivity and reliability has to be tested.

2. Materials & Methods

This cross-sectional pilot study was conducted on a cohort from households within several locations in Selangor. The inclusion criteria consisted of healthy women aged 18 years and above and women with well controlled non-communicable diseases such as diabetes and hypertension. The exclusion criteria consisted of pregnant

women, women who had delivered within the last two years, women who have had an abortion within the year and women who had undergone recent surgery on their reproductive tract or had undergone cancer treatment in the last six months.

The locations for the survey were identified by the Department of Statistics Malaysia and flyers in the Malay language containing the outline of the research project and contact telephone numbers of researchers were placed in letter boxes of houses within the specific location. Those women who responded to a second home visit were provided with both verbal and written information in the Malay language. Informed consent was obtained prior to their participation in this pilot study. Upon receiving their consent from the participants, an appointment was made for the researcher to visit the respondents again at home in order to administer the Malay language version of the QUID. Those who preferred to answer the questions themselves (self-administered) were allowed to do so; otherwise, the questions were read to each respondent and their responses marked accordingly. The participants were assured that they had the right to refuse to answer any question that they found sensitive or did not wish to answer. Using published tables with $\pm 5\%$ precision level, confidence interval of 95% and $p = 0.05$, the required sample size was calculated to be 100 for the pilot study [14]. The Malay language QUID was distributed to 111 healthy women who met the inclusion criteria.

2.1. Research Instrument

The QUID [12] was translated into the Malay language based on the MAPI Research Trust guidelines [15]. It included the following steps: forward translation, backward translation, a review by clinicians, cognitive debriefing, and international harmonization (if more than one language was involved), proof reading, and finally a written report. The researchers coordinated the full linguistic validation process with a team consisting of a bilingual Malay clinician, a Malay language teacher, including three Malay professional women. This resulted in the development of the Malay language QUID. A Likert scale was used to measure the responses to the questions [16] [17]. The respondents were asked to indicate their degree of urine leak, even a few drops, to a particular question on a 5-point scale with options ranging from none to all the time.

2.2. Statistical Analysis

Descriptive statistics were used to analyze the data. Factor analysis on the questionnaire for construct validity was performed using tests contained in SPSS (PASW version 20). Exploratory Factor Analysis (EFA) was applied to the six items of the questionnaire. First, the Keiser-Meyer-Olkin (KMO) test for sampling adequacy and Bartlett's test for sphericity was done to ensure that the EFA was adequate for principal component analysis (PCA). Extraction method was used for the PCA using eigenvalue, scree plot and component matrix. Cronbach's α was also determined for reliability of the extracted factors. Confirmatory Factor Analysis (CFA) was performed using SPSS AMOS version 20 to report on the theoretical relationships between the observed and unobserved variables in QUID including if the hypothesized model was a good fit to the observed data.

3. Results and Discussion

Validity refers to the extent a research instrument measures what it is intended to measure [16] [17] and reliability refers to the ability of an instrument to measure consistently [18]-[20]. The researchers had no prior beliefs about which or how many underlying factors could be found to explain the data. Therefore, based on the premise that no Malaysian studies had been conducted using the Malay language QUID, EFA was considered appropriate [16] [17].

3.1. Exploratory Factor Analysis (EFA)

Construct validity was determined by means of EFA using descriptive statistics, principal component analysis (PCA) extraction method [21] and varimax rotation [21]. The mean \pm SD, SEM, variance, skewness, kurtosis and range for QUID are stated in **Table 1**. Question 1 to 3 diagnosed SUI while Question 4 to 6 was related to UII. The wide difference in the mean and SD within these questions for SUI indicated that Question 1 was a more acceptable question by most Malaysian women compared to Questions 2 and 3. It is possible that many respondents may not have related SUI to activities associated in Questions 2 and 3. In contrast, Questions 4 to 6 had a narrower mean and SD. These questions were related to the diagnoses of UII and the questions appeared

Table 1. PCA communalities and descriptive statistics for items on the QUID.

Items	PCA		Descriptive statistics					
	Com.	M	SEM	SD	Var.	Sk.	Ku.	Ra.
Do you leak urine (even small drops), wet yourself, or wet your pads or undergarment when... <i>Adakah kencing anda terkeluar (walaupun titisan kecil), membasahkan anda, atau tuala wanita atau seluar dalam ketika...</i>								
Q1. You cough or sneeze? (<i>Anda terbatuk atau terbersin?</i>)	0.389	0.97	0.107	1.132	1.281	0.897	0.213	5
Q2. You bend over or lift something up? (<i>Anda membengkokkan badan atau mengangkat sesuatu barang?</i>)	0.824	0.26	0.062	0.657	0.431	2.219	3.123	2
Q3. You walk quickly, jog or exercise? (<i>Anda berjalan dengan cepat, berjoging atau bersenam?</i>)	0.797	0.24	0.055	0.576	0.331	2.274	3.929	2
Q4. You are undressing to use the toilet? (<i>Anda membuka pakaian untuk ke tandas?</i>)	0.711	0.56	0.091	0.960	0.922	1.934	4.271	5
Q5. You get such a strong and uncomfortable need to urinate that you leak urine before reaching the toilet? (<i>Anda berasa begitu terdesak sehingga anda terkencing sembelum sampai ke tandas?</i>)	0.748	0.58	0.095	1.005	1.010	1.811	3.318	5
Q6. You have to rush to the toilet because you get a sudden, strong need to urinate? (<i>Anda terges-gesa pergi ke tandas disebabkan rasa ingin terkencing yang datang secara tiba-tiba?</i>)	0.798	0.67	0.095	1.003	1.006	1.374	1.086	4

Note: Com. = communality, Var. = variance, Sk. = skewness, Ku. = kurtosis, Ra. = range.

relevant to them (**Table 1**). The test of normality (Kolmogorov-Smirnov) statistics ranged between 0.300 and 0.511, $df = 111$, $p = 0.000$.

In terms of responses to the six-item QUID, respondents were asked to indicate the frequency to questions on a 5-point scale (**Table 1**) ranging from 0 (none) to 5 (all the time). In terms of responses to a 5-point Likert scale for SUI, Questions 2 and 3 had a response ranging from none (0) to once in a while (2). It is possible that the lifestyle behavior in Questions 2 and 3 were different to the respondents' cultural differences; hence, the responses to these questions received lower scores. On the other hand, the respondents' score for UUI (Questions 4 to 6) was higher possible due the ability to related to the questions better. Furthermore, in order to diagnose mixed urinary incontinence (MUI) amongst this cohort, their responses were mainly to Questions 1, 3 to 6 with scores ranging between 0 and 5.

In the correlation matrix, these six items were inter-correlated with coefficient scores of $r = 0.156 - 0.779$, $p < 0.001 - 0.051$ (1-tailed). The determinant of the R-matrix was 0.070 which was greater than 0.000001. The KMO measure of sampling adequacy of 0.675 and Bartlett's Test of Sphericity (χ^2 value 284.633, $df = 15$, $p = 0.001$) indicated that the EFA was possible. Following the extraction method of PCA, the communalities ranged from 0.389 to 0.824 (**Table 1**).

In **Table 2**, the first and second components of the Malay language QUID accounted for the greatest amount of common variance compared to the rest of components. This is again reflected in the scree plot for the Malay language QUID (**Figure 1**). It had two values above the eigenvalue of 1. Even though the third score (0.758) was below eigenvalue of 1 and did not contribute sufficiently to the model, its presence, nevertheless, was indicative that with sufficient power, its score could increase to above eigenvalue of 1. This could result in the formation of a third component.

The PCA extraction method component matrix clearly demonstrated that all six items of QUID in component 1 were related to UI, of either MUI or UUI. On the other hand, component 2 had only two questions with positive values which diagnosed SUI, the rest were with negative values. But in **Table 3**, the rotation method using Varimax with Kaiser normalisation showed 2 components with 3 iterations. Component 1 consisted of Questions 3 to 6 (diagnosis for UUI) and component 2 had Question 2 and 3 (diagnosis for SUI). In contrast, Question 1 was extremely weak (0.165) in Component 2 but fairly strong (0.601) in Component 1 (**Table 3**) which had strong values for questions diagnosing UUI. Question 1 seems to show a closer relationship with UUI than with SUI, hence indicating that a third component, MUI might be present. Hence CFA analysis was performed to confirm if this hypothesized model is a good fit to the observed data [19].

Table 2. PCA: total variance explained: Malay version QUID.

Component	Initial eigenvalues			Extraction sums of squared loadings			Rotation sums of squared loadings		
	Total	% of variance	Cumulative%	Total	% of variance	Cumulative%	Total	% of variance	Cumulative%
1	3.109	51.822	51.822	3.109	51.822	51.822	2.628	43.806	43.806
2	1.158	19.302	71.123	1.158	19.302	71.123	1.639	27.317	71.123
3	0.758	12.631	83.754						
4	0.477	7.954	91.708						
5	0.338	5.632	97.340						
6	0.160	2.660	100.000						

Table 3. PCA: rotated component matrix of Malay language QUID.

Do you leak urine (even small drops), wet yourself, or wet your pads or undergarment when... <i>Adakah kencing anda terkeluar (walaupun titisan kecil), membasahkan anda, atau tuala wanita atau seluar dalam ketika...</i>	Component	
	1	2
Q1. You cough or sneeze? (<i>Anda terbatuk atau terbersin?</i>)	0.601	0.165
Q2. You bend over or lift up? (<i>Anda membengkokkan badan atau mengangkat sesuatu barang?</i>)	0.086	0.904
Q3. You walk quickly, jog or exercise? (<i>Anda berjalan dengan cepat, berjoging atau bersenam?</i>)	0.298	0.842
Q4. You are undressing to use the toilet? (<i>Anda membuka pakaian untuk ke tandas?</i>)	0.837	0.099
Q5. You get such a strong and uncomfortable need to urinate that you leak urine before reaching the toilet? (<i>Anda berasa begitu terdesak sehingga anda terkencing sembelum sampai ke tandas?</i>)	0.851	0.157
Q6. You have to rush to the toilet because you get a sudden, strong need to urinate? (<i>Anda terges-gesa pergi ke tandas disebabkan rasa ingin terkencing yang datang secara tiba-tiba?</i>)	0.864	0.229

Extraction method: principal component analysis (PCA).
Rotation method: varimax with kaiser normalization^a.

^aRotation converged in 3 iterations.

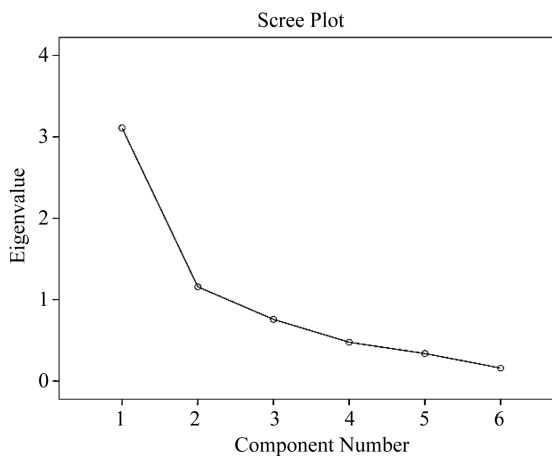


Figure 1. PCA scree plot: Malay language version QUID.

3.2. Confirmatory Factor Analysis (CFA)

The SPSS AMOS version 20 developed a hypothetical model that used to estimate a population covariance matrix and compared with the observed covariance matrix to minimize the difference between the estimated and observed matrices [22]. The six observed items were the six questions from QUID with three latent variables of SUI, UUI and MUI (Figure 2). Latent variables SUI was measured with Questions 1 to 3 while UUI was measured with Questions 4 to 6. Latent variable MUI was measured with all six observed variables (Questions 1 to 6). The total parameter summary of the model was 28; 9 weight regression, 1 covariance and 9 variances. A recursive model was formed with 15 variables (Figure 2). The CFA output from Figure 2 showed that the solution

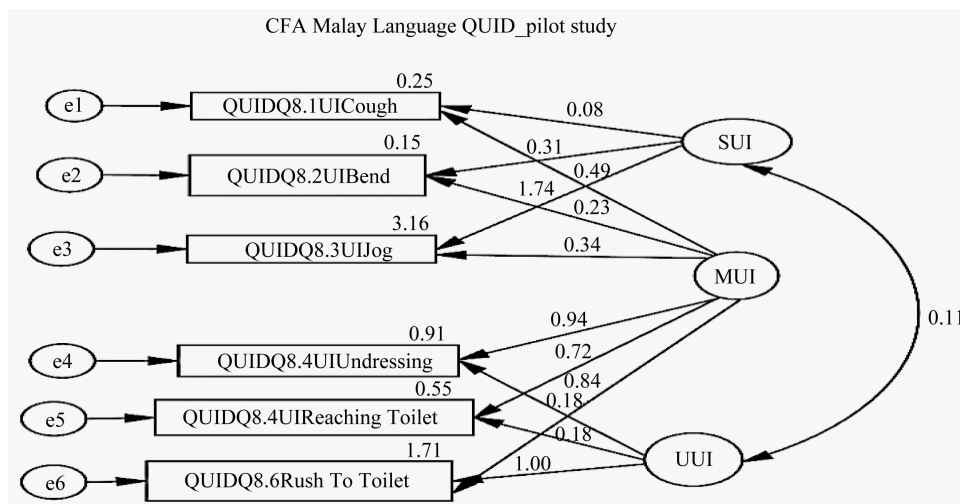


Figure 2. CFA illustrates the default model pathway with standardized estimates. Minimum was achieved. Minimization iteration 11, chi-square = 5.0, df = 5, p = 0.5.

was not admissible because two unobserved, exogenous variables had negative variance estimates probably due to the small sample size. The following values of absolute fit indices showed an acceptable level of fit: 1) The chi-square test with χ^2 value of 4.997, df = 5, p = 0.416, indicated a smaller difference between expected and observed covariance matrices; 2) GFI = 0.986, AGFI = 0.939, RMR = 0.021 and CMIN/DF = 1.0 indicated acceptable level of fit; 3) The baseline comparison values of NFI = 0.983 and CFI = 1.0 also indicated a good fit to the data; 4) RMSEA = 0.000 was considered a perfect fit indicating that the hypothesized model was a good fit to the observed data. Under the hypothesis of “close fit”, the probability of getting a sample RMSEA as large as 0.000 was 0.567.

4. Reliability Analysis

Cronbach’s α is the most widely used objective measure of reliability (internal consistency) of items in a questionnaire [18]-[20]. As the measurement of Cronbach’s α is a property of the scores on a test from a specific cohort, it is important that it is estimated every time it is used in different study cohorts. Acceptable values of Cronbach’s α , ranging from 0.70 to 0.95 have been reported by others [16]-[19]. In this study, the Cronbach’s α was 0.80 which indicated a scale of high reliability [20]. The Cronbach’s α for SUI 0.530 and for UII was 0.864 (Table 4). A reliable question is expected to have a positive relationship with the overall total, ideally having a corrected item-total correlation above 0.3 [18], [20]. The “corrected item-total correlation” for QUID questions related to SUI was between 0.349 and 0.528 while Question 4 to 6 related to UII was higher (0.655 to 0.749). Five of the questions (Questions 1, 3 to 6) in Table 4 had a total range from 0.454 to 0.749 which showed positive relationship with overall total, except for Question 2 which had a value of only 0.349. It displayed a weak positive or a negative relationship to the total, indicating Question 2 may be poor on reliability and is thus affecting the findings from the whole scale.

The Cronbach’s α in this study was 0.530 and 0.864 for SUI and UII respectively. This finding was similar to those reported by the American women using the English language QUID in a pilot study by Bradley *et al.* [12]. Their Cronbach’s α was 0.72 for SUI and 0.79 for UII. The only difference between the two cohorts was that the American respondents were recruited from those who had some degree of UI and had undergone corrective surgery while the Malaysian cohort was community-dwelling Malaysian women who considered themselves healthy.

5. Limitation of the Study

The CFA output from Figure 2 had indicated that the solution was not admissible due to small sample size. In the default model the Hoelter critical “N” suggested 244 for a significant level of 0.05 and 333 for a significant level of 0.01.

Table 4. Reliability test: item-total statistics Malay version QUID.

Do you leak urine (even small drops), wet yourself, or wet your pads or undergarment when... <i>Adakah kencing anda terkeluar (walaupun titisan kecil), membasahkan anda atau tuala wanita atau seluar dalam ketika...</i>	Cronbach's α coefficient	Scale mean if item deleted	Scale variance if item deleted	Corrected item-total correlation	Squared multiple correlation	Cronbach's α if item deleted
1. You cough or sneeze? (<i>Anda terbatuk atau terbersin?</i>)	0.530	2.31	10.360	0.454	0.269	0.804
2. You bend down or lift something up? (<i>Anda membengkokkan badan atau mengangkat sesuatu barang?</i>)	0.530	3.02	12.872	0.349	0.417	0.808
3. You walk quickly, jog or exercise? (<i>Anda berjalan dengan cepat, berjoging atau bersenam?</i>)	0.530	3.04	12.471	0.528	0.531	0.784
4. You are undressing to use the toilet? (<i>Anda membuka pakaian untuk ke tandas?</i>)	0.864	2.72	10.039	0.655	0.490	0.745
5. You get such a strong and uncomfortable need to urinate that you leak urine before reaching the toilet? (<i>Anda berasa begitu terdesak sehingga anda terkencing sebelum sampai ke tandas?</i>)	0.864	2.70	9.684	0.680	0.681	0.737
6. You have to rush to the toilet because you get a sudden, strong need to urinate? (<i>Anda terges-gesa pergi ke tandas disebabkan rasa ingin terkencing yang datang secara tiba-tiba?</i>)	0.864	2.61	9.349	0.749	0.716	0.719

6. Conclusion

From the various validity and reliability tests, it appears that QUID could be a valid and reliable instrument for the diagnosis of UI in Malaysian women. Collectively, these measures indicated that the Malay language QUID could be a useful tool for further studies on the prevalence and diagnosis of SUI and UII among Malaysian women.

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Disclosure of Interests

All authors are collaborative researchers in this project.

Ethics Approval

Ministry of Health Malaysia Ethics Committee Approval dated 1st June 2011 was obtained (Project no. NMRR-11-149-8830). Monash University Human Research Ethics Committee Certificate of Approval was obtained from 16th August 2011-16th August 2016 (Project no. CF10/1725-2010000963).

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