

**A Validity and Reliability Study of the Japanese Version of the Geriatric Depression Scale
15 (GDS-15-J)**

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ABSTRACT

Objective: The 15-item Geriatric Depression Scale (GDS-15) is one of the most widely used screening instruments for depression among the elderly. The aim of this study was to examine the validity and reliability of the Japanese version of the GDS-15 (GDS-15-J) in comparison with the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision (DSM-IV-TR) criteria for depression.

Methods: The study participants were 128 elderly outpatients (age range, 55–92 years) categorized into two groups (76 non-depressive patients, 52 depressive patients) based on the DSM-IV-TR criteria for depression.

Results: Logistic regression analysis showed that regardless of age and sex, the GDS-15-J score could be used to screen patients for depression ($p < 0.001$). The validity of the GDS-15-J for depression assessed against DSM-IV-TR criteria was excellent based on receiver operating characteristic analysis (optimal cutoff point: 6/7; sensitivity: 0.98; specificity: 0.86). The recommended optimal cutoff score when screening for depression is 6/7. To evaluate the constructive validity of the GDS-15-J, factor analysis was performed. Three factors were extracted. Cronbach's alpha reliability coefficient was 0.83 to the GDS-15-J scale, which indicated a high degree of internal consistency.

Conclusion: The GDS-15-J is a clinically applicable screening instrument for depression.

Key words: Geriatric Depression Scale; depression; validity; reliability; optimal cutoff point

INTRODUCTION

The 15-item Geriatric Depression Scale (GDS-15) (Sheikh & Yesavage, 1986) is one of the most widely used instruments for screening for depression in the elderly. The advantages of the GDS-15 over other depression scales are the ease and time-effectiveness of its administration. The GDS-15 is composed of 15 of the 30 items on the original GDS, which had the highest correlation with depressive symptoms in several validation studies (Brink, Yesavage, Lum, Heersema, Adey, & Rose, 1982; Yasavage, & Brink, 1983). For the GDS-15, all items were arranged in a one page, easy-to-understand yes/no format, similar to the GDS. Ten of the 15 items (Items 2–4, 6, 8–10, 12, 14 and 15) indicate the presence of depression when answered positively, while the remaining five items (Items 1, 5, 7, 11 and 13) indicate depression when answered negatively.

The number of patients around the world with Alzheimer's disease (AD) has been steadily increasing, as have the number of clinical trials for new AD drugs. The GDS-15 is useful for discriminating patients with AD from those with depression, and is therefore frequently used in clinical trials for AD drugs. However, due to the increasing number of Japanese patients with AD, a standardized Japanese version of the GDS-15 is required.

Although several Japanese versions of the GDS-15 have been developed, they have not been sufficiently translated and are not well adapted to Japanese culture. Translation errors in one of the Japanese versions (Niino, Imaizumi, & Kawakami, 1991) will be described in greater details in the Methods section.

However, a new Japanese version of the GDS-15 (hereafter GDS-15-J), which was translated by two of the authors (M.S. & T.A.) in 2008, is sufficiently translated and adapted to Japanese culture (Sugishita & Asada, 2009). The translation errors in the previous Japanese version of the GDS-15 were corrected in the GDS-15-J. However, the validity of the GDS-15-J for depression (major depressive and dysthymic disorder) in comparison with the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision (DSM-IV-TR) (American Psychiatric Association, 2000), has yet to be established. In addition, both the internal consistency and the constructive validity of the GDS-15-J need to be evaluated using factor analysis. Cronbach's alpha reliability for the **GDS-15-J** also needs to be evaluated.

Therefore, the aim of the present study was to evaluate the validity and reliability of the GDS-15-J for the screening of depression in comparison with the DSM-IV-TR criteria.

METHODS

All items on the GDS-15-J were converted into Japanese and then back into English by two of the authors (M.S. & T.A., 2009). Because Japanese people tend to be relatively modest, the word “you” was removed from three items (Items 7, 11, and 15) to make the questions less direct. The GDS-15-J is presented orally in Japanese, which has a large number of homophones; therefore, to make the questions more easily understood, the use of homophones was limited. When an English item is translated into Japanese, it becomes longer, and the longer the item, the more difficult it is to understand. Therefore, the length of the Japanese item kept as short as possible. The length of the 15 Japanese items on the GDS-15-J range from 14 to 36 morae (a mora is a unit representing the length of a sound in Japanese, similar to a syllable in English).

Previous Japanese versions of the GDS-15 were not well translated. One Japanese version (Niino et al., 1991) that is frequently used in Japan contained numerous translation errors. “Basically” in the original Item 1 was not translated. The original Item 2 did not include “*saikin*” (“recently”), but this was added in the Japanese version. “Most of the time” in the original Item 7 was incorrectly translated into “*itsumo*” (“always”) in the Japanese version. “Most” in the original Item 10 and “most people” in the original Item 15 were incorrectly translated into “*tanohito*” (“other people”) in the Japanese version. Due to these translation errors, more negative answers were given for Items 1 and 7, and more positive answers were given for Items 10 and 15 on Niino et al.’s Japanese version compared with the original English version. Consequently, for individuals assessed using Niino et al.’s version of the GDS-15, these errors resulted in higher scores for the associated items. In addition, more negative answers were given for Item 2 on Niino et al.’s version, which resulted in lower scores compared with the original English version. All of these translation errors were corrected in the GDS-15-J.

All participants (age range, 55–92 years) were recruited from a psychiatric outpatient

clinic. All patients had at least 6 years of formal education and were considered to be cognitively normal based on an absence of significant impairment in cognitive function or activities of daily living. Patients with severe visual or hearing impairments, aphasia, chronic neurologic diseases such as Parkinson's disease, multi-infarct dementia, brain tumor, seizure disorder, subdural hematoma, or history of significant head trauma were excluded. Patients with a history of schizophrenia or alcohol or substance abuse or dependence were also excluded. The enrolled participants were divided into two groups (a depressive group and a non-depressive group) based on DSM-IV-TR criteria as assessed by one of the authors (K.S.). The patients diagnosed as having major depression or dysthymic disorder were allocated to the depressive group, and the other subjects were allocated to the non-depressive group. Written informed consent was obtained from all participants between May 2011 and March 2014. After providing consent, participants were required to answer questions in relation to their demographic characteristics, including age, sex, marital status, place of birth, years of schooling and employment status. The GDS-15-J was presented to all participants orally, and all participants provided answers orally. Separate subject interviews were conducted by one of the authors (K.S.) to assess the participants using the DSM-IV-TR criteria for depression (major depressive and dysthymic disorder).

Logistic regression analysis was performed to examine which variables were associated with a DSM-IV-TR diagnosis of depression. To evaluate the validity of the GDS-15-J, a receiver operating characteristic (ROC) curve was plotted for GDS-15-J scores and DSM-IV-TR diagnosis (major depressive disorder, dysthymic disorder, and normal). To evaluate the constructive validity of the GDS-15-J, factor analysis was performed using maximum likelihood estimation of item parameters and promax rotation of the coordinate axes. Cronbach's alpha was used to determine the internal consistency reliability of the GDS-15-J. This study was approved by the Ethics Board of Juntendo University.

RESULTS

Participants

A total of 128 elderly outpatients (48 men, 80 women; mean age \pm standard

deviation, 74.4 ± 8.3 years; age range, 55–92 years) were included in this study. Among the participants, 76 were categorized as non-depressive, and 52 were categorized as depressive. There were significantly more non-depressive than depressive outpatients ($p < 0.03$, binomial test). Among the depressive patients, 45 (86.5%) had major depressive disorder and seven (13.5%) had dysthymic disorder. No significant differences were observed in age between the depressive and non-depressive patients ($p = 0.34$, t-test) (Table 1). However, the mean age of the non-depressive male patients was significantly higher than that of the depressive male patients ($p = 0.03$, t-test); no such significant difference was seen in the female patients ($p = 0.91$, t-test).

[Table 1]

GDS-15-J scores

Mean GDS-15-J scores are shown in Table 2. The mean \pm SD GDS-15-J score for the entire sample was 6.72 ± 3.95 (range, 0–15; $N = 128$). The mean \pm SD GDS-15-J scores for the depressive and non-depressive patients were 10.52 ± 2.28 (range, 6–15; $N = 52$) and 4.12 ± 2.45 (range, 0–10; $N = 76$), respectively. The distribution of GDS-15-J scores in the depressive and non-depressive patients is shown in Figure 1. No significant differences were observed in mean scores between male and female depressive ($p = 0.79$, Wilcoxon rank sum test) or non-depressive patients ($p = 0.07$, Wilcoxon rank sum test). Among all participants, the mean score was significantly higher for depressive than for non-depressive patients ($p < 0.001$, Wilcoxon rank sum test).

[Table 2]

[Figure 1]

Validity

Logistic regression analysis

Logistic regression analysis was performed to examine the associations between study variables and the DSM-IV-TR diagnosis of depression using diagnosis as the dependent variable and GDS-15-J score, age, and sex as independent variables. The GDS-15-J score was a significant independent variable ($p < 0.001$), but age and sex were not ($p = 0.884$ and $p = 0.506$, respectively) (Table 3). These results suggest that regardless of age and sex, the GDS-15-J score can be used to screen for depression.

[Table 3]

ROC Analysis

The ROC curve plotted for GDS-15-J scores and DSM-IV-TR diagnosis is shown in Figure 2. The area under the ROC curve for the GDS-15-J scores was 0.960, which suggests that the GDS-15-J is useful for screening patients for depression. The sensitivity and specificity values of the GDS-15-J are shown in Table 4. The optimal cutoff point best fit to the GDS-15-J was 6/7, with a sensitivity of 0.981 and specificity of 0.855. The second best fit was 5/6, with a sensitivity of 1.000 and a specificity of 0.803.

[Figure 2]

[Table 4]

Factor Analysis

A maximum likelihood method and promax rotation were applied to the 15 items of the GDS-15-J. Model fitness was assessed to determine the number of factors. The three-factor model was the best from the viewpoint of model fitness because it gave the minimum Akaike information criterion (AIC) and was the smallest model not significantly different from the saturated model. The chi-square statistic of the three-factor model was 74.33 with 63 degrees of freedom ($p = 0.155$) (Table 5). Factor loading and the uniqueness of the three factors is shown in Table 6. Items with a factor loading of 0.35 or greater were considered to be contributing

factors. The three factors in the GDS-15-J accounted for 34.7% of the variability, which was a relatively low value.

Factor 1 included six GDS-15-J items {Item 1: Satisfied with life (reversed) (“reversed” indicates item was reverse scored); Item 3: Life is empty; Item 5: In good spirits (reversed); Item 7: Happy most of the time (reversed); Item 14: Situation is hopeless; and Item 15: Most people are better off than you}. This factor accounted for 12.8% of the total variance and was named “pessimistic mood”. Factor 2 included two items (Item 8: Often feel helpless; and Item 12: Feel worthless). This factor accounted for 12.2% of the total variance and was named “negative self-evaluation”. Factor 3 included three items {Item 4: Often bored; Item 11: Wonderful to be alive now (reversed); and Item 13: Feel full of energy (reversed)}. This factor accounted for 9.7% of the total variance and was named “loss of energy”.

Four items (Items 2, 6, 9 and 10) had small factor loadings for all three factors. Five items (Items 2, 6, 9, 10 and 15) had high uniqueness, at more than 0.70 (Table 6). The correlation coefficient between Factors 1 and 2 was 0.665, between Factors 1 and 3 was 0.619, and between Factors 2 and 3 was 0.587, which were all high values. Two of the three factors (Factors 1 and 2) had acceptable internal consistency, as evidenced by a high Cronbach’s alpha (Factor 1: 0.7145, Factor 3: 0.6475). Factor 2 consisted of two items, so Cronbach’s alpha could not be calculated.

[Table 5]

[Table 6]

Reliability

Cronbach’s alpha reliability coefficient for the GDS-15-J was 0.83, indicating a high degree of internal consistency. The item-total correlations were also significant ($p < 0.001$, t-test), and higher than 0.30 for all items except for Item 15.

[Table 7]

DISCUSSION

The GDS-15-J scores for the depressive patients were significantly higher than those of the non-depressive patients, suggesting that the GDS-15-J can validly discriminate between depressive and non-depressive patients. The results of logistic regression analysis showed that among the GDS-15-J score, age, and sex, only the GDS-15-J score was significantly related to the DSM-IV-TR diagnosis of depression. These results suggest that patients can be validly screened for depression using GDS-15-J scores, regardless of age and sex.

Based on the ROC curve, the optimal cutoff point of 6/7 for the GDS-15-J yielded high sensitivity (0.981) and specificity (0.855). Schreiner, Hayakawa, Morimoto, and Kakuma (2003) also reported the same optimal cutoff point with high sensitivity (0.973) and specificity (0.959) for another Japanese version (Niino et al., 1991) of the GDS-15. The sensitivities and specificities of both versions were excellent. Therefore, the appropriate GDS-15 cutoff score for elderly Japanese would be 6/7. Although the current translation of the GDS-15-J represents an improvement over that of Niino et al. (1991), the specificity of the present version was slightly lower than that of Schreiner et al. (2003). The primary reason for this was thought to be the low mean score in their control group using Niino et al.'s Japanese version of the GDS-15 (1.85 ± 1.89), while the mean \pm SD scores in the depressive group using Niino et al.'s Japanese version was 10.16 ± 2.63 . In contrast, the mean \pm SD GDS-15-J score in the present study was 4.12 ± 2.45 , and the mean \pm SD GDS-15-J score in the depressive group was 10.52 ± 2.28 . The mean score of the control group in the study by Schreiner et al. (2003) was significantly lower ($p < 0.01$, t-test) than that of the control group in the present study, while that of the depressive group in the study by Schreiner et al. (2003) was almost the same as that of the depressive group in the present study. A systematic review on the criterion validity of the GDS (Wacanta et al. 2006) reviewed 12 papers on the validity of the GDS-15 using the DSM diagnostic system. The mean score of the control group in the study by Schreiner et al. (2003) was lower than those of the control groups reviewed by Wacanta et al. (2006). This could be derived by sampling the control group. The control group is usually recruited from primary care clinics, outpatient clinics, or nursing homes (Wacanta et al. 2006). The

participants in the control group in the study by Schreiner et al. (2003) were recruited from community recreation centers, which is not typical. The participants in the control group in the present study were recruited from a psychiatric outpatient clinic, which is more standard. The mean \pm SD age of the control group in the study by Schreiner et al. (2006) was 59.9 ± 6.29 years, and that of the depressive group was 63.6 ± 12.83 years. In contrast, the mean \pm SD age of the control group in the present study was 75.5 ± 8.3 , while that of the depressive group was 72.9 ± 8.1 years. The mean age of the control group in the study by Schreiner et al. (2003) was significantly lower ($p < 0.01$, t-test) than that in the present study. This age effect could have contributed to the lower score of the control group in the study by Schreiner et al. (2003).

Wacanta et al. (2006) reported that the most frequent (in 7 of 20 studies) cutoff score for the original English version of the GDS-15 was 6/7, and the second most frequent was 5/6 (in 4 of 20 studies); these findings are consistent with the results of the two studies using the Japanese version of the GDS-15 (Schreiner et al., 2003 and the present study). In the present study, the 5/6 cutoff point was the second best fit, and the sensitivity (1.000) and the specificity (0.803) were excellent.

Three factors that accounted for 34.7% of the variability were extracted in the present study and labeled as follows: Factor 1, “pessimistic mood”; Factor 2, “negative self-evaluation”; and Factor 3, “loss of energy”. These factors are suitable for use in a depression scale. A previous meta-analysis (Kim, DeCoster, Huang, & Bryant, 2013) indicated that most of the studies applying factor analysis to investigate the original English version of the GDS-15 (Sheikh & Yasavage, 1986) extracted between two and four factors. Five studies applying factor analysis to investigate the Japanese version of the GDS-15 have been reported (Yatomi, 1994; Schreiner et al., 2001; Onishi, Umegaki, Suzuki, Uemura, Kuzuya, & Iguchi, 2004; Onishi, Suzuki, Umegaki, Endo, Kawamura, & Iguchi, 2006; Imai et al., 2014). All of these studies employed the Japanese translation by Niino et al. (1991). One of these studies (Schreiner et al., 2001) examined patients in the post-vascular phase and extracted two factors. That study reported that the factor structure of the post-stroke sample differed from that of non-stroke elderly. In the remaining four studies, which examined non-stroke subjects, the number of reported factors ranged from three to four. In the present study using the Japanese

version of the GDS-15 created by Sugishita and Asada (2009), three factors were extracted. Therefore, three studies (Yatomi, 1994; Imai et al., 2014; the present study) reported extracting three factors. Factor 1 had a similar loading structure in two of these three studies (Yatomi, 1994 and the present study). In Yatomi (1994), Items 2, 3, 4, 8, 14 and 15 loaded on Factor 1 (“depressed mood”), and in the present study, Items 1, 3, 7, 14, and 15 loaded on Factor 1 (“pessimistic mood”). The differences in the three studies regarding the factor loadings were likely due to the differences in sampling schemes and Japanese translations of the GDS-15.

To evaluate the reliability of the GDS-15-J, internal consistency was examined using Cronbach’s alpha coefficient. Cronbach’s alpha coefficient for the GDS-15-J was 0.83 (Table 7), indicating a high degree of internal consistency. Since the validity and reliability of the GDS-15-J are excellent, the GDS-15-J should be considered a clinically applicable screening instrument for depression.

The GDS-15 has two highly desirable features for the screening of depression in the elderly, namely, the ease and time-effectiveness of its administration. However, the strength of these two features could be improved if the number of items on the GDS-15-J were reduced. Factor analysis in the present study showed that the uniqueness of Items 2, 6, 9, 10 and 15 were higher than 0.70, the factor loadings of Items 2, 6, 9 and 10 were less than 0.35, and the item-total correlations of Item 15 were less than 0.30. These data suggest that Items 2, 6, 9, 10 and 15 are not appropriate for a depression scale. It will be necessary to examine in a future study whether the GDS-10-J, in which five items are excluded from the GDS-15-J, is more suitable for the screening of depression in the elderly.

Clinical Implications

The GDS-15-J is a clinically applicable screening instrument for depression. Since the GDS-15-J can adequately discriminate between patients with AD and those with depression, it is expected to be useful in both clinical practice and clinical trials for new AD drugs.

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[Appendix]

Appendix: The Geriatric Depression Scale-Short Form-Japanese (GDS-S-J) (Sugishita & Asada, 2009)

	はい	いいえ
1 あなたは、あなたの人生に、ほぼ満足していますか？	0	1
2 これまでやってきたことや、興味があったことの多くをやめてしまいましたか？	1	0
3 あなたは、あなたの人生は空しいと感じていますか？	1	0
4 しばしば、退屈になりますか？	1	0
5 あなたは、たいてい、機嫌がよいですか？	0	1
6 あなたに、何か悪いことが起ころうとしているのではないかと、心配ですか？	1	0
7 たいてい、幸せだと感じていますか？	0	1
8 あなたは、しばしば無力であると感じていますか？	1	0
9 外出して新しいことをするよりも、自宅にいるほうが良いと思いますか？	1	0
10 たいていの人よりも、記憶が低下していると思いますか？	1	0
11 現在、生きていることは、素晴らしいことだと思いますか？	0	1
12 あなたは、現在のありのままのあなたを、かなり価値がないと感じますか？	1	0
13 あなたは、元気一杯ですか？	0	1
14 あなたの状況は絶望的だと、思いますか？	1	0
15 たいていの方は、あなたより良い暮らしをしていると思いますか？	1	0

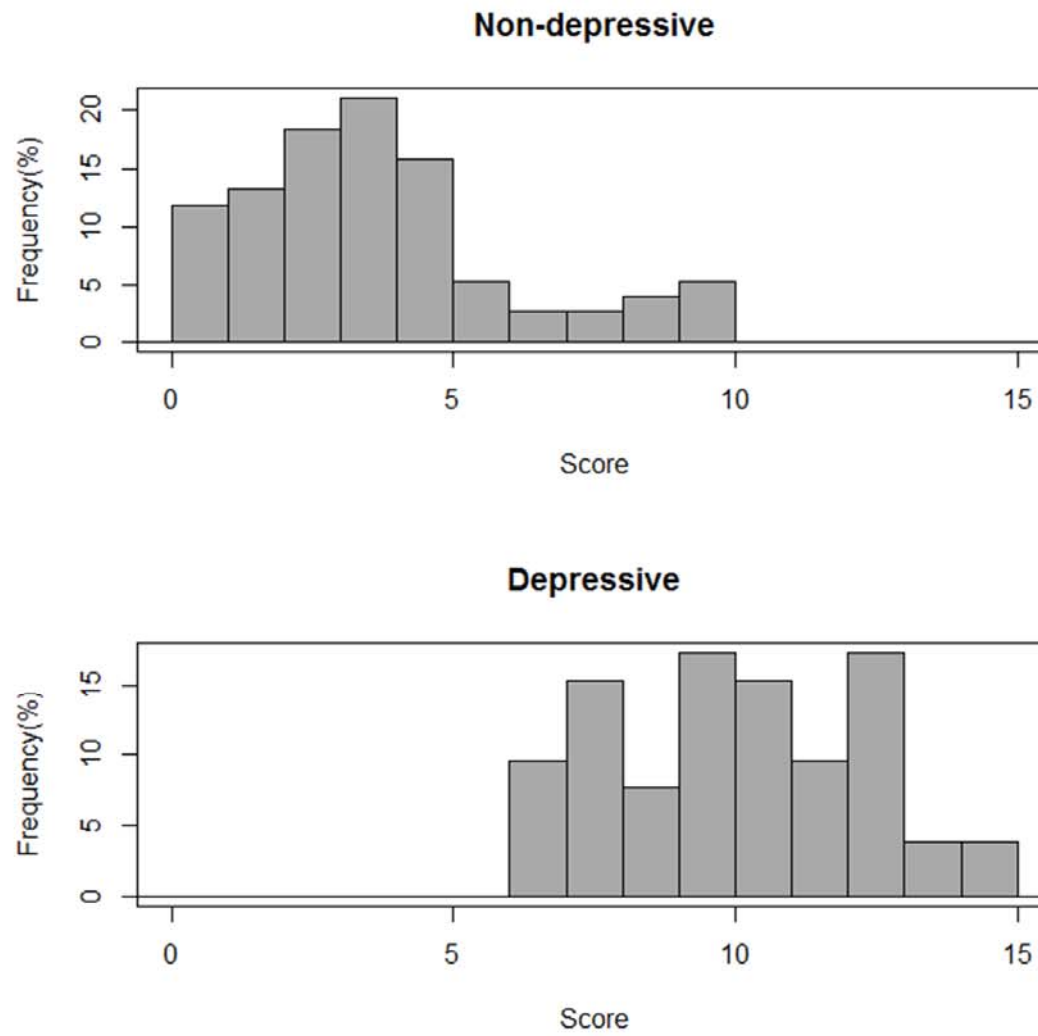
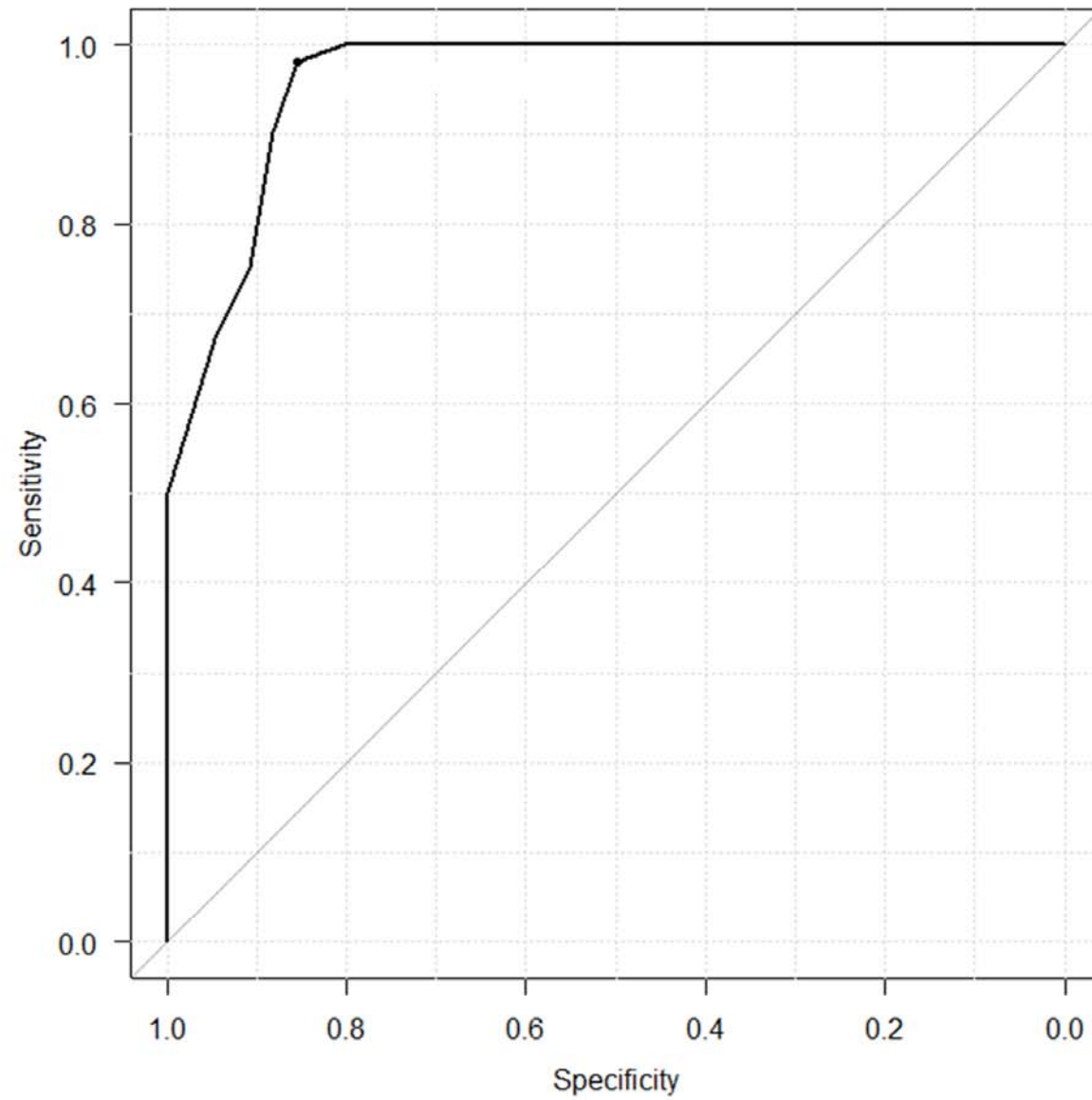


Figure 1. Distribution of GDS-15-J scores in the depressive and non-depressive patients



The area under the ROC curve was 0.960.

Figure 2. ROC curve plotted for GDC-15-J scores and DSM-IV-TR diagnosis

Table 1. Mean age of the depressive and non-depressive patients

All participants						
	Mean	SD	Minimum	Median	Maximum	N
Non-depressive	75.5	8.3	55	77.5	92	76
Depressive	72.9	8.1	55	72.0	87	52
Total	74.4	8.3	55	75.5	92	128

Males						
	Mean	SD	Minimum	Median	Maximum	N
Non-depressive	73.6	8.5	58	75.5	92	30
Depressive	73.3	8.4	59	71.5	87	18
Total	73.5	8.4	58	75.0	92	48

Females						
	Mean	SD	Minimum	Median	Maximum	N
Non-depressive	76.7	8.0	55	78	90	46
Depressive	72.7	8.0	55	72	85	34
Total	75.0	8.2	55	77	90	80

SD: Standard deviation.

Table 2. GDS-15-J scores for the depressive and non-depressive patients

All participants							
	Mean	SD	0%	25%	50%	75%	100%
Non-depressive	4.12	2.45	0.00	2.75	4.00	5.00	10.00
Depressive	10.52	2.28	6.00	8.75	10.50	12.25	15.00
Total	6.72	3.95	0.00	-	-	-	15.00

Non-depressive patients							
	Mean	SD	0%	25%	50%	75%	100%
Male	3.47	2.05	0.00	2.00	4.00	4.00	10.00
Female	4.54	2.62	0.00	3.00	4.00	6.00	10.00

Depressive patients							
	Mean	SD	0%	25%	50%	75%	100%
Male	10.61	2.20	6.00	10.00	10.00	12.75	14.00
Female	10.47	2.35	7.00	8.25	11.00	12.00	15.00

SD: standard deviation.

Table 3. Results of logistic regression analysis of GDS-15-J scores

	Regression coefficient	Standard error	Probability
(Intercept)	-6.265	3.193	0.050
GDS-15-J score	0.904	0.157	<0.001
Age	-0.006	0.039	0.884
Sex (male)	-0.493	0.741	0.506

Table 4. Sensitivity and specificity of the GDS-15-J

Cutoff point	Non-depressive	Non-depressive	Depressive	Depressive	Sensitivity	Specificity
	Negative	Positive	Negative	Positive		
5/6	61	15	0	52	1.000	0.803
6/7	65	11	1	51	0.981	0.855
7/8	67	9	5	47	0.904	0.882
8/9	69	7	13	39	0.750	0.908
9/10	72	4	17	35	0.673	0.947
10/11	76	0	26	26	0.500	1.000

Table 5. Parameter estimates of the factor analysis model

Model	Degrees of freedom	Chi-square	P value	Upper model	Saturated model	Akaike information criterion
One factor	90	135.23	0.001	34.83 (p=0.0016)	136.35 (p=0.001)	173.65
Two factors	76	100.40	0.032	26.07 (p=0.0166)	101.24 (p=0.028)	165.25
Three factors	63	74.33	0.155	20.26 (p=0.062)	74.96 (p=0.144)	163.85
Four factors	51	54.07	0.358	15.33 (p=0.1679)	54.52 (p=0.342)	166.40

Table 6. Factor loadings and uniqueness of the GDS-15-J

Item	Factor 1	Factor 2	Factor 3	Uniqueness
1 Satisfied with life (reversed*)	0.742	-0.153	-0.027	0.595
2 Dropped activities	0.123	0.106	0.156	0.889
3 Life is empty	0.426	0.181	0.001	0.683
4 Often bored	-0.183	0.028	0.631	0.688
5 In good spirits (reversed*)	0.575	-0.292	0.290	0.633
6 Afraid something bad will happen	0.111	0.229	0.229	0.754
7 Happy most of the time (reversed*)	0.654	-0.040	0.055	0.562
8 Often feel helpless	-0.133	0.799	0.042	0.448
9 Prefer to stay at home	0.105	0.150	0.316	0.748
10 Problems with memory	0.102	0.242	0.078	0.859
11 Wonderful to be alive now (reversed*)	0.091	0.157	0.518	0.523
12 Feel worthless	-0.101	0.863	-0.014	0.375
13 Feel full of energy (reversed*)	0.101	-0.097	0.688	0.522
14 Situation is hopeless	0.369	0.339	-0.101	0.659
15 Most people are better off than you	0.410	0.116	-0.185	0.837
Sums of squared loadings	1.923	1.834	1.457	-
Proportion variance	0.128	0.122	0.097	-
Cumulative variance	0.128	0.250	0.347	-

Note: Items marked with “reversed*” indicates reverse scoring.

Table 7. Cronbach's alpha and item-total correlations

Item	Cronbach's alpha	Item-total correlation coefficient
1	0.8212	0.4293
2	0.8282	0.3203
3	0.8168	0.4972
4	0.8274	0.3343
5	0.8208	0.4351
6	0.8211	0.4315
7	0.8163	0.5104
8	0.8151	0.5220
9	0.8184	0.4721
10	0.8269	0.3376
11	0.8109	0.5867
12	0.8126	0.5597
13	0.8152	0.5226
14	0.8174	0.5047
15	0.8291	0.2991
