

Validation of the Korean Version of the Depression in Old Age Scale and Comparison with Other Depression Screening Questionnaires Used in Elderly Patients in Medical Settings

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Objective: The Depression in Old Age Scale (DIA-S) is a new screening tool for assessing depression in the elderly. The primary aims of this study were to describe the validation of the Korean version of the DIA-S (K-DIA-S) and to compare its validity with that of other depression screening questionnaires used in elderly outpatients in medical settings.

Methods: A total of 385 elderly outpatients completed the K-DIA-S and underwent the Mini International Neuropsychiatric Interview to diagnose depressive disorders. Other measures included the 15-item short form of the Geriatric Depression Scale (SGDS), the 9-item depression module of the Patient Health Questionnaire (PHQ-9), and the Montgomery-Asberg Depression Rating Scale (MADRS). Reliability and validity tests, an optimal cutoff point estimate, and receiver operating characteristic curve analysis were performed to investigate the diagnostic validity of the K-DIA-S. Areas under the curves (AUCs) for the K-DIA-S, SGDS, and PHQ-9 were compared statistically.

Results: The K-DIA-S showed good internal consistency and strong correlations with the SGDS ($r = 0.853$), PHQ-9 ($r = 0.739$), and MADRS ($r = 0.772$). The cut-off point of the K-DIA-S that can be recommended for screening depressive symptoms was a score of 4. For "any depressive disorder", the AUC (standard error) for the K-DIA-S was 0.896 (0.015), which was significantly larger than that for the PHQ-9 ($p = 0.033$).

Conclusion: The present findings suggest that the K-DIA-S has good psychometric properties and is a valid and reliable tool for assessing depressive symptoms in elderly populations and medically ill patients.

KEY WORDS: Depression in Old Age Scale (DIA-S); Korean; Elderly; Depressive disorder; Validation.

INTRODUCTION

Depressive disorders affect elderly people with cognitive impairments and disability, and worsen the outcomes

of many medical illnesses.^{1,2} Additionally, elderly patients need differentiated diagnosis and treatment strategies for depressive disorder.³ Thus, in elderly people, early detection and treatment of depressive symptoms is essential. Furthermore, screening in medical settings is important because depressive disorders are especially prevalent among the medically ill elderly.^{2,4,5}

To guarantee low costs, screening questionnaires for mood disorders should be entirely self-administered and selected based on several considerations, including ease of administration and interpretation, suitability for use by primary health professionals with various backgrounds and training, and the availability of adequate psychometric literature.⁶⁻⁸ In particular, screening question-

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naires must meet these requirements in medically ill elderly populations. Well-established international depression screening questionnaires for use in elderly populations that meet these requirements include the Geriatric Depression Scale (GDS), the Patient Health Questionnaire (PHQ), and the depression module of the Hospital Anxiety and Depression Scale (HADS-D). The GDS,^{9,10} the first depression scale developed especially for the elderly, and the 15-item short form of the GDS (SGDS)^{11,12} are the most frequently used depression screening questionnaires in the elderly. However, as the GDS was originally developed for community-dwelling elderly populations, it has not gained popularity in primary health-care or other medical settings, and may assess “general distress” in addition to depressive symptoms.¹¹⁻¹³ On the other hand, the PHQ^{14,15} and the HADS-D¹⁶ were designed for use in primary care centers. However, many clinicians have reported serious limitations when applying the PHQ or the HADS-D to the Korean elderly, more than 60% of whom are illiterate and require that the interviewer read the question items, because of difficulties experienced responding to the four degrees of symptom severity rather than a simple “yes/no” alternative.¹⁷

The Depression in Old Age Scale (DIA-S) is a new self-rated scale for screening depression in older-aged adults.¹⁸ It was developed by Heidenblut and Zank based on the diagnostic criteria for depressive disorders described in the International Classification of Diseases (ICD-10)¹⁹ and the Diagnostic and Statistical Manual of Mental Disorders, fourth edition (DSM-IV).²⁰ The DIA-S was designed to be brief and easy to apply. This scale includes 10 items related to depressive symptoms. As the items are unambiguous and clearly phrased, requiring simply a “yes” or “no” response, the DIA-S is suitable for verbal administration and is easy to understand and respond to. Furthermore, the DIA-S purposely contains no items pertaining to common somatic concerns among the medically ill elderly (i.e., disturbances in energy level, appetite, and sleep), because such items have poor discriminatory power. In the first previous validation study, the DIA-S proved to be a good alternative to the SGDS and can also be used with elderly patients in poor general condition.^{18,21}

The objectives of this study were to establish the reliability and validity of the Korean version of the DIA-S (K-DIA-S) and to compare the diagnostic accuracy of the

K-DIA-S, SGDS, and the 9-item depression module of PHQ (PHQ-9) for an elderly population in medical settings.

METHODS

Subjects

All subjects were consecutively registered elderly patients, aged ≥ 60 years, who visited the outpatient clinic of eight different university hospitals distributed among the territories of the Republic of Korea between September 1, 2016 and February 28, 2017. Those who could not complete the interviews and assessments (for various reasons such as severe physical disability, poor vision, and deafness) and/or scored < 15 on the Mini-Mental State Examination (MMSE)²² were excluded from the study. A total of 385 subjects who had agreed to participate were included. All subjects provided informed consent after the study procedure had been fully explained to them. The Institutional Review Board of the Ethical Committee of Jeju National University Hospital, Republic of Korea, approved the study protocol (JEJUNUH 2016-10-025).

Measures and Procedures

A two-stage interview was performed with each subject: during the first stage, the K-DIA-S was administered by a trained interviewer. The other depression screening questionnaires, including the SGDS and the PHQ-9, were selected to assess the validity with the K-DIA-S. The interviewers read out the questions to, and recorded the answers of, patients who were illiterate and/or physically handicapped. In the second stage of the interview, all subjects were administered the Korean version of the Mini International Neuropsychiatric Interview (MINI)^{23,24} to diagnose depressive disorders. Major depressive disorder was diagnosed according to the DSM-IV criteria.²⁰ Minor depressive disorder was defined as the presence of two to four depressive symptoms (with one of them being either depressed mood or loss of interest or pleasure) during a 2-week period according to the research criteria proposed in DSM-IV Appendix B. For the analysis, subjects were assigned to a diagnostic group (major depressive disorder) or to a broader group, “any depressive disorder”, including both major depressive disorder and minor depressive disorder in this study. In addition, all subjects were interviewed using the Montgomery-Asberg Depression Rating

Scale (MADRS).²⁵⁾ All investigators and interviewers involved in this study were clinical psychiatrists with more than 10 years of clinical experience of depressive disorders, and who had received formal training in the use of all of the rating scales. Each part of the study was conducted by an independent interviewer blinded to the results of the other interview.

The DIA-S consists of 10 short statements about depressive symptoms that are responded to according to a simple yes/no answer format. The scale ranges from 0 (no depressive symptoms) to 10 (maximum number of depressive symptoms). The original DIA-S has good internal consistency (Cronbach's $\alpha = 0.84$), as well as strong correlations with the diagnostic criterion ($r = 0.73$).^{18,21)} The English version of the DIA-S was translated into Korean by three psychiatrists, and then two other bilingual psychiatrists blindly performed the back-translation. A preliminary translation was modified until the back-translated version was comparable with the English version, such that the Korean version would be intelligible for elderly Koreans. Three of the study authors (YEJ, MDK, and WMB) reviewed the results before producing the final version of the questionnaire.

The SGDS is the most widely used self-rating scale for screening for depression in elderly patients. It is composed of 15 dichotomous depression items with total scores ranging from 0 to 15; higher scores indicate more severe depressive symptoms.^{11,12)} In other studies of the SGDS, sensitivity and specificity ranged from 79% to 100% and 67% to 80% respectively in primary care elderly.²⁶⁾ The SGDS was validated for use in Korean elderly, and a score of 8 was suggested as the optimal cutoff point to screen for depressive disorders.²⁷⁾

The PHQ-9 is a self-report tool for diagnosing depressive disorders according to the DSM-IV criteria. Respondents rate each item on a 4-point scale (0–3); total score ranges from 0 to 27 and higher scores indicate more severe depressive symptoms.^{14,15)} In diagnostic meta-analysis, the PHQ-9 has good diagnostic properties in medical settings (sensitivity 92% and specificity 80%).²⁸⁾ The Korean version of the PHQ-9 has been validated for use in elderly populations, and a score of 5 was suggested as the optimal cutoff point to screen for depressive disorders.²⁹⁾

The MADRS is a 10-item scale and is the most widely used instrument for clinically assessing the severity of depressive symptoms.²⁵⁾ The Korean version of the MADRS

has been confirmed to be valid and reliable.³⁰⁾

Statistical Analysis

The reliability of the K-DIA-S was indexed by its internal consistency using Cronbach's α -coefficient. Concurrent validity was determined using Pearson's correlation, to compute the strength and direction of the relationships between scores on the K-DIA-S and those on the other measures (SGDS, PHQ-9, and MADRS). MINI diagnoses of "major depressive disorder" and "any depressive disorder" constituted the criterion standard. Analyses were performed separately for these two groups. A K-DIA-S cutoff score was obtained using receiver operating characteristic (ROC) analysis. The ROC curves were interpreted in two ways according to the principles specified by Löwe *et al.*³¹⁾ First, to obtain an optimal trade-off between false-positives (i.e., cases erroneously diagnosed as depressive disorder) and false-negatives (i.e., undiagnosed cases of depressive disorder) in one step, cutoff scores with the maximum Youden Index (sensitivity + specificity – 1) were used. Second, following the principles of a two-stage procedure for screening depressive disorders, cutoff scores with sensitivity and specificity of $\geq 75\%$ were examined. In clinical settings, positive results are typically followed by a further diagnostic interview. Thus, in the first step of a two-stage screening approach, high sensitivity (i.e., missing as few patients as possible) is more important than high specificity. The area under the curve (AUC), positive predictive value (PPV), negative predictive value (NPV), positive likelihood ratio (LR+) and negative likelihood ratio (LR–)³²⁾ were measured for the suggested optimal and two-stage screening cutoff points for the K-DIA-S. As the AUCs provide a measure of the diagnostic accuracy of the scales, the AUCs for the K-DIA-S, SGDS, and PHQ-9 were compared statistically using a non-parametric approach.³³⁾ Statistical analyses were performed using the SPSS (ver. 19.0; IBM Corp., Armonk, NY, USA) and MedCalc (ver. 16.8; MedCalc Software, Ostend, Belgium) statistical packages. For all analyses, a two-tailed p value < 0.05 was considered significant.

RESULTS

Sample Characteristics

All relevant patient characteristics are presented in Table 1. Of the 385 subjects (aged 60–85 years; mean age

= 70.2 years, standard deviation [SD] = 6.0 years; female subjects = 60.0%), 174 (45.2%) were classified into the "any depressive disorder" group: 45 (11.7%) with major depressive disorder and 129 (33.5%) with minor depressive disorder.

Reliability and Validity

The internal consistency of the K-DIA-S was 0.790 ($p < 0.001$). The item-total correlations of each item on the K-DIA-S were statistically significant ($r = 0.308$ – 0.609 , $p < 0.001$) (Table 2). Based on these data, it would appear

that the K-DIA-S is internally consistent and has good content validity. To assess the concurrent validity of the K-DIA-S, total scores on the K-DIA-S were compared with those on the SGDS, PHQ-9, and MADRS. The results from the K-DIA-S correlated closely with those from the SGDS ($r = 0.853$, $p < 0.001$), PHQ-9 ($r = 0.739$, $p < 0.001$), and MADRS ($r = 0.772$, $p < 0.001$) (Table 3). The mean score on the K-DIA-S was 6.6 (SD = 2.1) in the group with any depressive disorder and 2.6 (SD = 2.1) in the nondepressed group ($p < 0.001$, Student's t test).

Table 1. Comparison of characteristics between the depressed and nondepressed groups

Characteristic	Total subject (n = 385)	Any depressive disorder	
		Yes (n = 174)	No (n = 211)
Sex			
Male	154 (40.0)	70 (40.2)	84 (39.8)
Female	231 (60.0)	104 (59.8)	127 (60.2)
Age group (yr)	70.2 ± 6.0	69.8 ± 6.8	70.5 ± 5.3
Marital status			
Married	193 (53.2)	90 (51.7)	103 (54.5)
Widowed/unmarried/divorced	170 (46.8)	84 (48.3)	86 (45.5)
Education			
Below 6 yr	170 (45.0)	98 (56.3)	72 (35.5)
6–12 yr	171 (45.2)	67 (38.5)	104 (51.0)
Above 12 yr	37 (9.8)	9 (5.2)	28 (13.7)
Family structure			
Living with family	251 (66.8)	111 (63.8)	140 (69.3)
Living alone	125 (33.2)	63 (36.2)	62 (30.7)
Self-reported SES			
High	22 (5.8)	6 (3.4)	16 (7.8)
Middle	274 (71.1)	103 (59.2)	171 (83.0)
Low	84 (22.1)	65 (37.4)	19 (9.2)
Mean score of MMSE	25.3 ± 3.2	25.3 ± 3.3	25.2 ± 3.1

Values are presented as number (%) or mean ± standard deviation. SES, socioeconomic status; MMSE, Mini-Mental State Examination.

Table 2. Internal consistency of the K-DIA-S

Item	Mean value if item deleted	Scale variance if item deleted	Corrected item-total correlation	Cronbach's α if item deleted
1. I am feeling down.	3.82	6.571	0.609	0.753
2. I worry that I might say or do the wrong thing.	3.90	6.760	0.520	0.764
3. I can relax easily.	3.93	7.284	0.308	0.790
4. My life seems to make little sense.	4.06	7.275	0.341	0.785
5. It's hard to motivate myself.	3.96	6.889	0.472	0.770
6. I'm worried about the future.	3.88	6.889	0.466	0.771
7. I can enjoy my life, even when things are sometimes more difficult.	4.03	6.833	0.516	0.765
8. Difficulties tend to overwhelm me.	4.02	6.929	0.471	0.770
9. I tend to brood a lot.	3.92	7.039	0.406	0.778
10. Basically I am content with my life.	4.00	6.857	0.495	0.768

K-DIA-S, Korean version of the Depression in Old Age Scale.

Accuracy in Detecting Any Depressive Disorder

ROC analysis was conducted to ascertain the cutoff point that provided the highest degree of sensitivity and specificity for the diagnosis of any depressive disorder. The AUC of the K-DIA-S was 0.896, and the standard error (SE) was 0.015 ($p < 0.001$, Fig. 1); this indicates that the K-DIA-S has a high degree of discriminatory power (95% confidence interval [CI], 0.86–0.93). The ROC curves indicated that the optimal cutoff point of the K-DIA-S for detecting any depressive disorder was ≥ 4 (sensitivity = 80.5%, specificity = 80.1%, PPV = 76.9%, NPV = 83.3%, LR+ = 4.04, LR- = 0.24), equal to the cutoff point suggested for two-stage screening process for any depressive disorder (Table 4). The AUCs (SE) of each diagnostic tool were calculated as follows: the K-DIA-S, 0.896 (0.015); the SGDS, 0.886 (0.016); and the PHQ-9, 0.860

(0.018). In pairwise comparisons, the AUC for the K-DIA-S was significantly larger than that for the PHQ-9 ($p = 0.033$). No significant difference was observed between the AUCs of the K-DIA-S and the SGDS ($p = 0.380$).

Accuracy in Detecting Major Depressive Disorder

The AUC of the K-DIA-S was 0.923, and the SE was 0.016 ($p < 0.001$, Fig. 1), indicating that the K-DIA-S provides a significantly high level of discrimination (95% CI, 0.89–0.95). The ROC curves indicate that the optimal cutoff point of the K-DIA-S for detecting major depressive disorder was ≥ 6 (sensitivity = 88.9%, specificity = 82.4%, PPV = 40.0%, NPV = 98.2%, LR+ = 5.04, LR- = 0.13). In contrast, the cutoff point suggested for the two-stage screening process for major depressive disorder was ≥ 5 (sensitivity = 91.9%, specificity = 75.0%, PPV = 32.5%, NPV = 98.5%, LR+ = 3.64, LR- = 0.12) (Table 4). To compare the diagnostic accuracy for major depressive disorder of the K-DIA-S with that of the other depression screening tools, the AUCs (SE) of each diagnostic tool were calculated as follows: the K-DIA-S, 0.923 (0.016); the SGDS, 0.915 (0.018); and the PHQ-9, 0.915 (0.016). Although the AUC of the K-DIA-S was slightly superior to those of the SGDS and the PHQ-9, statistical comparison of the AUCs showed that the difference among the three diagnostic tools was not significant.

Table 3. Correlations between scores on the K-DIA-S and other scales

	K-DIA-S	SGDS	PHQ-9	MADRS	MMSE
K-DIA-S	1.000	0.853*	0.739*	0.772*	-0.024
SGDS		1.000	0.766*	0.780*	-0.037
PHQ-9			1.000	0.792*	0.035
MADRS				1.000	0.018
MMSE					1.000

K-DIA-S, Korean version of the Depression in Old Age Scale; SGDS, short form of the Geriatric Depression Scale; PHQ-9, 9-item depression module of the Patient Health Questionnaire; MADRS, Montgomery-Asberg Depression Rating Scale; MMSE, Mini-Mental State Examination.

* $p < 0.001$ (two-tailed).

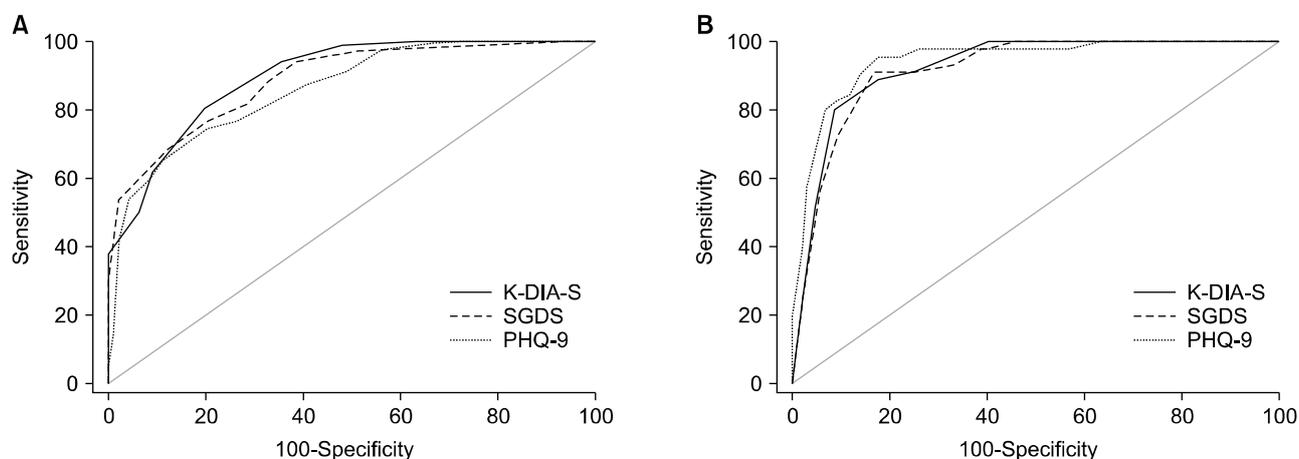


Fig. 1. Comparison between the receiver operating characteristic curves of the various depression screening questionnaires assessed in this study. (A) Any depressive disorder. (B) Major depressive disorder.

K-DIA-S, Korean version of the Depression in Old Age Scale; SGDS, short form of the Geriatric Depression Scale; PHQ-9, 9-item depression module of the Patient Health Questionnaire.

Table 4. Operating characteristics of the K-DIA-S

Scale and cutoff points	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	LR+	LR-	AUC (SE)
Any depressive disorder (n = 174)							0.896 (0.015)
≥ 3	94.3	64.5	68.6	93.2	2.65	0.09	
≥ 4* [†]	80.5	80.1	76.9	83.3	4.04	0.24	
≥ 5	61.5	91.0	84.9	74.1	6.83	0.42	
≥ 6	50.0	93.8	87.0	69.5	8.12	0.53	
Major depressive disorder (n = 45)							0.923 (0.016)
≥ 4	100.0	59.7	24.7	100.0	2.48	0.00	
≥ 5 [†]	91.1	75.0	32.5	98.5	3.64	0.12	
≥ 6*	88.9	82.4	40.0	98.2	5.04	0.13	
≥ 7	80.0	91.2	54.5	97.2	9.07	0.22	

K-DIA-S, Korean version of the Depression in Old Age Scale; PPV, positive predictive value; NPV, negative predictive value; LR+, positive likelihood ratio; LR-, negative likelihood ratio; AUC, area under the curve; SE, standard error.

*Optimal cutoff points according to maximal Youden Index (sensitivity + specificity - 1).

[†]Cutoff points recommended for a two-stage screening process (maximal sensitivity and specificity ≥ 75%).

DISCUSSION

The present findings suggest that the K-DIA-S has good psychometric properties and may be a reliable and valid tool for screening depressive symptoms in elderly patients in medical settings. Compared with the original DIA-S ($\alpha = 0.84$) and Persian version ($\alpha = 0.821$),³⁴ the K-DIA-S has a somewhat low internal consistency ($\alpha = 0.790$), but the internal consistency reliability, defined as the correlations of each item with the total K-DIA-S score and taking 0.30 as an acceptable corrected item-total correlation,³⁵ was adequate. The validity of the K-DIA-S was shown by the correlations of its scores with those of the SGDS, PHQ-9, and MADRS. The strong correlations of the K-DIA-S with the other scales indicate that the K-DIA-S accurately assesses depressive symptoms.

Our analysis of the K-DIA-S showed that a cutoff point of 4, for any depressive disorder in elderly patients in medical settings, was recommended according to both the maximum Youden Index and the two-stage screening approach (sensitivity 80.5% and specificity 80.1%). These results are consistent with previous reports.^{21,34} In contrast, the optimal cutoff point and the cutoff point suggested for a two-stage screening approach differed for detecting "major depressive disorder" (≥ 5 and ≥ 6 , respectively). In clinical settings, the cutoff point should be selected according to both the clinical purpose and accuracy of the instrument. Regarding instruments screening for depression, the optimal cutoff point will minimize false negatives (i.e., depressed persons falsely classified as

"probably not depressed"). Therefore, we suggest that a cutoff point of 5 be used for the K-DIA-S; this value has a sensitivity less than 90% and the least loss in specificity is appropriate for detecting "major depressive disorder".

In addition, the excellent AUC values for any depressive disorder and major depressive disorder demonstrate the validity of the K-DIA-S. However, compared to the diagnosis of major depressive disorder, the operating characteristics of the K-DIA-S for any depressive disorder were somewhat lower. This may reflect the greater difficulty in detecting minor depressive disorders compared with major depressive disorder. Statistical comparison of the AUCs between the K-DIA-S and the PHQ-9 for diagnosing any depressive disorder revealed a significant difference, with the AUC of the K-DIA-S being slightly superior to that of the SGDS (albeit not achieving significance at the 5% level). Thus, in terms of global diagnostic accuracy, as indexed by the AUC,³⁶ the K-DIA-S may be more suitable for identifying depressive disorders (including minor depressive disorder) in elderly patients in medical settings than the other depression screening scales assessed in this study.

We acknowledge several limitations of this study. First, our sample comprised elderly outpatients drawn from eight university hospitals; thus, our population may not have been representative of all elderly patients in medical settings. The second limitation was that no data were obtained on inter-rater and test-retest reliability. Finally, the subjects completed three self-rating scales (the K-DIA-S, SGDS, and PHQ-9) measuring depression within a single

questionnaire pack. Although the structure and content of the three scales differ, and other questionnaires were inserted between them within the pack, the order of presentation of the instruments, and the repetition engendered by their similar content, could have affected the results.

The DIA-S, which is a useful and novel diagnostic scale designed to improve the accuracy of depressive disorder diagnoses, was translated into a Korean version, the K-DIA-S, which appears to be a valid and reliable tool for screening for depression in the elderly in medical settings. The K-DIA-S proved to be a good alternative to the SGDS and the PHQ-9. However, further studies are needed to evaluate the K-DIA-S more fully. These studies should assess the applicability of the K-DIA-S to different populations and settings.

■ Conflicts of Interest

No potential conflict of interest relevant to this article was reported.

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