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Research article

Self-construal and behavioral motivation systems among patients with depression in Indonesia: A hospital-based study

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HIGHLIGHTS

- This was the first study to validate and revised the SCS and BIS/BAS in an Indonesian population.
- This study was the first to explore the link between self-construal, neural motivational systems and depression in Indonesia.
- This study did not draw causal relations between predictors and the outcome because of its cross-sectional nature.
- We used occupation to measure socioeconomic status rather than income to see its linkage with depression and self-construal.
- We did not measure effects of ethnicity, although Indonesia has various ethnic groups with different societies and cultures.

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ABSTRACT

Objective: To validate Indonesian versions of two social/cultural psychological scales: the Self-Construal Scale (SCS) that measures independent and interdependent cultural values, and the Behavioral Inhibition (Avoidance) System and Behavioral Approach System (BIS/BAS) that measures motivation focus. We also explored the cultural background for the rising prevalence of depression in Indonesia.
Design: Case (hospital)–control (population) study.
Setting: Hasanuddin University Hospital (cases) and Makassar city region (controls), Indonesia.
Participants: Participants (N = 369) were 165 patients with depression recruited from a university hospital, and 204 healthy controls without a history of mental disorders recruited from locations within a 30-minute walk from the hospital.
Outcome measures: Depression was diagnosed by psychiatrists with reference to Indonesian mental disorder guidelines (*Pedoman Penggolongan dan Diagnosa Gangguan Jiwa edisi 3*). Participants' independent and interdependent cultural values, and neural motivational systems were measured with the SCS and BIS/BAS.
Results: Exploratory and confirmatory factor analyses showed that our revised 12-item SCS and the 13-item, three-factor BIS/BAS had a good model fit for the Indonesian population. MANCOVA showed that the SCS Independent subscale and the BAS subscales were significantly associated with depression after adjustment for age, sex, religion, education, and occupation.
Conclusion: These findings may guide provision of appropriate treatment for patients based on their social and cultural environment. In addition, this study contributes to understanding underlying reasons for the increasing

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prevalence of depression in Indonesia, where society is changing from traditional collectivism to global individualism.

1. Introduction

This study aimed to explore self-construal and neural motivational systems among patients with depression in Indonesia. The World Health Organization reported that 322 million people live with depression globally, meaning depression is currently one of the largest public health problems worldwide [1]. Nearly half of identified people with depression live in the Southeast Asia and Western Pacific Regions, where the prevalence of depression increased by 18.4% between 2005 and 2015. In Indonesia, the number of people with depression has reached 9.1 million (3.7% of the population). However, the Indonesia Family Life Survey, which is a longitudinal survey of Indonesian family health that started in 1993, reported the prevalence of depression in the adult population was 23.47% [2]. It is therefore urgent to explore risk factors and appropriate treatment for depression in Indonesia. However, few studies have focused on these issues.

Known risk factors for depression include adverse life events, social status, religiosity, genetic factors, and cultural psychological aspects [3, 4]. Studies in European populations identified potential genetic risk factors for depression. However, it was later found that this genotype was more prevalent in East Asia than Europe, despite Europe having a higher prevalence of mood disorders and anxiety compared with East Asia [5]. This contradiction may be explained by differences in social organization. For example, depression is less likely to occur in "collective" societies such as those in Asia than in "individualistic" European societies, regardless of genetic traits [4].

Cultural context is related to individual happiness and well-being [6]. Cultural psychology considers self-construal a cultural factor that is central to understanding cultural differences; for example, as shown in a comparison between European- and Asian-Americans [7]. Interdependent self-construal has been directly and indirectly associated with depression among Asian-American [7] and Vietnamese-American adolescents [8]. To our knowledge, only two previous Indonesian studies analyzed self-construal. One study compared the role of family in approving romantic relationships between samples of Australian and Indonesian university students [9]. The other study focused on Indonesian college students and showed that interdependent self-construal was associated with social anxiety [10].

The reinforcement sensitivity of two different neurological self-regulatory systems may also be associated with depression: 1) the behavioral inhibition (avoidance) system (BIS), which represents aversive motivation, and 2) the behavioral approach system (BAS), which represents appetitive motivation. This theory was proposed by Gray (1987), who argued that the BIS was related to anxiety-related cues and was sensitive to punishment signals, whereas the BAS was related to positive engagement toward a goal-directed approach and reward cues [11]. Carver and White (1994) further developed a BIS/BAS scale to assess individual differences in personality reflecting these two systems [12]. The scale has been used widely in association with psychopathologies, including depression and anxiety. For example, higher behavior inhibition was associated with depression in European and Chinese adolescents [13, 14]. Lower behavioral approach was associated with the presence of depression in Iranian and Japanese adults [15, 16] and with anhedonia symptoms in those with depression [17], which was assumed to stem from impairments in various aspects of goal and reward processing [18]. In previous functional magnetic resonance imaging studies, depression was associated with hypoactivation of the left frontal region and abnormalities in the orbitofrontal region of the brain; these areas have roles in positive affect and appetitive motivation, and the progression of reward and punishment stimuli, respectively [19, 20]. However, only one study in this area has been conducted in Jakarta, Indonesia, which revealed behavioral inhibition/approach were associated with risk behaviors among female inmates [21].

Cultural psychological values are defined as a macro concept [22], but aspects such as self-construal have been assessed and analyzed by self-reported measures to determine individual differences in representative cultural values (i.e., independence and interdependence) [23]. Questionnaires investigating these issues have been translated into different languages and used among various populations in several countries. However, there are limited Indonesian versions of these questionnaires, despite Indonesia having the fourth largest population (about 270 million people in 2018) in the world.

This study validated Indonesian versions of two cultural psychological scales: the Self-Construal Scale (SCS) developed by Singelis and the BIS/BAS. We aimed to use these scales to explore the cultural background of the rising prevalence of depression in Indonesia.

2. Methods

2.1. Participants

This study was conducted in Makassar, which is the capital of South Sulawesi Province, Indonesia. Makassar is the largest city in Eastern Indonesia. The prevalence of depression in South Sulawesi Province was estimated at 7.8% (95% confidence interval [CI]: 7.3%–8.4%), which was higher than the country-wide prevalence (6.1%) [24].

This study used a case-control design. The case group comprised 165 patients diagnosed with depression at the Hasanuddin University Hospital that were willing to voluntarily participate in this study. Licensed Indonesian psychiatrists diagnosed depression with reference to the Indonesian mental disorder guidelines for classification and diagnosis (*Pedoman Penggolongan dan Diagnosa Gangguan Jiwa edisi 3*). The control group was recruited by visiting communities within a 30-minute walk from the University Hospital; 204 healthy volunteers were willing to participate in this study. Psychiatrists confirmed that none of the control group participants showed any symptoms of depression. In total, our analyses included 369 participants.

All research was performed after obtaining written informed consent from each participant. This study was approved by the Ministry of Education and Culture (formerly the Ministry of Research, Technology and Higher Education) Ethics Committee of Medical Research, Indonesia (approval number: 01/H4.8.4.5.31/PP36-KOMETIK/2017) granted to the Faculty of Medicine, Hasanuddin University and Hasanuddin University Hospital, and by the Kyoto University Graduate School and Faculty of Medicine Ethics Committee (G1099) granted to the Graduate School of Asian and African Area Studies, Kyoto University. Participants could refuse to answer any questionnaire item and could withdraw from this study at any time. Participants in both the case and control groups were provided with light meals and beverages but received no remuneration for their participation.

2.2. Interview survey

Face-to-face interviews were conducted with all participants. The interview questionnaire collected information about participants' age, sex, religion, educational background (highest educational level completed), and occupation. As most participants were Muslim, religion was classified as Islam or others. The highest educational level was classified as high (diploma [S0], university [S1], or postgraduate [S2]), medium (senior high school [SMA] or junior high school [SMP]), and low (elementary school or below). Occupation was classified as "public servant/teacher," "private sector/business/other waged labor,"

"housewife/househusband," and "no job/retired." Participants also completed the SCS and BIS/BAS scales, which are explained in the following section.

2.3. Psychological scales

This study used two common cultural psychological scales. The SCS is a 30-item self-reported scale that is widely used as a measure of independence and interdependence in self-construal [23, 25, 26]. Since its development, the SCS has been translated and validated in several languages [27]. The SCS comprises 15 statements that measure the independent self (e.g., "I enjoy being unique from others") and 15 statements that measure the interdependent self (e.g., "I will sacrifice my self-interest for the group that I am in"). Responses are on a Likert-scale from 1 (strongly disagree) to 7 (strongly agree). Two previous studies developed Indonesian versions of the SCS. However, one study did not examine the reliability of the translated scale [9] and the other study reported Cronbach's alphas of 0.704 for the interdependent subscale and 0.705 for the independent subscale [10]. Neither study made the Indonesian version open to the public.

The BIS/BAS is 24-item scale used to examine two motivational behavioral systems. The BIS measures the tendency to avoid aversive outcomes, and the BAS corresponds to goal-oriented behavior or appetitive motivation [12]. Participants rate themselves for each item using a 4-point Likert-type scale: 1 = "very true for me," 2 = "somewhat true for me," 3 = "somewhat false for me," and 4 = "very false for me." The scale comprises four subscales, with the BIS corresponding to one subscale (e.g., "Criticism or scolding hurts me quite a bit"). The three BAS subscales are BAS Drive, BAS Reward Responsiveness, and BAS Fun Seeking. BAS Drive contains items that show the pursuit of desired goals, such as "When I want something, I usually go all-out to get it." The BAS Reward Responsiveness subscale contains items that measure positive attitudes toward rewards (e.g., "It would excite me to win a contest"). Finally, the BAS Fun Seeking subscale contains items that reflect the desire to chase new rewards on the spur of the moment (e.g., "I will often do things for no other reason than that they might be fun"). A previous Indonesian study that used this scale did not report the validity of the translation or the translated questionnaire [21].

2.4. Translation procedure

Despite previous Indonesian studies, this study independently developed Indonesian versions of these psychological scales. The original English versions of the scales were first translated into Bahasa Indonesia by professional translators (Simul International, Inc.), who were independent from the research team. A group of Indonesian psychiatrists (lead by AJT, KL, and TI) then checked the translations and made necessary modifications to ensure the items were suitable for the Indonesian context. Next, 37 Indonesian university students completed the Indonesian versions; these students correctly understood and could answer each question. Finally, the Indonesian versions were back-translated into English and Japanese by professional translators (different translators from the first step: Simul International, Inc.); these translators did not read or refer to the original English or Japanese versions. The research team then conducted an evaluation of the translated scales through a group discussion, including checking the questions one by one, and confirmed that the translations did not change the original meanings of the items, were appropriate for the Indonesian context, and easy for potential interviewees to understand. The only exception was one BIS/BAS item (Question 15): "I often act on the spur of the moment." In the back translation, this sentence was translated as "I often take action immediately." We judged that the Indonesian question "*Saya sering melakukan tindakan dengan serta-merta*" reflected the meaning of the original sentence. The Indonesian versions of the scales are available in Supplementary Information (S1 Appendix).

2.5. Participant and public involvement statement

In this study, experienced psychiatrists designed research methods that appeared to be meaningful and appropriate for the participants. However, no participants were involved in the research design itself.

2.6. Statistical analyses

The internal consistency of each scale was measured by calculating the Cronbach's alpha. Although no universal threshold exists for internal consistency, we considered the Cronbach alpha value was sufficient if it was as high as reported for the original scales (0.60 for the SCS in the original study was the lowest value) [23]. In addition, exploratory factor analyses (EFA) were conducted to explore the structure of the scales used in this study. Varimax rotation was used to show distributions of question items on two main factors. After conducting the EFA, the next step was to confirm the factor structure of the original scales with confirmatory factor analysis (CFA) with maximum likelihood (ML) model as the estimator. Several indices were used to test the model fit of the scales: chi-square statistics, chi-square per degrees of freedom, the comparative fit index (CFI), and the Tucker-Lewis index (TLI) (values > 0.90). We also used the standardized root mean square residual (SRMR) (values < 0.08) and root mean square error of approximation (RMSEA) (values < 0.06).

Chi-square tests were performed to compare sex, religion, education, and occupation between the case and control groups. Wilcoxon's test was used to compare age, Independent SCS, Interdependent SCS, BIS, BAS Drive, BAS Reward Responsiveness, and BAS Fun Seeking between the two groups. A two-way multivariate analysis of covariance (MANCOVA) was used to explore associations between depression and SCS and BIS/BAS scores. All statistical analyses were conducted with R version 3.6.1, and the CFA used Lavaan version 0.6–11 in R (The R Foundation for Statistical Computing). $P < 0.05$ was considered statistically significant.

3. Results

3.1. Validity of the Indonesian versions of the psychological scales

3.1.1. EFA

Table 1 shows the Cronbach's alphas for the Indonesian versions of the SCS and BIS/BAS. The values were high for both scales for both the control and case groups (SCS: 0.86 and 0.88; BIS/BAS: 0.81 and 0.92, respectively).

Factor loadings for each item are shown in the Supplementary Information (S2 Appendix). Figure 1 shows the distribution of items on Factors 1 and 2 for the SCS after varimax rotation. The Independent and Interdependent SCS items were mostly grouped into two clusters, and the factor loadings on both factors for the latter were generally higher than those for the former.

Figure 2 shows the factor loadings for the BIS/BAS items. The BIS items were clearly separated from the three BAS subscales. The BAS Reward Responsiveness subscale was characterized by higher Factor 1 and lower Factor 2 loadings. However, the BAS Fun Seeking and BAS Drive subscales covered similar regions.

These results confirmed that the Indonesian versions of the SCS and BIS/BAS measured self-construal and neurological systems of behavioral inhibition and activation for Indonesian people, respectively. However, careful attention is necessary given the differences in the BAS Fun Seeking and BAS Drive subscales.

3.1.2. CFA for the SCS

To validate the model, we first tested the 30 widely used SCS items and the original 24 items with a two-factor structure using CFA with ML estimators (Table 2). The model fit was neither poor nor very good: $\chi^2(404) = 1196.373$, CFI = 0.685, TLI = 0.661, SRMR = 0.073, and RMSEA = 0.074 (95%CI: 0.069–0.079) for the 30 item scale; and $\chi^2(253) = 645.097$, CFI = 0.760, TLI = 0.735, SRMR = 0.067, and RMSEA =

0.071 (95%CI: 0.065–0.078) for the 24 item scale. Based on the factor loadings of each item, we decided to try for a better model by selecting the items with highest factor loadings, which resulted in a 12-item scale comprising six items for the Independent subscale and six items for the Interdependent subscale. The revised scale showed a good model fit: $\chi^2(53) = 114.993$, CFI = 0.915, TLI = 0.894, SRMR = 0.059, and RMSEA = 0.057 (95%CI: 0.043–0.071).

3.1.3. CFA for the BIS/BAS

To validate the BIS/BAS scale, CFA was conducted with the original 24 item scale using a four-factor solution. The fit indices (Table 3) showed that this original model did not fit the data well: $\chi^2(164) = 585.330$, CFI = 0.840, TLI = 0.815, SRMR = 0.072, and RMSEA = 0.084 (90%CI: 0.077–0.092). According to our previous EFA results, the BAS Drive and Fun-Seeking subscales covered many of same regions; therefore, we tested the BIS/BAS scale with a three-factor solution, combining the BAS Drive and Fun-Seeking items. However, the model fit was no better than the original four-factor structure. Guided by our EFA results, we retained items with the highest factor loadings and ended up with a 13-item revised BIS/BAS scale. We performed CFA for this revised version, with a three-factor structure. The fit indices of this three-factor 13-item scale showed a better model than the original model: $\chi^2(62) = 162.517$, CFI = 0.948, TLI = 0.935, SRMR = 0.042, and RMSEA = 0.067 (90%CI: 0.054–0.079).

3.2. Self-construal among patients with depression in Indonesia

Table 4 shows participants' characteristics. Unexpectedly, the proportion of females in the control group was higher than in the case group. Almost all participants were Muslims, but the proportion of Muslims was slightly smaller in the case group (89.8%) compared with the control group (97.1%). More case group participants had "no job" (22.9%) compared with the control group (5.9%). However, there were no significant differences in age or education level between the case and control groups.

For the original 30 SCS items, the SCS Independent score was lower in the case group (4.99 ± 0.73) than in the control group (5.26 ± 0.85; $P = 0.002318$), but no significant difference was observed in the SCS Interdependent scores. However, in the revised 12-item scale, the results showed a significant difference in SCS Interdependent score between the case (4.65 ± 1.03) and control (4.06 ± 1.10; $P < 0.0001$) groups. The BAS Drive, Fun Seeking, and Reward Responsiveness scores of the original BIS/BAS scales were lower in the case group than in the control group ($P < 0.001$ to $P < 0.0001$), but no significant difference was observed in BIS scores. Participants' scores for the revised BIS/BAS scales also showed that the case group scored lower for BAS Drive and Fun Seeking (11.84 ± 2.62) than the control group (13.29 ± 2.46, $P < 0.0001$) but higher in the BIS, although the differences were not significant.

3.2.1. Original 30-item SCS results

Table 5 shows the two-way MANCOVA for the original 30-item SCS. Wilk's test showed that depression ($P < 0.001$, $\eta^2 = 0.11$) and the interaction of depression and age ($P = 0.022$, $\eta^2 = 0.02$) had a significant effect on the original SCS scores, although the effect sizes were not large. Further testing of the between-subject effect was performed after Wilk's test and the results (Supplementary Tables S1) showed that depression had a significant effect on the original SCS Independent score ($P < 0.001$), but not on the Interdependent score.

3.2.2. Revised 12-item SCS results

Table 6 shows the MANCOVA results for the revised 12-item SCS with other variables. Wilk's test showed that only depression had a significant effect on SCS scores ($P < 0.001$, $\eta^2 = 0.11$).

Further testing of between-subject effect was performed, and the results (Supplementary Tables S2) showed depression had a significant effect on SCS Independent score, where case group participants had lower scores (EM. mean ± SE = 5.28 ± 0.23, $P = 0.014$) compared with the control group (EM. mean ± SE = 6.11 ± 0.24). A significant effect of depression on SCS Interdependent score was also found ($P < 0.001$), with case group participants scoring higher than those in the control group.

3.3. Behavioral motivation system for patients with depression in Indonesia

3.3.1. Original BIS/BAS results

Table 7 shows the MANCOVA results for the original BIS/BAS scores with other variables. There were significant effects for depression ($P < 0.001$, $\eta^2 = 0.23$), age ($P = 0.036$, $\eta^2 = 0.02$), and the interaction of depression and occupation in the private sector ($P = 0.040$, $\eta^2 = 0.02$) on BIS/BAS scores.

Further analysis of between-subject effects (Supplementary Tables S3) showed that depression had a significant effect on all three BAS subscales ($P < 0.001$) but not the BIS subscale. Participants in the case group tended to have lower BAS scores compared with the control group. Age also had a significant effect on the BAS Reward Responsiveness ($P = 0.023$) and BIS ($P < 0.001$) subscales. Those aged <30 years had the highest BAS Reward Responsiveness score, which showed a trend of being lower with increasing age. The same trend was also observed for the BIS score, whereby younger participants had higher BIS score.

3.3.2. Revised 13-item, three-factor BIS/BAS scale

Table 8 presents the MANCOVA results for the revised BIS/BAS scale with 13 items and three factors. There were significant effects of depression ($P < 0.001$, $\eta^2 = 0.19$), age ($P = 0.028$, $\eta^2 = 0.02$), and the interaction of depression and private sector occupation ($P = 0.036$, $\eta^2 = 0.02$) on the revised BIS/BAS scale.

Furthermore, both BAS subscale scores tended to be lower in the case group compared with the control group ($P < 0.001$) but there were no significant differences in BIS score (Supplementary Tables S4). BAS Reward Responsiveness and BIS scores tended to be significantly higher among those aged <30 years. Pairwise comparison with the Tukey method showed that the BAS Reward Responsiveness scores of those aged <30 years significantly differed from those aged 50–60 years (EM. mean ± SE = 2.20 ± 0.65, $P = 0.007$), and the BIS scores for participants aged <30 years significantly differed from those aged >60 years ($P = 0.027$). There were no significant differences between age groups observed for BIS scores in control group participants, but there was a significant difference in the BIS scores of participants with depression aged <30 years and those aged 30–39 years (EM. mean ± SE = 2.88 ± 0.75, $P = 0.0013$) and >60 years (EM. mean ± SE = 3.30 ± 0.80, $P = 0.0005$), whereby people with depression aged <30 years scored higher on the BIS.

4. Discussion

This study attempted to validate the Indonesian versions of two psychological scales: the SCS and the BIS/BAS, and find the best model-fit for these Indonesian versions. To achieve this, we used a rigorous approach using EFA and CFA to finally propose two revised and shorter versions of each scale. Several previous studies focused on different cultures and languages have also attempted to validate and revise these two scales [28, 29, 30, 31, 32]. We did not replicate either of the scales reported in previous studies, but used our own versions based on our EFA analysis, only retaining items with the highest factor loadings. This showed that a 12-item SCS and a 13-item, three-factor BIS/BAS scale were the best models to use for an Indonesian sample. We described the results of the relationships between each of the original psychological scales and depression to allow comparison with other ethnic groups in previous studies, as well as the revised versions of the scales that were new models for the Indonesian population.

This study had some limitations. First, because we used a cross-sectional design rather than a cohort design, we could not draw causal

relationships between the predictors and the outcome. Second, socio-economic status (SES) is potentially associated with depression and self-construal, but we used occupation to reflect SES rather than cash income. A high proportion of participants (especially those with depression) refused to answer or answered "0" (24.7% in total) for the item covering cash income.

Occupation was a possible confounding factor in this study, as occupation (including "no job") was also a variable related to SES and cash income [33], and most participants completed this question. We believe that this study appropriately considered the effect of SES by including occupation (but not income) as a confounding factor. Another possible confounding factor was that we did not measure effects of ethnic differences, although Indonesia has various ethnic groups who belong to different societies and cultures. Among study participants, 78.8% indicated their ethnic group was Makassar, Bugis, or a mix; Bugis and Makassar are the main ethnic groups in and around Makassar city and have close historical relationships each other. In addition, 5.8% of participants belonged to the Toraja ethnic group, who mostly live in the northern mountainous part of South Sulawesi Province. The remaining participants were from various ethnic groups from other parts of the province or other provinces. As most participants were Bugis/Makassar, it was not appropriate to conduct comparisons among different ethnic groups. However, we adjusted for confounding effects of ethnic group using the "religion" variable; all Bugis/Makassar people are Muslims, whereas almost all Toraja people are Christians.

Further analyses of self-construal among our participants showed that patients with depression in Indonesia were less independent and less active in term of behaviors relating to drive, response to reward, or fun seeking. Markus and Kitayama [22] suggested that European-Americans displayed an independent view of self-construal (represented by separateness, internal attributes, and uniqueness of individuals), whereas East Asians such as Japanese showed an interdependent view of the self (connectedness, social context, and relationships). Some studies have suggested that self-construal was not associated with depression [34], whereas others suggested that the interdependent self was associated with depression [7, 8].

In contrast, this study found that the independent self was (negatively) associated with depression, but the interdependent self was not. This may be attributable to cultural differences between Indonesia and other societies investigated in previous studies. Research from the US among European-American and Chinese-American college students found the independent self was negatively associated with depression, whereas the interdependent self was positively correlated with depression in the European-American sample but not in the Chinese-American sample [35]. In another study involving college students in the US with diverse cultural backgrounds, the independent self was found to moderate the link between social support and depression [36]. That study reported higher independent self-construal was significantly correlated with a better mental health outcome (less depression), and social support for depression was more beneficial for people with low independent self-construal in a collectivistic society as people value other's input and help more that those with a high independent self [37]. Depressive symptoms are associated with less social support and interpersonal deficits, and commonly result from social defeat where individuals with depression may rely on the aid of close, communal type relationships [19].

Table 1. Cronbach's alpha values for the Indonesian versions of the psychological scales.

Psychological Scale	Case (Depression)	Control	All
Singelis's Self-Construal Scale (SCS)	0.88	0.86	0.86
Behavioral Approach System and Behavioral Inhibition (Avoidance) System (BIS/BAS)	0.92	0.81	0.88

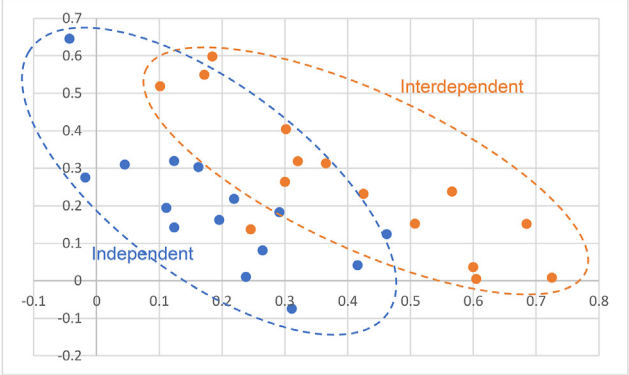

Figure 1. Distribution of Self-Construal Scale items on two factors.

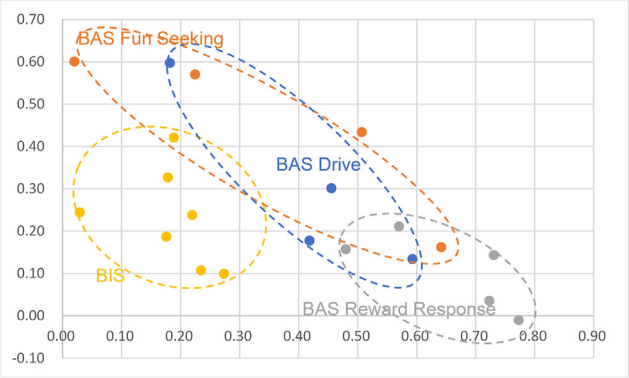

Figure 2. Distribution of Behavioral Inhibition System/Behavioral Approach System items on two main factors.

Previous studies suggested that anxiety and mood disorders were more prevalent in European countries than East Asian countries, despite a genetic risk factor (e.g., S alleles of 5-HTTLPR of the serotonin transport gene) being more prevalent in the latter [4]. This result may be explained by cultural differences, as East Asian countries have a collectivist society (interdependent people) whereas European countries are individualist (independent people) [4]. Previous studies that investigated the SCS and depression focused on Europeans and Asians living in the US, which is considered the country of individualism [7, 8, 34]. In contrast, this study was conducted in Indonesia, which is known as a collectivist (interdependent) society [36]. Interdependent individuals in an individual society can be positively detected in statistical analyses, whereas independent individuals in a collectivist society can be negatively detected [37]. This background difference is thought to explain the differences in the results. Therefore, it is reasonable to suggest that a less independent self is a risk factor for depression in a collectivist society.

Our finding of the relationship between the BIS/BAS and depression was congruent with the results of previous studies that found the BIS had significant effects on the occurrence of depression and anxiety in the US [38]. Conversely, in a study involving patients with major depressive disorder, low BAS predicted the presence of depression and the number of symptoms, level of depression, and longer recovery time; that study also found that BIS score was not significantly associated with the course of depression [39]. The BAS was also found to be negatively associated with depression among Iranian college students [15]. In a sample of Chinese older adults, high BAS sensitivity enhanced adaptive emotion regulation strategies that led to lower depression [40]. A recent study reported the BAS negatively moderated the relationship between stressful life events and depressive symptoms in a community sample of Japanese adults, whereas the BIS had no effect [16]. Comparison of BIS/BAS scores between previous studies and our study showed higher

Table 2. Confirmatory factor analyses for the self-construal scale with fit indices.

	χ2	df	χ/df	CFI	TLI	RMSEA	SRMR
SCS Two Factors 30 items	1196.373	404	2.96	0.685	0.661	0.074 (0.069–0.079)	0.073
SCS Two Factors 24 Items	645.097	253	2.54	0.760	0.735	0.071 (0.065–0.078)	0.067
SCS Two Factors 12 Items	114.993	53	2.17	0.915	0.894	0.057 (0.043–0.071)	0.059

SCS: Self Construal Scale; TLI: Tucker-Lewis index (non-normed fit index); CFI: comparative fit index; RMSEA: root mean square error of approximation; SRMR: standardized root mean square residual.

Table 3. Confirmatory factor analyses with fit indices for the behavioral inhibition (avoidance) system and behavioral approach system scale.

	Chi2	df	Chi2/df	CFI	TLI	RMSEA	SRMR
BIS/BAS Four Factors 24 Items	585.330	164	3.56	0.840	0.815	0.084 (0.077–0.092)	0.072
BIS/BAS Three Factors 24 Items	592.798	167	3.55	0.838	0.816	0.084 (0.077–0.091)	0.073
BIS/BAS Three Factors 13 Items	162.517	62	2.62	0.948	0.935	0.067 (0.054–0.079)	0.042

BIS/BAS: Behavioral Inhibition (Avoidance) System/Behavioral Approach System; TLI: Tucker-Lewis index (non-normed fit index); CFI: comparative fit index; RMSEA: root mean square error of approximation; SRMR: standardized root mean square residual.

BIS scores and lower BAS scores in this study than other studies, suggesting that the collectivist society of Indonesia has higher behavior inhibition [38]. Therefore, behavior inhibitory individuals were less likely to be detected in the statistical analyses. The reason why the BAS factors were negatively associated with depression may be attributable to cultural differences.

This was the first study to explore associations between self-construal and neural motivational systems and depression in Indonesia. We validated and revised Indonesian versions of the SCS and the BIS/BAS. The revised Indonesian versions of the SCS and BIS/BAS scales were only used for this study, but we believe that these versions are suitable to use in Indonesian context. Further studies regarding use of the SCS and BIS/

Table 4. Participants' characteristics.

	Case	Control	Significance
No. of Participants	160	204	
Female	59.4%	70.1%	$P = 0.04303$
Age (years) mean ± SD	44.3 ± 14.1	41.9 ± 11.8	NS
Age Class, n(%)			
<30 years old	27 (7.62%)	30 (8.47%)	$P = 0.01843$
30 – 39 years old	29 (8.19 %)	71 (20.10%)	
40 – 49 years old	39 (11.01%)	44 (12.42%)	
50 – 59 years old	33 (9.32%)	42 (11.86%)	
≥ 60 years old	22 (6.21%)	17 (4.80%)	
Religion, n (%)			
Islam	141 (89.8)	198 (97.1)	$P = 0.008472$
Others	16 (10.2)	6 (2.9)	
Education, n			
High (Diploma [S0], University [S1], Postgraduate [S2, S3])	64	76	NS
Medium (Senior [SMA]/Junior high school [SMP])	75	85	
Low (Elementary school)	20	43	
Occupation, n (%)			
Public servant/teacher	15 (9.8)	20 (9.8)	$P < 0.001$
Private sector/business/others	60 (39.2)	91 (44.6)	
Housewife/househusband	43 (28.1)	81 (39.7)	
No job/retired	35 (22.9)	12 (5.9)	
SCS Independence (Original Items), mean ± SD	4.99 ± 0.73	5.26 ± 0.85	$P = 0.002318$
SCS Interdependence (Original Items), mean ± SD	5.11 ± 0.69	4.98 ± 0.79	NS
SCS Independence (12 Items), mean ± SD	5.27 ± 0.76	5.80 ± 0.85	$P < 0.0001$
SCS Interdependence (12 Items), mean ± SD	4.70 ± 1.01	4.20 ± 1.11	$P = 0.02181$
BAS Drive (Original Items), mean ± SD	11.43 ± 2.51	12.41 ± 2.32	$P = 0.0001447$
BAS Fun Seeking (Original Items), mean ± SD	10.70 ± 2.89	11.80 ± 2.28	$P < 0.0001$
BAS Reward Responsiveness (Original Items), mean ± SD	15.19 ± 3.51	17.90 ± 2.19	$P < 0.0001$
BIS (Original Items), mean ± SD	19.81 ± 3.42	19.31 ± 3.12	NS
BAS Drive + Fun Seeking (13 Items), mean ± SD	11.84 ± 2.62	13.29 ± 2.46	$P < 0.0001$
BAS Reward Responsiveness (13 Items), mean ± SD	15.19 ± 3.51	17.64 ± 2.83	$P < 0.0001$
BIS (13 Items), mean ± SD	12.00 ± 3.09	12.25 ± 2.65	NS

BIS, Behavioral Inhibition System; BAS, Behavioral Approach System; SCS, Self-construal Scale; SD, standard deviation.

Table 5. Multivariate test for the original 30-item independent and interdependent self-construal scale scores.

Variables	Wilk's	F	df	Sig.	η^2
Depression (Yes = 1, No = 0)	0.895	18.643	2, 316	<0.001	0.11
Gender: Female = 1, Male = 0	0.982	2.796	2, 316	NS	0.02
Age Class	0.973	1.090	8, 632	NS	0.01
Religion: Islam = 1, Others = 0	0.983	2.663	2, 316	NS	0.02
Education High	0.994	0.948	2, 316	NS	0.00
Education: Middle	0.994	0.912	2, 316	NS	0.00
Occupation: Public Sector	0.999	0.030	2, 316	NS	0.00
Occupation: Private Sector	0.999	0.081	2, 316	NS	0.00
Occupation: Housewife/ Househusband	0.991	1.363	2, 316	NS	0.00
Depression × Female	0.988	1.898	2, 316	NS	0.01
Depression × Age	0.969	1.265	8, 632	NS	0.02
Depression × Religion	0.997	0.526	2, 316	NS	0.00
Depression × High Education	0.997	0.466	2, 316	NS	0.00
Depression × Middle Education	0.999	0.152	2, 316	NS	0.00
Depression × Public Sector	0.998	0.267	2, 316	NS	0.00
Depression × Private Sector	0.986	2.292	2, 316	NS	0.01
Depression × Housewife/ Househusband	0.992	1.236	2, 316	NS	0.00

Table 6. Multivariate test for the revised 12-item independent and interdependent self-construal scale scores.

Variables	Wilk's	F	df	Sig.	η^2
Depression (Yes = 1, No = 0)	0.760	50.216	2, 318	<0.001	0.22
Gender: Female = 1, Male = 0	0.981	2.993	2, 318	NS	0.02
Age Class	0.984	0.640	8, 636	NS	0.00
Religion: Islam = 1, Others = 0	0.991	1.439	2, 318	NS	0.00
Education High	0.997	1.438	2, 318	NS	0.00
Education: Middle	0.984	2.549	2, 318	NS	0.02
Occupation: Public Sector	0.999	0.039	2, 318	NS	0.00
Occupation: Private Sector	0.999	0.196	2, 318	NS	0.00
Occupation: Housewife/ Househusband	0.990	1.735	2, 318	NS	0.00
Depression × Female	0.992	1.344	2, 318	NS	0.00
Depression × Age	0.991	0.347	8, 636	NS	0.00
Depression × Religion	0.999	0.012	2, 318	NS	0.00
Depression × High Education	0.997	0.414	2, 318	NS	0.00
Depression × Middle Education	0.984	2.644	2, 318	NS	0.02
Depression × Public Sector	0.996	0.663	2, 318	NS	0.00
Depression × Private Sector	0.986	2.283	2, 318	NS	0.01
Depression × Housewife/ Househusband	0. 993	1.152	2, 318	NS	0.00

BAS scales in the Indonesian context as well as other cultures are needed to further validate our revised versions. Our MANCOVA showed that the SCS Independent and BAS subscales were associated with depression.

Table 7. Multivariate test for the original behavioral inhibition system/behavioral activation system scale.

Variables	Wilk's	F	df	Sig.	η^2
Depression (Yes = 1, No = 0)	0.766	24.263	4, 317	<0.001	0.23
Gender: Female = 1, Male = 0	0.9974	0.251	4, 317	NS	0.00
Age Class	0.917	1.734	16, 969	0.036	0.02
Religion: Islam = 1, Others = 0	0.994	0.518	4, 317	NS	0.00
Education High	0.980	1.581	4, 317	NS	0.02
Education: Middle	0.999	0.041	4, 317	NS	0.00
Occupation: Public Sector	0.989	0.895	4, 317	NS	0.01
Occupation: Private Sector	0.989	0.871	4, 317	NS	0.01
Occupation: Housewife/ Househusband	0.995	0.359	4, 317	NS	0.00
Depression × Female	0.982	1.446	4, 317	NS	0.02
Depression × Age	0.926	1.548	16, 969	NS	0.02
Depression × Religion	0.982	1.425	4, 317	NS	0.02
Depression × High Education	0.984	1.248	4, 317	NS	0.02
Depression × Middle Education	0.991	0.707	4, 317	NS	0.00
Depression × Public Sector	0.997	0.232	4, 317	NS	0.00
Depression × Private Sector	0.969	2.525	4, 317	0.040	0.03
Depression × Housewife/ Househusband	0.991	0.741	4, 317	NS	0.00

Table 8. Multivariate test for the revised 13-item, three-factor behavioral inhibition system/behavioral activation system scale.

Variables	Wilk's	F	df	Sig.	η^2
Depression (Yes = 1, No = 0)	0.826	22.394	3, 318	<0.001	0.19
Gender: Female = 1, Male = 0	0.998	0.171	3, 318	NS	0.00
Age Class	0.922	2.173	12, 842	0.028	0.02
Religion: Islam = 1, Others = 0	0.996	0.417	3, 318	NS	0.00
Education: High	0.988	1.284	3, 318	NS	0.01
Education: Middle	0.998	0.169	3, 318	NS	0.00
Occupation: Public Sector	0.993	0.711	3, 318	NS	0.00
Occupation: Private Sector	0.984	1.673	3, 318	NS	0.02
Occupation: Housewife/ Househusband	0.998	0.230	3, 318	NS	0.00
Depression × Female	0.988	1.286	3, 318	NS	0.01
Depression × Age	0.937	1.743	12, 842	NS	0.02
Depression × Religion	0.994	0.694	3, 318	NS	0.00
Depression × High Education	0.994	0.687	3, 318	NS	0.00
Depression × Middle Education	0.994	0.617	3, 318	NS	0.00
Depression × Public Sector	0.999	0.116	3, 318	NS	0.00
Depression × Private Sector	0.973	2.868	3, 318	0.036	0.03
Depression × Housewife/ Househusband	0.988	1.292	3, 318	NS	0.01

These findings are useful to guide provision of appropriate treatment for patients based on their social and cultural environment. In addition, our findings contribute to building understanding of reasons for the increasing prevalence of depression in Indonesia, which is undergoing rapid social change from traditional collectivism to global individualism.

Previous studies that used these scales also showed within-country differences in self-construal, either between different regions or between different ethnic groups [40, 41, 42, 43]. Indonesian people are generally known as collectivistic and interdependent, but the country comprises thousands of islands and with more than 1000 ethnic groups; therefore, people in rural areas may still be collectivist, whereas those in the cities may be more Westernized and individualistic. Further studies

are necessary among other Indonesian ethnic groups at different stages of Europeanization and with different cultures.

Declarations

Author contribution statement

Triana Istiqlal: Performed the experiments; Analyzed and interpreted the data; Wrote the paper.

Andi Agus Mumang; Kristian Liaury; Andi Jayalangkara Tanra; Hana Shimizu-Furusawa: Performed the experiments; Analyzed and interpreted the data.

Yukiko Uchida; Masahiro Kihara; Takafumi Ishida: Conceived and designed the experiments; Analyzed and interpreted the data.

Irawan Yusuf: Conceived and designed the experiments; Performed the experiments.

Takuro Furusawa: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Wrote the paper.

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Data availability statement

Data included in article/supp. material/referenced in article.

Declaration of interest's statement

The authors declare no conflict of interest.

Additional information

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