Development and Construct Validation of the Korean Competence Scale (KCS)

Chang-Wan Han,1,2 Yuki Yajima,3 Eun-Joo Lee,4 Chun-Man Park,5 Makiko Meguro,6 Kazuo Nakajima7 and Masahiro Kohzuki1

1Department of Internal Medicine and Rehabilitation Science, Tohoku University Graduate School of Medicine, Sendai 980-8574,
2School of Health and Welfare, Woosong University, Deajoen, Korea,
3Social and Environmental Sciences, Graduate School of Medicine and Dentistry, Okayama University, Okayama 700-8530,
4Division of Neuropsychology, Department of Disability Medicine, Tohoku University Graduate School of Medicine, Sendai 980-8574,
5Department of Public Health, Graduate School of Natural Science, Keimyung University, Korea,
6Division of Physiological Medicine, St. George’s Hospital Medical School, Cranmer Terrace, London, UK, and
7Department of Welfare System and Health Science (Health and Welfare Science), Okayama Prefectural University, Soja 719-1197

Han, C.-W., Yajima, Y., Lee, E.-J., Park, C.-M., Meguro, M., Nakajima, K. and Kohzuki, M. Development and Construct Validation of the Korean Competence Scale (KCS). Tohoku J. Exp. Med., 2004, 203 (4), 331-337 — A comprehensive Korean competence scale (KCS) designed for Korean older adults, was developed and its construct validity evaluated. KCS assesses their higher levels of functional competence than activities of daily livings (ADL), necessary for independence in the home and community. The internal structure of the scale was tested using an exploratory and confirmatory factor analysis with two elderly Korean sample groups. As expected, the exploratory factor analysis result demonstrated a three-factor solution comprised of the following three domains: instrumental self-maintenance, intellectual activity, and social role. The confirmatory factor analysis results showed that an acceptable solution could be estimated for a second-order factor model comprised of these factors. These findings provide evidence for the construct validity of the instrument and have implications for future research on factorial invariance. ——— Korean competence scale; construct validity; factor analysis; older community resident
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Functional competence has been widely used as a main rehabilitation outcome to measure the degree of independence in the home and community. Until now, many researchers have developed measures for assessing the functional competence in the elderly population, but mostly they were designed to evaluate only a part of the functional independence, namely the activities of daily living (ADL) and/or the instrumental ADL (IADL) (Wang et al. 2002). The ADL scales generally cover basic activities such as feeding, bathing, and toilet use (Katz et al. 1963; Mahoney and Barthel 1965; Schoening et al. 1965), whereas the IADL scales include more complex activities such as housework, money management, shopping and so on (Lawton and Brody 1969; Holbrook and Skilbeck 1983; Fillenbaum 1985).

In recent years, activities like effectance, corresponding to intellectual activity and social role (Lawton 1972), more complex than ADL and/or IADL, have attracted increasing attention. Independent living in a community requires skills to manage these complex activities such as recreation, hobbies, and social interaction as well as basic ADL and IADL. In Japan, the Tokyo Metropolitan Institute of Gerontology developed a comprehensive competence scale (called the TMIG competence index) for measuring instrumental self-maintenance (corresponding to IADL), intellectual activity and social role. Internal consistency, construct validity, and cross validity of the scale have already been examined using a sample of Japanese community-based older adults (Koyano et al. 1987, 1991; Koyano and Shibata 1992). The TMIG competence index measures high level competence, which usually deteriorates before ADL. Therefore, it is useful to detect early onset of disability and dementia among community-based older residents, as well as providing useful tool for medical, social and psychological studies. In Korea, however, a comprehensive competence scale like the TMIG competence index does not exist, although some studies have reported the ADL and IADL in community-based samples (e.g., Lee and Lee 1997).

In addition, the TMIG competence index seems to be unsuitable for Korean older adults because of social and cultural differences. Prominently high percentages of illiteracy among the Korean elderly may underestimate their level of intellectual activities despite their higher functional independence. The purpose of this study was therefore to develop a comprehensive competence scale applicable for Korean older adults (called the Korean competence scale [KCS]) based on the TMIG competence index, and to evaluate its construct validity.

**Methods**

**Subject**

The study subjects were older community residents living in the Song-ju area and Seoul, Korea. In the Song-ju area, the survey was conducted by health advisors in March 2001.

Out of 1964 people aged 65 years and over in the city, 1933 older adults were enrolled in the survey (response rate=98.3%). The survey contents included demographic information (sex, age) and information concerning competence. In order to develop the KCS, we prepared eight items selected from the TMIG competence index and translated into Korean using back translation technique. First, the fourth author translated from Japanese to Korean. Another person, the first author who has familiarity with both Korean and Japanese, translated back into Japanese. After some discrepancies found in the back translation process were modified, a pilot survey was conducted with a small sample of older adults. Based on the results and discussions, the final version was obtained. The response to each item was “yes” (able to do) or “no” (unable to do), and “yes” was scored 1 and “no” 0. Finally, 1303 subjects who completed all the survey questionnaire items or whose family members responded in their stead were used for our statistical analysis (called “Song-ju sample”).

The second interview survey was conducted in 15 health care facilities for the elderly in Seoul by 20 social workers, from December 2001 to
February 2002. Out of 580 users of those facilities aged 65 years or more, 580 enrolled in the survey. The content of the questionnaire was the same as that used in the Song-ju survey (response rate=100%). The respondents lacking information on any item were excluded, and 565 respondents who completed all the questionnaire items were finally used for our statistical analysis (called the “Seoul sample”).

The study protocol was approved by the institutional committee and all subjects gave informed consent.

Analytic strategies

For statistical analysis, the 1868 subjects of both the “Song-ju sample” and “Seoul sample” were randomized with 50% probability into two samples: the exploratory sample (n=958) and the confirmatory sample (n=910).

In order to examine the factor structure of the KCS, we performed an exploratory factor analysis (EFA) using the exploratory sample. Because the KCS has eight binary items, we estimated a factor solution using the M-plus program’s weighted least squares parameter estimates and a diagonal weight matrix with robust standard errors and mean- and variance-adjusted chi-square test statistic (WLMSV) (Muthén and Muthén 1998). The number of factors retained was determined according to the theoretical hypothesis, the size of eigenvalues and ease of interpreting the factor solution with an oblique rotation (PROMAX).

Moreover, we conducted a confirmatory factor analysis (CFA) to establish the factor structure demonstrated by the EFA result. In the analysis, we hypothesized and tested a second-order factor model comprised of the factors obtained from the above EFA results as first-order factors, and “Competence” as a second-order factor using the confirmatory sample. The parameters were estimated using the WLMSMV estimator. The model fitness to the data was evaluated by several fit indices: chi-square per degree of freedom ($\chi^2$/df), comparative fit index (CFI), Tucker-Lewis index (TLI) and root mean square error of approximation (RMSEA). Generally, the fit indices can be judged as an acceptable fit to the data with the following values: $\chi^2$/df <2 or 3, CFI >0.95, TLI >0.95, RMSEA <0.06, and SRMR <0.08. Significance tests for the parameter estimates (path coefficients) were conducted with the values of non-standardized coefficients divided by standardized error (corresponding to $t$-values). If a $t$-value over 1.96 is shown, the path can be judged as statistically significant ($p$<0.05).

RESULTS

Study subjects

The exploratory sample consisted of 417 males (43.5%) and 541 females (56.5%). While the mean age of the sample was 72.2 years (s.d.=5.90, range 65-96), that of the males was 72.0 (s.d.=5.32), and that of the females was 72.4 (s.d.=6.30). According to the age brackets (cut off = 75 years old), there were 672 “younger-old” subjects (70.1%) and 286 “older-old” subjects (29.9%).

The confirmatory sample consisted of 370 males (40.7%) and 540 females (59.3%). The mean age of the sample was 72.3 years (s.d.=6.06, range 65-99). By the sex brackets, the mean age of the males was 72.3 (s.d.=5.42), and that of the females was 72.8 (s.d.=6.47). No significant difference in the mean age between the males and females was found. According to the age brackets, there were 628 “younger-old” subjects (69.0%) and 282 “older-old” subjects (31.0%).

There were no significant differences between the above two samples in the distribution of the demographic characteristics.

Response distribution of the KCS items

Response distributions of the KCS items are shown in Table 1. Over 70% of the two samples responded “yes” to all KCS items except for item 4. Especially, the highest frequency of the “yes” was found in item 2, “I can buy daily necessities” (exploratory sample: 80.1%, confirmatory sample: 79.6%), whereas the lowest frequency was found in the item 4, “I read newspapers or books” (ex-
Development and Construct Validation of the KCS

Exploratory factor analysis

Table 2 presents the factor pattern matrix from the EFA using the oblique solution (PROMAX solution). The EFA indicated that, among the one- to three-factor solutions, the three-factor solution accounting for 59.1% of the variance was the most interpretable. In the solution, three items indicated greater than 0.4 factor loadings on the first factor: items 1, 2, and 3. Because all of these items reflect the ability to perform IADL, the first factor was interpreted as the “Instrumental self-maintenance” factor.

The items that indicated greater than 0.4 factor loading on the second factor were items 6, 7, and 8. Therefore, the second factor was interpreted as the “Social role” factor.

The two items that indicated greater than 0.4 factor-loading on the third factor were items 4 and 5. We interpreted the third factor as the “Intellectual activity” factor. In the above results, the KCS items had a simple factor structure.

The factor correlation matrix is also presented on the bottom of Table 2. There was a high correlation ($r=0.585$) between the first and the second factor, whereas there were weak correlations between the first and the third factor ($r=0.160$), and between the second and third factor ($r=0.189$).

Confirmatory factor analysis

We hypothesized and tested the KCS second-order factor model comprised of the above three factors, “Instrumental self-maintenance,” “Intellectual activity” and “Social role” using a confirmatory factor analysis. As a result, the second-order factor model (Fig. 1) yielded an adequate fit to the data: $\chi^2/df = 1.264$, CFI = 0.999, TLI = 0.999, RMSEA = 0.017, SRMR = 0.026. All standardized path coefficients in the model were moderate to high (0.640 to 0.989) and the $t$-values of the path coefficients in the model were acceptable at the $p=0.05$ level.

DISCUSSION

The main purpose of this study was to develop the KCS, and to test its construct validity across two Korean samples using EFA and CFA. The authors believe that the study results would provide a useful measurement to assess the effectiveness of community health and welfare services for older adults living in the community.

In developing the KCS, we used data obtained from two different areas: the “Song-ju sample” and the “Seoul sample.” We randomly divided the data ($n=1868$) into two groups with

<table>
<thead>
<tr>
<th>Item</th>
<th>Exploratory sample</th>
<th>Confirmatory sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>X1 I can ride a bus or subway</td>
<td>20.5 79.5</td>
<td>21.0 79.0</td>
</tr>
<tr>
<td>X2 I can buy daily necessities alone</td>
<td>19.9 80.1</td>
<td>20.4 79.6</td>
</tr>
<tr>
<td>X3 I can make a meal by myself</td>
<td>20.0 80.0</td>
<td>21.3 78.8</td>
</tr>
<tr>
<td>X4 I read newspapers or books</td>
<td>71.9 28.1</td>
<td>72.2 27.8</td>
</tr>
<tr>
<td>X5 I am interested in health information</td>
<td>24.0 76.0</td>
<td>23.6 76.4</td>
</tr>
<tr>
<td>X6 I can visit my friends</td>
<td>25.1 74.9</td>
<td>27.8 72.2</td>
</tr>
<tr>
<td>X7 I can advise my family or friends</td>
<td>26.9 73.1</td>
<td>25.3 74.7</td>
</tr>
<tr>
<td>X8 I can initiate conversation with young people</td>
<td>20.4 79.6</td>
<td>21.8 78.2</td>
</tr>
</tbody>
</table>


Response distributions of the KCS items (presented as percentages)
### Table 2. Three factor solution to exploratory factor analysis of the Korean Competence Scale item (n=958)

<table>
<thead>
<tr>
<th>Item</th>
<th>1: Instrumental self-maintenance</th>
<th>2: Social role</th>
<th>3: Intellectual activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>X1 I can ride a bus or subway</td>
<td>0.823</td>
<td>-0.056</td>
<td>0.446</td>
</tr>
<tr>
<td>X2 I can buy daily necessities alone</td>
<td>0.818</td>
<td>0.066</td>
<td>0.328</td>
</tr>
<tr>
<td>X3 I can make a meal by myself</td>
<td>0.710</td>
<td>0.076</td>
<td>0.035</td>
</tr>
<tr>
<td>X4 I read newspapers or books</td>
<td>0.316</td>
<td>-0.047</td>
<td>0.548</td>
</tr>
<tr>
<td>X5 I am interested in health information</td>
<td>0.000</td>
<td>0.324</td>
<td>0.447</td>
</tr>
<tr>
<td>X6 I can visit my friends</td>
<td>0.288</td>
<td>0.613</td>
<td>-0.094</td>
</tr>
<tr>
<td>X7 I can advise my family or friends</td>
<td>-0.132</td>
<td>0.975</td>
<td>0.26</td>
</tr>
<tr>
<td>X8 I can initiate conversation with young people</td>
<td>0.141</td>
<td>0.582</td>
<td>0.039</td>
</tr>
</tbody>
</table>

Factor correlation matrix

<table>
<thead>
<tr>
<th>Instruments</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instrumental Self-maintenance</td>
<td>1.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Social role</td>
<td>0.585</td>
<td>1.000</td>
<td></td>
</tr>
<tr>
<td>Intellectual activity</td>
<td>0.160</td>
<td>0.189</td>
<td>1.000</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Eigenvalue</th>
<th>Variance (%)</th>
<th>Cumulative variance (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.416</td>
<td>25.8</td>
<td>29.1</td>
</tr>
<tr>
<td>1.046</td>
<td>22.3</td>
<td></td>
</tr>
<tr>
<td>0.892</td>
<td>11.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>25.8</td>
<td></td>
</tr>
</tbody>
</table>

![Fig. 1. Measurement model of the Korean competence scale (Standardized WLSMV solution)](image)

$\chi^2=16.432$, df=13, $\chi^2$/df=1.264, CFI=0.999, TLI=0.999, RMSEA=0.017, SRMR=0.026.
50% probability and conducted an EFA using one group (exploratory sample) and a CFA using the other group (confirmatory sample). This procedure suggested by Jöreskog and colleagues (Jöreskog and Lawley 1968; Jöreskog 1971) provided substantial evidence for the reliability of the EFA results.

It should be noted that most of the exploratory and confirmatory samples appeared independent of the KCS items except for item 4. The results supported our expectations and previous ADL and IADL studies (Lee and Lee 1997). For example, Lee and colleagues (1997) reported that, in a rural area, about 90% of the community-based older samples were completely independent in ADL and about 70% independent in IADL. Therefore, the existing ADL scales were difficult to apply to the community-based older residents, because the scales are likely to exhibit ceiling effects, which have scores at or near the highest possible value.

For the above reason, we tried to develop a scale for assessing the ability to perform more difficult activities than ADL. The KCS consisted of three domains: “Instrumental self-maintenance,” “Intellectual activity” and “Social role,” according to the TMIG competence index. The instrumental self-maintenance refers to the ability to perform more complex activities such as using public transportation, shopping and preparing meals which are less directly body-oriented than ADL; the intellectual activity refers to the ability to interact and to explore various psycho-social environments; and the social role refers to the ability to fulfill social responsibilities as taking part as a member of a social group.

In order to establish the construct validity of the KCS, we conducted EFA and CFA. The EFA result yielded a three-factor solution: “Instrumental self-maintenance,” “Intellectual activity,” and “Social role,” which is consistent with our theoretical hypothesis. In addition, the weak and moderate correlations among these factors (0.160 to 0.585) imply that the KCS has a second-order factor structure comprised of three factors as first-order factors, and “Competence” as a second-order factor. However, it is well known that the researcher’s bias is likely to influence the determination of the number of factors and the interpretation of the obtained factors (Fabrigar et al. 1999).

In order to obtain further evidence on the KCS factor structure, the authors conducted a CFA. A CFA has several important advantages over EFA and enables researchers to test the measurement model of the factors underlying a set of questions using multiple fit indices (Bryant et al. 1999; John and Benet-Martínez 2000; MacCallum and Austin 2000). We tested the KCS second-order factor model comprised of three factors obtained from the EFA results. This factor model is theoretically adequate, because the latent ability on competence is considered a uni-dimensional but hierarchical construct with some sub-domains. The CFA showed that the hypothesized three-factor second-order factor model fit the data. In addition, all path coefficients in the model were weak and moderate. These results provide evidence for the construct validity and uni-dimensionality of the KCS and allow researchers to sum the instrumental self-maintenance items, the intellectual activity items, and the social role items, and to create the KCS total score. Therefore, researchers can use the KCS total score and/or the sub-scores depending on their interest. The total score may provide a general description of level of the functional competence and enable early intervention by enhancing community genetic screening for functional disabilities. On the other hand, the sub-score may contribute to practitioners and researchers with more detailed information on the functional competence and also the pattern of functional dependence in individual cases or study populations.

In summary, the authors examined the construct validity of the KCS with samples from two different communities using an EFA and a CFA. Given that most of the activities in which older adults engage are social, Korean competence scale including social roles could be expected
to provide useful information for depicting their high level competence. For further improvement of the KCS, future researches focusing on other types of validities and reliabilities of the KCS and focusing on possible biases that occur due to social and cultural backgrounds (e.g., gender role and social norm) are required.

References