

## Problems in assessment of depression in Japanese community-dwelling elderly by CES-D(Center of Epidemiologic Studies Depression) scale

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### Abstract

This study aimed to determine the reliability and validity of items of the Japanese version of the CES-D (Center of Epidemiologic Studies Depression) scale when applied to independent community-dwelling Japanese elderly from the viewpoints of internal consistency and goodness-of-fit for the model. Subjects were 1791 community-dwelling independent elderly people aged 60 and over. This study used the Japanese version of the CES-D and GDS(Geriatric depression scale) scales. Principle component analysis was applied to the correlation matrix of 20 items of the CES-D scale to examine consistency of the scale. The indices of goodness-of-fit index (GFI) and the adjusted goodness-of-fit index (AGFI) were also calculated. Reliability of the CES-D scale was examined by Cronbach alpha coefficients and split-half reliability by the Spearman-Brown formula. Model fitting for the first-order factorial model of the Japanese version of the CES-D scale was good (GFI = 0.883, AGFI = 0.855), and the reliability as a psychological scale was also sufficient (Cronbach's alpha coefficient = 0.811 and split-half reliability = 0.823). A correlation coefficient between total scores of the GDS and the CES-D scale was moderate but significant ( $r = 0.653$ ,  $p < 0.01$ ). However, for four items of the CES-D scale, sufficient validity was not obtained in examining the internal consistency of the scale. A major problem as an assessment scale of depression was not recognized in the Japanese version of the CES-D scale, but the individual items should be re-examined in further studies.

**Key words** : adolescents, social skills, psychological skills, physical skills, sport experience

### 1. Introduction

Since 1980, the development of international diagnostic standards for various psychiatric diseases has been actively discussed in the United States, and diagnostic standards for depression have also been repeatedly revised. Previous studies have developed several depression scales, such as the SDS (Self-rating Depression Scale),<sup>15)</sup> the GDS (Geriatric Depression Scale),<sup>2)</sup> Hamilton's depression scale,<sup>3)</sup> and the CES-D

(Center of Epidemiologic Studies Depression) scale.<sup>9)</sup> The CES-D scale was developed by the National Institute of Mental Health (NIMH) to screen for symptoms of depression in an ordinary population. The items of the CES-D scale were selected in reference to the depression scales of the SDS and the BDI (Beck's depression inventory),<sup>1)</sup> and the validity as a psychological scale was also verified in clinical field trials. In Japan, Shima et al.<sup>12)</sup> translated the CES-D scale into Japanese, and this scale has been

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used in many applied studies.<sup>4-7), 11, 12)</sup>

The CES-D scale consists of 20 items, and assesses depression symptoms from the total score. This scale was originally developed as a self-report depression scale, but it is also used in an interview setting. The CES-D items are measured for frequency of various depression symptoms within a week using a 4-point Likert scale. Screening for depression symptoms is generally carried out using a cut-off value of 16 points of the total score.

In the process of developing a psychological scale, item selection, scaling and examination of model fitting are important procedures. In item selection, items showing a high relationship with a valid standard were selected from the viewpoint of internal consistency. Further, goodness-of-fit for the model has recently been statistically examined.

In the Japanese version of the CES-D scale, the internal consistency of each item has been examined but goodness-of-fit for the model has not been sufficiently examined. Although Shima<sup>11)</sup> and Radloff<sup>9)</sup> reported a multiple factor structure of the CES-D scale, sufficient examinations concerning to the validity and reliability of items consisting each subscale are necessary to determine the validity of these subscales. The CES-D scale is the only depression scale with subscales, and a more detail assessment of depression characteristics using these subscales is expected. In this sense, the validity and reliability of individual items of the CES-D scale should be reexamined for the Japanese version. These examinations determine some problems with the Japanese version of the CES-D scale. In Japan, the existing depression scales developed in other countries have often been used to assess depression symptoms of the elderly. Therefore, these examinations are important and provide indications as to whether or not it is appropriate for assessing depression symptoms in elderly Japanese, whether assessment by total or subscale score is appropriate, and whether or not development of another depression scale for elderly Japanese is needed. Furthermore, many of the previous studies concerning this scale, such as that by Iwata et al.,<sup>4-7)</sup> focused on young or middle-aged populations, and there are few studies

focusing on the elderly population and determining the problems applying to them.

This study aimed to determine the reliability and validity of items of the Japanese version of the CES-D scale when applied to independent community-dwelling Japanese elderly from the viewpoints of internal consistency and goodness-of-fit for the model.

## 2. Methods

### 2.1. Subjects and data collection

We selected survey areas of Kushiro City in Hokkaido, Akita City in Akita, Mito City in Ibaraki, Kanazawa City in Ishikawa, Fukui City in Fukui, Komaki City in Aichi and Gifu City in Gifu based on the limitations of availability within our research fields. We delivered a questionnaire to a total of 1900 subjects (100 to 300 questionnaires were distributed in each area.), and collected 1865 replies. After screening the data for gender, age and disease history, data from 1791 subjects (effective response rate 94%) was used for the analysis. The investigators in this study were researchers working at universities in each prefecture. They gathered data in a general delivery survey and interview setting or education class setting. Prior to the survey, investigators explained to the subjects that they could refuse to participate in the survey, and that they would not be disadvantaged in their privacy.

Subjects were community-dwelling independent elderly people aged 60 and over, almost all of whom participated in health or culture education classes for the elderly offered by each municipality, such as healthy exercise programs, recreational sports and traditional culture programs of flower arrangement, calligraphy, “go” games and “haiku” poems. Thus, they were independent and relatively active community-dwelling elderly people.

## 2. 2. Questionnaire

This study used the CES-D scale which was translated into Japanese by Shima et al.<sup>12)</sup> This scale consists of 20 items with a 4-point Likert scale from nothing = 0 to always = 3 (for four items, the pattern of the reverse rating scale was from nothing = 3 to always = 0). Depression level advances with increasing item score.

In addition, we also used the GDS (geriatric depression scale)<sup>2)</sup> to examine the validity of the

CES-D scale. This scale has been used throughout the world due to its simplicity. The GDS consists of 15 items with a dichotomous scale.

## 2.3. Statistics analyses

Descriptive statistics for 20 items of the CES-D were calculated to confirm the characteristics of items responses, and then gender difference in total score of the CES-D scale was tested. Normality of the distribution of the total scores was confirmed by

Table 1 Descriptive statistics of CES-D scale

			Frequency	Mean	SD	Skewness	Kurtosis
Total	CES1	I was bothered by things that usually don't bother me	1650	0.6	0.57	0.24	-0.76
	CES2	I did not feel like eating; my appetite was poor	1652	0.3	0.51	1.52	1.36
	CES3	I felt that I could not shake off the blues even with help from my family and friends	1616	0.3	0.51	1.66	1.88
	CES4	I felt that I was just as good as other people	1586	0.8	0.61	0.10	-0.43
	CES5	I had trouble keeping my mind on what I was doing	1610	0.5	0.61	0.90	-0.21
	CES6	I felt depressed	1561	0.5	0.60	0.93	-0.13
	CES7	I felt like everything I did was an effort	1628	0.6	0.62	0.42	-0.67
	CES8	I felt hopeful about the future	1505	1.0	0.49	-0.07	1.19
	CES9	I thought my life had been a failure	1577	0.3	0.55	1.36	0.89
	CES10	I felt fearful	1585	0.3	0.55	1.37	0.93
	CES11	My sleep was restless	1636	0.6	0.64	0.61	-0.60
	CES12	I was happy	1585	0.8	0.50	-0.33	0.33
	CES13	I talked less than usual	1599	0.5	0.64	1.03	-0.06
	CES14	I felt lonely	1662	0.7	0.47	-0.77	-1.41
	CES15	People were unfriendly	1578	0.3	0.53	1.56	1.50
	CES16	I enjoyed life	1584	0.8	0.54	-0.09	-0.27
	CES17	I had crying spells	1590	0.3	0.53	1.44	1.12
	CES18	I felt sad	1591	0.4	0.57	1.18	0.42
	CES19	I felt that people disliked me	1610	0.2	0.47	1.91	2.84
	CES20	I could not 'get going'	1652	0.6	0.63	0.62	-0.57
Total score			1105	9.9	5.11	0.74	0.47
Males	CES1	I was bothered by things that usually don't bother me	777	0.6	0.57	0.27	-0.79
	CES2	I did not feel like eating; my appetite was poor	775	0.3	0.51	1.60	1.67
	CES3	I felt that I could not shake off the blues even with help from my family and friends	766	0.3	0.52	1.78	2.31
	CES4	I felt that I was just as good as other people	752	0.8	0.58	0.08	-0.42
	CES5	I had trouble keeping my mind on what I was doing	767	0.5	0.62	0.95	-0.13
	CES6	I felt depressed	753	0.4	0.59	0.98	-0.03
	CES7	I felt like everything I did was an effort	763	0.6	0.64	0.54	-0.64
	CES8	I felt hopeful about the future	737	0.9	0.46	-0.27	1.60
	CES9	I thought my life had been a failure	752	0.3	0.55	1.46	1.19
	CES10	I felt fearful	759	0.3	0.52	1.44	1.13
	CES11	My sleep was restless	772	0.5	0.62	0.84	-0.30
	CES12	I was happy	759	0.8	0.45	-0.72	0.45
	CES13	I talked less than usual	763	0.5	0.67	0.86	-0.43
	CES14	I felt lonely	768	0.7	0.45	-0.93	-1.13
	CES15	People were unfriendly	746	0.3	0.54	1.36	0.90
	CES16	I enjoyed life	758	0.8	0.51	-0.33	-0.29
	CES17	I had crying spells	756	0.2	0.48	1.82	2.48
	CES18	I felt sad	751	0.3	0.54	1.27	0.64
	CES19	I felt that people disliked me	761	0.2	0.46	1.73	2.06
	CES20	I could not 'get going'	774	0.5	0.62	0.75	-0.43
Total score			564	9.5	5.04	0.67	0.00
Females	CES1	I was bothered by things that usually don't bother me	833	0.6	0.57	0.20	-0.73
	CES2	I did not feel like eating; my appetite was poor	837	0.3	0.50	1.46	1.17
	CES3	I felt that I could not shake off the blues even with help from my family and friends	813	0.3	0.50	1.58	1.56
	CES4	I felt that I was just as good as other people	796	0.9	0.61	0.07	-0.39
	CES5	I had trouble keeping my mind on what I was doing	806	0.5	0.60	0.83	-0.29
	CES6	I felt depressed	780	0.5	0.60	0.89	-0.21
	CES7	I felt like everything I did was an effort	821	0.7	0.61	0.33	-0.66
	CES8	I felt hopeful about the future	735	1.0	0.50	-0.01	1.08
	CES9	I thought my life had been a failure	787	0.4	0.56	1.27	0.65
	CES10	I felt fearful	790	0.4	0.57	1.31	0.73
	CES11	My sleep was restless	820	0.7	0.64	0.43	-0.69
	CES12	I was happy	789	0.8	0.53	-0.15	0.14
	CES13	I talked less than usual	798	0.4	0.59	1.21	0.46
	CES14	I felt lonely	857	0.7	0.47	-0.68	-1.54
	CES15	People were unfriendly	794	0.3	0.53	1.76	2.21
	CES16	I enjoyed life	789	0.8	0.56	0.00	-0.33
	CES17	I had crying spells	797	0.4	0.57	1.19	0.43
	CES18	I felt sad	802	0.4	0.58	1.10	0.21
	CES19	I felt that people disliked me	812	0.2	0.48	2.05	3.46
	CES20	I could not 'get going'	837	0.6	0.62	0.51	-0.63
Total score			527	10.2	5.06	0.80	0.78

Normal Q-Q plots. Principle component analysis was applied to the correlation matrix of 20 items of the CES-D scale to examine consistency of the scale. The indices of goodness-of-fit index (GFI) and the adjusted goodness-of-fit index (AGFI) were also calculated. Reliability of the CES-D scale was examined by Cronbach alpha coefficients and split-half reliability by the Spearman-Brown formula. In each analysis, missing values were treated by pair-wise deletion.

### 3. Results

Descriptive statistics for the CES-D scores are shown in Table 1. A significant gender difference in total score was not found ( $p > 0.01$ ). Figure 1 shows the normal Q-Q plots for total score, and a few deviations from a normal line were found.

Table 2 shows the result applying principal component analysis to 20 items of the CES-D scale. The contribution of the principle component was 27.8%. The principal component loading values were greater than 0.450 except for four items of “I feel that I am just as good as other people (No.4),” “I feel hopeful about the future (No.8),” “I am happy (No.12)” and “I enjoy life (No.16).” The loading values of these four items were lower than 0.2. The

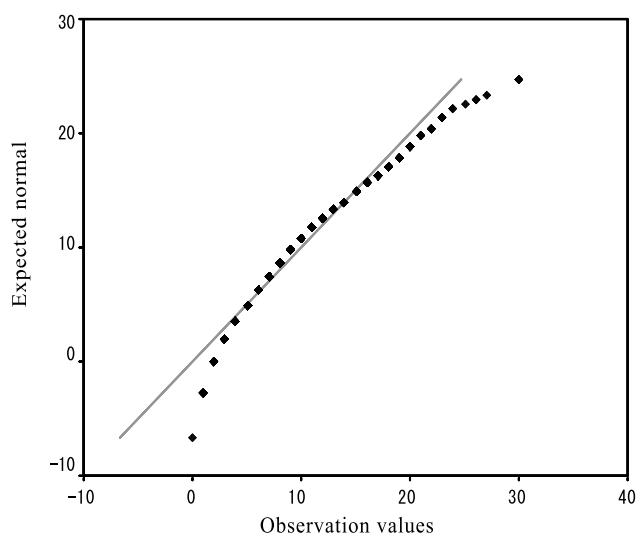


Figure 1 Normal Q-Q plots of total score of CES-D

loading value of “I feel lonely (No.14)” showed a moderate but negative value.

In examining the model fitting when administering the principle component analysis, a Chi-square value was significant ( $\chi^2 = 1916.04$ ,  $p < 0.01$ ), and both GFI and AGFI were 0.800 or more (GFI = 0.883, AGFI = 0.855). Cronbach’s alpha coefficient and split-half reliability by the Spearman-Brown formula were greater than 0.800 (Cronbach’s alpha coefficient = 0.811 and split-half reliability = 0.823). Furthermore, a correlation coefficient between total scores of the GDS and the CES-D scale was moderate but

Table 2 The principle component of each item of CES-D scale

	Contents	Principle component
CES1	I was bothered by things that usually don't bother me	0.578
CES2	I did not feel like eating; my appetite was poor	0.468
CES3	I felt that I could not shake off the blues even with help from my family and friends	0.662
CES4	I felt that I was just as good as other people	0.037
CES5	I had trouble keeping my mind on what I was doing	0.615
CES6	I felt depressed	0.719
CES7	I felt like everything I did was an effort	0.623
CES8	I felt hopeful about the future	0.054
CES9	I thought my life had been a failure	0.526
CES10	I felt fearful	0.593
CES11	My sleep was restless	0.536
CES12	I was happy	0.156
CES13	I talked less than usual	0.535
CES14	I felt lonely	-0.534
CES15	People were unfriendly	0.520
CES16	I enjoyed life	0.186
CES17	I had crying spells	0.592
CES18	I felt sad	0.650
CES19	I felt that people disliked me	0.558
CES20	I could not 'get going'	0.616
	Contribution (%)	27.8

significant ( $r = 0.653$ ,  $p < 0.01$ ).

#### 4. Discussion

The total score of the CES-D scale in this study was higher than that of a general adult sample aged  $32.3 \pm 9.6$  years reported in a previous study<sup>11)</sup>, and this supports Shima's report<sup>11)</sup> investigating depression characteristics in the elderly.

When evaluating phenomena using a psychological scale, it is desirable that the scores distribute normally. In the normal Q-Q plot of the total score of the CES-D scale, a few deviations from an expected normally distributed line were recognized. Normalization of the total scores may be needed to more accurately assess depression characteristics in the elderly by the CES-D scale. In further studies developing standards for assessing depression symptom levels in the Japanese version of the CES-D scale, more complete normalization of the CES-D scores may be required.

In the result of principle component analysis examining the validity of each CES-D item from the point of internal consistency, the principle component loading values of the following four items, "I feel that I am just as good as other people (No.4)," "I feel hopeful about the future (No.8)," "I am happy (No.12)" and "I enjoy life (No.16)," were lower than 0.2. These items compose the subscale of "positive affect" in the original version. In this study, item scores of these items tended to be greater than in those of the other items (Table 1). Furthermore, Yatomi et al.<sup>14)</sup> reported that positive affect in the Japanese elderly was independent on the other depression symptoms. Considering these findings, it is considered the possibility that there are specific depression characteristics of the Japanese elderly and factor structure reflecting these characteristics. When developing a psychological scale using multivariate analysis, the factorial structure of the scale should be examined after determining the validity of individual items using stepwise variable selection in exploratory factor analysis.<sup>8)</sup> The Japanese version of the CES-D scale, however, was developed under the restriction that the number and item content not be changed from the original version.<sup>14)</sup> This may also be one

of the reasons that a few items showing low internal consistency were included among the items.

In general, establishing a model is useful to our understanding of psychological phenomena. In structural equation modeling in multivariate analysis, there are factor models such as parallel or hierarchical models. Recently, a higher-order factor model and a multiple indicator multiple case (MIMIC) model have been proposed in covariance structure analysis.<sup>13)</sup> In modeling for depression in the elderly, different factor models of the first-order factor model and the second-order factor model assuming the higher-order factor have been examined.<sup>11)</sup> In examining goodness-of-fit for the first-order factor model composed of four factors, both goodness-of-fit indices of GFI and AGFI were relatively high (GFI = 0.883, AGFI = 0.855), and the four-factor model is considered to be valid when using these 20 items. Toyoda<sup>13)</sup> indicated that the desirable levels of GFI and AGFI are 0.9 or more. There is a possibility that model fitting is improved by re-examining the individual items or by assuming other factor models, and these should be examined in further studies. Although a few items showing low factor validity were included among the items, this scale is considered to be able to assess depression symptoms of the elderly using the total score.

The desirable reliability coefficient level (Cronbach's alpha coefficient) of a psychological questionnaire is required to be 0.8 or more.<sup>10)</sup> Many previous studies examining the reliability of the CES-D scale reported that reliability coefficients of 0.8 or more were obtained.<sup>4-7, 11)</sup> Also in this study, the reliability coefficients of the Cronbach alpha coefficient and Spearman-Brown formula were greater than 0.8, and sufficient reliability as a psychological assessment scale is considered to be confirmed.

The geriatric depression scale (GDS), which consists of 15 items with a dichotomous rating scale, has also been used as a general-purpose depression scale for the elderly. In this study, a moderate but significant correlation of 0.653 was obtained between the CES-D and the GDS total scores. In a previous study<sup>11)</sup> investigating the relationships between the CES-D scale and Hamilton's depression scale when

applied to 20 subjects with an impairment of mood, it was reported that the correlation between total scores of both scales was 0.846. In a study examining the relationship between the self-rating depression scale (SDS) and the CES-D scale<sup>11)</sup>, a significant relationship was found, but it was not necessarily high. Considering the fact that a common view about the concept of the depression has not been obtained, the result that a moderate but significant correlation was obtained between the GDS and the CES-D scale may suggest that there is a close relationship between these depression scales.

In conclusion, this study examined reliability and validity of the Japanese version of the CES-D scale from the viewpoint of internal consistency and goodness-of-fit to a model when applied to the independent community-dwelling elderly. Model fitting for the first-order factorial model of the Japanese version of the CES-D scale was good, and the reliability as a psychological scale was also sufficient. Furthermore, a close relationship with another depression scale (GDS) was obtained. However, for four items of the CES-D scale, sufficient validity was not obtained in examining the internal consistency, and it was considered the possibility that there is a specific factor structure of the Japanese elderly. The individual items should be re-examined in the further studies.

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