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Japanese version of the Brief Sense of Community Scale: construct validity and reliability

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Abstract

Background: The Brief Sense of Community Scale is a widely accepted eight-item scale that measures the four dimensions of sense of community; however, the factor structure of the Japanese version of this scale has never been confirmed. In this study, we demonstrated the reliability and validity of the Japanese version of the Brief Sense of Community Scale.

Methods: After completing the back translation of the scale, a sample of 993 Japanese individuals completed the Japanese version of the Brief Sense of Community Scale.

Results: The results indicate that the Japanese version of the Brief Sense of Community Scale is comparable to the original scale and demonstrated adequate goodness-of-fit for both the four-factor and second-order models, which demonstrates its validity. Nonetheless, it remains necessary to consider possible cross-national cultural concerns when utilizing the scale.

Conclusions: The Japanese version of the Brief Sense of Community Scale will contribute toward the creation of a community in which all members feel comfortable.

Keywords: Brief Sense of Community Scale (BSCS), Confirmatory factor analysis, Gender, Japanese, Psychological sense of community, Reliability, Validity

Background

Sense of Community (SOC)—sometimes also called “psychological sense of community”—refers to “a feeling that members have of belonging, a feeling that members matter to one another and to the group, and a shared faith that members’ needs will be met through their commitment to be together” [1]. The concept of SOC has mainly evolved from the theoretical framework of McMillan and Chavis [1], which emphasizes the following four

core dimensions of SOC: need fulfilment (a sense that members’ needs will be met by the resources received by their group membership); membership (a shared sense of personal relatedness or belonging to the community); influence (a sense of mattering to group members or community, such as by making a difference in the group); and emotional connection (a belief among members related to a shared history, place, time, and experiences).

Nonetheless, some researchers have argued that the four dimensions of SOC are not relevant for the measurement of SOC in a statistical sense [2, 3]; it has frequently been reported that measurements including reversal items or response methods cannot provide statistical clarity of the SOC for any samples [2, 4]. Additionally, the necessity of a measure including fewer

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items, which can be utilized in various community contexts, has been raised [2, 5].

To address these problems, Peterson et al. [5] created the Brief Sense of Community Scale (BSCS) and confirmed its reliability and validity. Comprising only eight items, the BSCS can not only measure the four SOC dimensions proposed by McMillan and Chavis [1] but can also represent a robust factor structure [5]. Recently, BSCS has gained attention for its applicability in various community studies, such as those among youth [6, 7], LGBT individuals [8], and residents [5]; moreover, it has been translated to several non-English languages [9]. BSCS is widely used in Asia, including China [10–13], Korea [14], Vietnam [15], and Japan [16], as well as in the Western community. However, problems exist in the BSCS used in Asia, such as the translation process being unclear [10–19] and back translate being performed but not examined for validity [20]. In addition, the factor structure of the BSCS has not been examined, and many studies use the BSCS as a one-factor [10–20]. We believe that it is necessary to clarify the factor structure of the BSCS in Asia and to verify its validity to make cross-national comparisons with the Western community. We conducted the present study in Japan as the first step, and the findings can be compared with those in other regions of Asia in the future.

It is noteworthy that the most SOC studies in Japan developed their own measures instead of adopting Western ones [21–23]. This is because the strong influence of Japan's unique socio-cultural contexts, such as “*ie*” (household) and “*mura*” (village community), can hinder the accurate translation of a measure to Japanese [21]. Nonetheless, the independent measures developed in Japan cannot be considered suitable for application in future cross-national studies on SOC. The Japanese version of the BSCS will resolve this issue of the generalization of SOC measurements.

Considering this situation, we developed a Japanese version of the BSCS and examined its reliability and validity within a sample of Japanese community residents. To verify the “criterion-related validity,” we also used the Sense of Community Scale 2 (SCI-2), Community Consciousness Scale (CCS [21, 22]), and Center for Epidemiologic Studies Depression Scale (CES-D [24]). Below, we briefly explain why each of the three scales were used for the criterion-related validity test.

- (i) SCI-2: As a McMillan-Chavis four-factor structure was confirmed in SCI-2 by increasing the number of items, eliminating inverted items, and making changes to the required responses, it is expected that all factors of SCI-2 would be positively cor-

related with those of the Japanese version of the BSCS.

- (ii) CCS: CCS is a widely accepted measure of SOC that was developed in Japan and includes the roles of the government and initiatives by citizens of the community. [21, 22]
- (iii) CES-D: SOC has been shown to improve an individual's mental health [1, 25, 26], and CES-D, a measure of depression, is negatively correlated with BSCS. [5, 11, 12, 18]

Methods

Participants

The survey was outsourced to an online survey agency (Cross Marketing Co., Ltd.). Participants were Japanese residents from various age groups and regions who provided their consent to participate. The survey was conducted such that the number of men and women and those in each age group were approximately equal. In total, 1000 Japanese people were recruited to participate in the survey in November 2021. Excluding a few suspicious responses (such as those with the same answers throughout the questionnaires), the responses of 993 participants (498 men and 495 women) were used for further statistical analysis. The mean and standard deviation of the ages were 49.55 years and 16.74 years, respectively. Among the participants, 33.53% were aged 18–39, 31.13% were aged 40–59, and 33.33% were aged 60 or older. In terms of educational level, 2.11% were less than high school educated, 29.41% had completed high school, 19.64% had graduated from junior college or vocational school, 43.20% had earned a bachelor's degree, and 5.64% had a master's degree or higher. A total of 53.07% of the participants lived in the eastern region of Japan (Hokkaido, Tohoku, Kanto region) and 49.63% in the western region (Chubu, Kinki, Chugoku, Shikoku, Kyushu, Okinawa region). In addition, the eastern and western regions have different cultures (e.g., food flavoring) [27]. Thus, both regions are geographically and culturally different. As the Chubu region can be considered either to the east or the west [28], it was classified as the western region in this study.

Measures

Japanese version of the BSCS

The BSCS, created by Peterson et al. [5], comprises eight items scored on a 5-point Likert-type scale (ranging from 1 = strongly disagree to 5 = strongly agree) to assess the four dimensions of SOC (needs fulfilment, membership, influence, and emotional connection). The scale's reliability was confirmed by an internal consistency of Cronbach's $\alpha = 0.85 \sim 0.92$ [5, 7]. We translated the BSCS into

Japanese after obtaining permission and performed the standard procedure of back-translation with advice from Dr. Peterson.

Sense of Community Index 2 (SCI-2)

SCI-2 is a 24-item self-report scale that adopts the theoretical framework of McMillan and Chavis [1]; its four subscales are “reinforcement of needs,” “membership,” “influence,” and “shared emotional connection.” [29] The scale’s reliability was confirmed by an internal consistency of Cronbach’s $\alpha=0.91$ for the entire scale and $0.79\sim 0.86$ for the subscales [30]. The SCI-2 items are scored on a 4-point Likert scale ranging from 0 (not at all) to 3 (completely), with six items under each subscale.

Short version of Community Conscious Scale

The short version of community conscious scale is a 12-item self-report questionnaire [22]. This scale is a short version of the CCS [21, 31] considers SOC to be a multifaceted concept that included the roles of government and citizen agency in the community. The items are scored on a 5-point Likert-type scale ranging from 1 (disagree) to 5 (agree). This scale comprises the following four subscales, each including three items: solidarity (e.g., “I want to participate in voluntary activities in my community”), self-determination (e.g., “In the problem solving in the community, it is important to build up an equal partnership between the residents and administration”), attachment (e.g., “Because I live temporarily in this community, I have neither the concern of nor the attachment to my community”), and dependency on others (e.g., “It is acceptable that the residents leave the activities in improving their living environment in the community to more dedicated people”).

Japanese version of the Center for Epidemiologic Studies Depression (CES-D)

The Japanese version of the CES-D is a 20-item self-report scale that measures depression under the following four subscales: “somatic complaints,” “depressed affect,” “positive affect,” and “interpersonal problems” [32]. Participants respond to the 20 items based on their experiences within the past week on a 4-point Likert scale ranging from 0 (rarely or none of the time, less than 1 day) to 3 (most or all the time, 5–7 days).

Procedures

This study was approved by the Ethics Committee of the authors’ university. Participation was entirely voluntary. Before administering the questionnaire, the participants were informed of the survey overview and terms of confidentiality, and their consent was obtained. Cross

Marketing awarded the participants with reward points for completing the questionnaire.

Statistical analyses

Confirmatory factor analysis (CFA) was performed using the Mplus 8.1 statistical software package [33]. Additionally, the maximum likelihood estimator (ML) was applied for CFA estimation in this study. To test the goodness-of-fit, we conducted comparative fit index (CFI), Tucker–Lewis index (TLI), root mean square error of approximation (RMSEA), standardized root mean square residual (SRMR), Akaike’s information criterion (AIC), Bayesian information criterion (BIC), and Akaike’s Bayesian information criterion (ABIC). The cut-off values for acceptable model fit used in this study are: RMSEA ≥ 0.10 for poor fit and <0.06 for good fit; CFI >0.90 for acceptable fit and >0.95 for good fit; and SRMR <0.10 for acceptable fit and <0.08 for good fit [34, 35]. For additional analyses, multiple-group CFA was conducted to examine gender and region of residence (eastern or western region) invariance. Furthermore, measurement invariance was tested by creating three models: a configural model (no constraints), metric invariance model (with item loading constraints to be equal across groups), and scalar invariance model (with item loadings and item intercepts with simultaneous constraints to be equal across groups). Following the hierarchy of these nested models, they were compared with each other. We focused on the ratio of χ^2 to its degree of freedom, Δ CFI, Δ RMSEA and Δ SRMR as indicators in the model comparisons. Model invariance is indicated by $\Delta\chi^2/\Delta df$ of less than or equal to 5 and Δ CFI smaller than 0.01, accompanied by Δ RMSEA smaller than 0.015 and Δ SRMR smaller than 0.03 [36–38]. For the comparison of factor means, we followed guidelines [39] and demonstrated ΔM and p -value.

Other analyses were conducted using the program R version 3.6.3 [40]. Cronbach’s alpha coefficients, McDonald’s omega coefficients, and correlations between the Japanese BSCS and other measures were established by calculating the Pearson’s correlation coefficients. All statistical analyses used two-tailed tests. For all statistical evaluations, p values less than 0.05 were considered indicative of significant differences.

Results

Factor structure

The mean scores for each item of the Japanese BSCS are shown in Table 1. The mean values for each item ranged 2.33–3.10, with standard deviations ranging 0.91–1.04. Skewness and kurtosis were smaller than 1. Confirmatory factor analyses were used to examine the goodness-of-fit. Based on the original scale validation study [5], three

Table 1 Descriptive Statistics of the Japanese BSCS Items

	Mean	(SD)	Skewness	Kurtosis	Item 1	Item 2	Item 3	Item 4	Item 5	Item 6	Item 7	Item 8	NF	MB	IF	EC
Item 1	3.10	(.96)	-0.41	-0.12	-											
Item 2	3.06	(.94)	-0.29	-0.13	.80**	-										
Item 3	2.93	(1.03)	-0.22	-0.47	.56**	.61**	-									
Item 4	3.08	(1.04)	-0.37	-0.42	.53**	.57**	.86**	-								
Item 5	2.33	(1.04)	0.32	-0.65	.27**	.29**	.41**	.37**	-							
Item 6	2.65	(.91)	-0.12	-0.05	.41**	.46**	.51**	.48**	.61**	-						
Item 7	2.80	(1.04)	-0.16	-0.64	.49**	.54**	.71**	.70**	.52**	.66**	-					
Item 8	2.86	(1.04)	-0.18	-0.54	.45**	.52**	.71**	.69**	.49**	.61**	.84**	-				
NF	6.16	(1.81)	-0.38	0.00	.95**	.95**	.62**	.58**	.30**	.46**	.54**	.51**	-			
MB	6.02	(2.00)	-0.33	-0.34	.56**	.61**	.96**	.96**	.40**	.51**	.73**	.73**	.62**	-		
IF	4.97	(1.75)	0.19	-0.11	.37**	.41**	.51**	.47**	.91**	.88**	.66**	.61**	.41**	.51**	-	
EC	5.66	(2.00)	-0.21	-0.52	.49**	.56**	.74**	.73**	.53**	.67**	.96**	.96**	.55**	.76**	.66**	-
BSCS	22.81	(6.30)	-0.31	0.10	.71**	.76**	.86**	.83**	.63**	.75**	.88**	.85**	.77**	.88**	.77**	.90**

** $p < .01$

models were tested for use among Japanese participants (Fig. 1). As shown in Table 2, the four-factor and second-order models demonstrated acceptable fits, whereas the one-factor case did not. Therefore, although the second-order model had higher AIC, BIC, and ABIC than the four-factor model, we will examine the gender and region of residence invariances for both.

Multiple-group CFA was performed to examine the gender and region of residence invariances in both models. In the four-factor model, the metric invariance and configural models showed acceptable cutoff criteria (gender: $\Delta\chi^2/\Delta df = 1.46$, $\Delta CFI = -0.001$, $\Delta RMSEA = -0.006$ and $\Delta SRMR = 0.016$; region: $\Delta\chi^2/\Delta df = 0.98$, $\Delta CFI = 0.000$, $\Delta RMSEA = -0.006$ and $\Delta SRMR = 0.011$). The metric invariance and scalar invariance models

also showed acceptable cutoff criteria (gender: $\Delta\chi^2/\Delta df = 0.75$, $\Delta CFI = 0.000$, $\Delta RMSEA = -0.004$ and $\Delta SRMR = 0.001$; region: $\Delta\chi^2/\Delta df = 1.31$, $\Delta CFI = -0.001$, $\Delta RMSEA = -0.002$ and $\Delta SRMR = 0.003$). Consequently, the scalar invariance model was supported in the four-factor model (Table 3). Meanwhile, in the second-order model, the metric invariance and configural models were acceptable (gender: $\Delta\chi^2/\Delta df = 4.47$, $\Delta CFI = -0.004$, $\Delta RMSEA = -0.002$ and $\Delta SRMR = -0.019$; region: $\Delta\chi^2/\Delta df = 4.11$, $\Delta CFI = -0.004$, $\Delta RMSEA = -0.003$ and $\Delta SRMR = 0.010$). The metric invariance and scalar invariance models also showed acceptable cutoff criteria (gender: $\Delta\chi^2/\Delta df = 0.78$, $\Delta CFI = 0.000$, $\Delta RMSEA = -0.009$ and $\Delta SRMR = 0.000$; region: $\Delta\chi^2/\Delta df = 1.32$, $\Delta CFI = -0.001$, $\Delta RMSEA = -0.007$ and

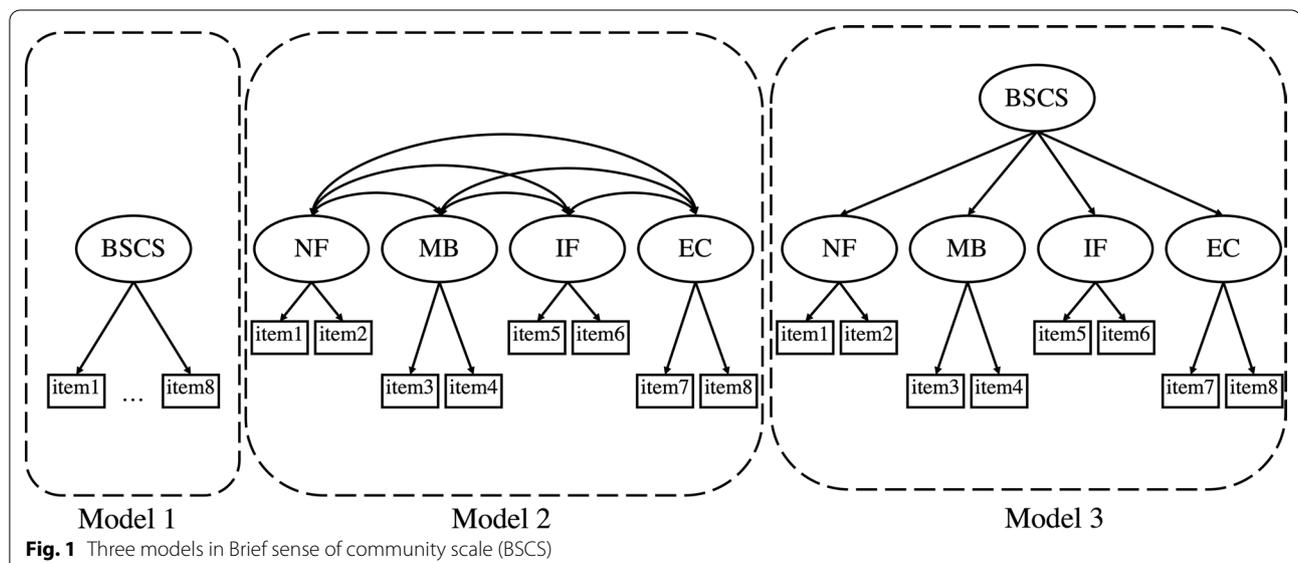


Table 2 Factor Loadings for the Japanese BSCS

Items (internal reliability)	Standardized loadings		
	1 factor	4 factor	Second-order
BSCS total ($\alpha = .91 / \omega = .91$)			
Needs Fulfillment ($\alpha = .89 / \omega = .89$)	–		.68
1 I can get what I need in this neighborhood	.62	.85	.85
2 This neighborhood helps me fulfil my needs	.68	.94	.94
Membership ($\alpha = .92 / \omega = .92$)	–		.86
3 I feel like a member of this neighborhood	.86	.94	.94
4 I belong in this neighborhood	.84	.91	.91
Influence ($\alpha = .75 / \omega = .75$)	–		.79
5 I have a say about what goes on in my neighborhood	.54	.69	.69
6 People in this neighborhood are good at influencing each other	.68	.89	.88
Emotional Connection ($\alpha = .91 / \omega = .91$)	–		.96
7 I feel connected to this neighborhood	.88	.93	.93
8 I have a good bond with others in this neighborhood	.86	.90	.90
χ^2	1312.56***	39.53***	140.76***
df	20	14	16
CFI	.785	.996	.979
TLI	.699	.992	.964
RMSEA	.255	.043	.089
90 Percent CI	.243–.267	.027–.059	.075–.102
SRMR	.081	.013	.035
AIC	17,874.910	16,613.880	16,711.110
BIC	17,992.528	16,760.902	16,848.330
ABIC	17,916.303	16,665.621	16,759.401

*** $p < .001$

Δ SRMR = -0.001). Therefore, the scalar invariance model was supported in the second-order model as well (Table 3).

Finally, the factor means were compared between genders. In the four-factor model, women had lower factor means than men for both IN and EC, which were all non-significant (NF: $\Delta M = 0.02, p = 0.73$; MB: $\Delta M = 0.01, p = 0.09$; IN: $\Delta M = -0.03, p = 0.60$; EC: $\Delta M = -0.02, p = 0.72$). Meanwhile, in the second-order model, women had lower factor means than men, which were not significant ($\Delta M = -0.02, p = 0.83$). Similarly, factor means were also compared between the regions. In the four-factor model, the western region had higher factor means than the eastern region with the exception of NF, which were not significant (NF: $\Delta M = -0.01, p = 0.81$; MB: $\Delta M = 0.07, p = 0.30$; IN: $\Delta M = 0.03, p = 0.55$; EC: $\Delta M = 0.10, p = 0.11$). Meanwhile, in the second-order model, the western region had higher factor means than eastern region, which were not significant ($\Delta M = 0.08, p = 0.23$). Thus, we did not find differences between the factor means of men and women, in the eastern and western regions either in the four-factor or the second-order models.

Reliability and validity of the BSCS

The descriptive statistics of the Japanese version of the BSCS are presented in Table 1, which indicates that the intercorrelations between all domains were significant, ranging from $r = 0.41$ to 0.76 . The values for the internal consistency reliability were acceptable for need fulfillment ($\alpha = 0.89 / \omega = 0.89$), membership ($\alpha = 0.92 / \omega = 0.92$), influence ($\alpha = 0.75 / \omega = 0.75$), and emotional connection ($\alpha = 0.91 / \omega = 0.91$), as well as for the total BSCS scores ($\alpha = 0.91 / \omega = 0.91$).

Table 4 shows the correlations between demographic variables and the four domains of the BSCS, and between BSCS and the other scales. Age was significantly associated with membership ($r = 0.16, p < 0.01$; 95% CI $0.06 \sim 0.27$) and emotional connection ($r = 0.14, p < 0.01$; 95% CI $0.03 \sim 0.24$). Additionally, educational level was significantly associated with needs fulfillment ($r = .15, p < 0.01$; 95% CI $0.05 \sim 0.25$). The correlations between all domains in the Japanese BSCS and SCI-2 were significant, ranging from $r = 0.29 \sim 0.56, p < 0.01$. All domains of the Japanese BSCS were significantly positively correlated with solidarity ($r = 0.39 \sim 0.54, p < 0.01$), self-determination ($r = 0.32 \sim 0.40, p < 0.01$), and attachment

Table 3 Measurement Invariance of Four factor model and Second-order model Among Gender Groups and Region Groups for the Japanese BSCS

	χ^2	df	CFI	RMSEA	SRMR	$\Delta\chi^2/\Delta df$	ΔCFI	$\Delta RMSEA$	$\Delta SRMR$
<i>Gender</i>									
Four factor model									
Male	41.72**	14	.991	.063	.014				
Female	43.57**	14	.990	.065	.025				
Multigroup analysis									
Configural	85.29**	28	.991	.064	.020				
Metric	96.96**	36	.990	.058	.036	1.46	-.001	-.006	.016
Scalar	102.92**	44	.990	.052	.037	.75	.000	-.004	.001
Second-order model									
Male	72.77**	16	.981	.084	.027				
Female	109.03**	16	.969	.108	.045				
Multigroup analysis									
Configural	181.80**	32	.975	.097	.037				
Metric	217.54**	40	.971	.095	.056	4.47	-.004	-.002	-.019
Scalar	223.80**	48	.971	.086	.056	.78	.000	-.009	.000
<i>Region</i>									
Four factor model									
East	27.31*	14	.996	.042	.017				
West	32.90**	14	.993	.054	.017				
Multigroup analysis									
Configural	60.21**	28	.995	.048	.017				
Metric	68.07**	36	.995	.042	.028	.98	.000	-.006	.011
Scalar	78.51**	44	.994	.040	.031	1.31	-.001	-.002	.003
Second-order model									
East	75.68**	16	.982	.084	.032				
West	96.80**	16	.970	.104	.045				
Multigroup analysis									
Configural	172.48**	32	.977	.094	.038				
Metric	205.35**	40	.973	.091	.048	4.11	-.004	-.003	.010
Scalar	215.94**	48	.972	.084	.047	1.32	-.001	-.007	-.001

* $p < .05$, ** $p < .01$

($r = 0.33 \sim 0.58$, $p < 0.01$) in the CCS. Dependency on others in the CCS demonstrated a significantly negative correlation with only membership ($r = -0.11$, $p < 0.01$). All factors of the Japanese version of the BSCS, except influence, were negatively correlated with CES-D ($r = -0.15 \sim -0.21$, $p < 0.01$).

Discussion

We developed the Japanese version of the BSCS and confirmed its four subscales—“needs fulfilment,” “membership,” “influence,” and “emotional connection”—through analyses of its factor. For the factor structure, acceptable goodness-of-fit was confirmed in both the four-factor and second-order models. The multiple-group CFA by gender and region of residence found identical factor

structures and non-differentiable factor loadings and intercept. Additionally, the factor means were not differentiable in the four-factor and second-order models. The BSCS has represented the same factor structures across various samples, such as in midwestern United states neighborhood residents [5], youth [6, 7], and LGB individuals [8]. Therefore, the factor structure of BSCS may show demonstrate robustness even in communities within different cultures and demographics. We also note that the four-factor and second-order models in this study, in addition to the previous study cases [5–8], showed adequate goodness-of-fit.

Let us discuss the correlations between the Japanese version of the BSCS and other measures, which can indicate acceptable reliability and validity of the Japanese BSCS. First, the significantly positive correlations

Table 4 Correlations between the Japanese BSCS and other scales

	α	ω	BSCS			
			NF	MB	IN	EC
Gender			.00	.00	-.03	-.01
Age			.07	.16**	.05	.14**
Education			.15**	.05	.10	.07
Live (month)			.04	.22**	.08	.19**
SCI-2						
Reinforcement of Needs	.94	.94	.42**	.49**	.49**	.56**
Membership	.92		.31**	.39**	.49**	.48**
Influence	.92	.92	.29**	.36**	.48**	.44**
Shared Emotional Connection	.93	.93	.36**	.44**	.47**	.52**
CCS						
Solidarity	.91	.91	.39**	.46**	.48**	.54**
Self-determination	.90	.90	.33**	.38**	.32**	.40**
Attachment	.50	.65	.42**	.58**	.33**	.56**
Dependency on others	.86	.86	.01	-.11*	-.02	-.09
CES-D	.91	.92	-.15**	-.21**	-.04	-.21**

** $p < .01$

between each factor of the BSCS and all factors of the SCI-2 indicate that the Japanese version of the BSCS corresponds to the four dimensions of McMillan and Chavis [1]. Second, in the correlations between the BSCS and CCS, we found that “solidarity,” “self-determination,” and “attachment” in the CCS were positively correlated with all factors of the BSCS; additionally, “dependence on others” in the CCS demonstrated a negative correlation with only “group membership” in the BSCS. As “dependence on others” is a factor that indicates an indifference toward local issues and reliance on unknown others to solve them [21, 22, 31], it is possible that the feeling of being a part of the community results in a decrease in the indifference toward the community. Third, CES-D was negatively correlated with the BSCS. This indicates that a sense of community is related to individual mental health in Japan, as in previous studies [5, 25, 26].

It is also remarkable that the correlations between the Japanese version of the BSCS and the demographic variables were generally consistent with those in previous studies [5, 8], and that the Japanese version of the BSCS had a factor structure in common with cases in previous studies [5–8]. Taken together, these results suggest that the BSCS has a robust factor structure, even across different cultures.

Limitations

This study has some limitations. We note that the relationships between the SOC and “community participation” could not be evaluated. As local activities remain

restricted due to COVID-19 in Japan [41], we did not continue to measure community participation as it may mislead further analysis. We hope that future studies will analyze the community participation from the perspective of the SOC.

The second limitation is that comparisons by place of residence could only be made for the broad categories of the eastern and western regions. In this study, respondents were asked about their place of residence, but only up to prefecture. It is possible that SOC may differ between those who live in urban areas and those who live in rural areas, even in the same prefecture. In the future, it will be necessary to examine differences by size of cities of residence and type of community, such as rural or urban.

The third limitation is related to the survey methodology; we used an online survey agency to collect data from participants of various ages and living across different areas of Japan. However, nonprobability online surveys, as in this study, have been noted to be less accurate than probability telephone and online surveys [42]. Therefore, it may be necessary to conduct a probability survey, or a survey of all members of a particular local community, to examine whether a similar factor structure can be obtained.

Finally, as this study was conducted on Japanese participants, it remains unclear whether the factor structure identified in the present study is also observed in other countries, particularly in Asia. In the future, it will be necessary to clarify the factor structure of the BSCS through cross-national comparisons.

Conclusions

Despite the abovementioned limitations, this study is the first in Asia to utilize the BSCS. The Japanese version of the BSCS was found to have good internal consistency. The positive correlations with other SOC scales and negative correlations with depression indicate that the validity of the Japanese BSCS is relatively comparable to the original BSCS. The Japanese BSCS is an 8-item scale for the assessment of SOC in Japanese communities, which will contribute to the creation of communities in which members feel a sense of “belonging.” Moreover, the Japanese version of the BSCS will enable cross-national comparative studies of SOC in the future.

Abbreviations

SOC: Sense of community; BSCS: Brief Sense of Community Scale; SCI-2: Sense of Community Scale 2; CCS: Community Consciousness Scale; CES-D: Center for Epidemiologic Studies Depression Scale; CFA: Confirmatory factor analysis; ML: Maximum likelihood estimator; CFI: Comparative fit index; TL: Tucker–Lewis index; RMSEA: Root mean square error of approximation; SRMR: Standardized root mean square residual; AIC: Akaike’s information criterion; BIC: Bayesian information criterion; ABIC: Akaike’s Bayesian information criterion.

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Author contributions

K.Y. and K.A. conceptualized the project. K.Y. collected the data. K.A. analyzed the data. K.Y. and K.A. wrote the manuscript. T.H. and K.W. contributed to the analysis and interpretation of the findings. T.H. and K.W. revised and edited the final manuscript. All authors read and approved the final manuscript.

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Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

This study has been approved by the research ethics committee of Hokkaido University of Education (No: 2021114002). Participants were informed about the survey overview and terms of confidentiality, and their informed consent was obtained. All methods were performed in accordance with the relevant guidelines and regulations.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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References

- McMillan DW, Chavis DM. Sense of community: a definition and theory. *J Community Psychol*. 1986;14(1):6–23. [https://doi.org/10.1002/1520-6629\(198601\)14:1%3c6::AID-JCOP2290140103%3e3.0.CO;2-I](https://doi.org/10.1002/1520-6629(198601)14:1%3c6::AID-JCOP2290140103%3e3.0.CO;2-I).
- Long DA, Perkins DD. Confirmatory factor analysis of the sense of community index and development of a brief SCI. *J Community Psychol*. 2003;31(3):279–96. <https://doi.org/10.1002/jcop.10046>.
- Vieno A, Perkins DD, Smith TM, Santinello M. Democratic school climate and sense of community in school: a multilevel analysis. *Am J Community Psychol*. 2005;36(3–4):327–41. <https://doi.org/10.1007/s10464-005-8629-8>.
- Peterson NA, Speer PW, Hughey J. Measuring sense of community: a methodological interpretation of the factor structure debate. *J Community Psychol*. 2006;34(4):453–69. <https://doi.org/10.1002/jcop.20109>.
- Peterson NA, Speer PW, McMillan DW. Validation of a brief sense of community scale: confirmation of the principal theory of sense of community. *J Community Psychol*. 2008;36(1):61–73. <https://doi.org/10.1002/jcop.20217>.
- Lardier DT Jr, Opara I, Cantu I, Garcia-Reid P, Reid RJ. The brief sense of community scale: testing dimensionality and measurement invariance by gender among Hispanic/Latinx youth. *J Community Psychol*. 2022;50(1):409–25. <https://doi.org/10.1002/jcop.22585>.
- Lardier DT Jr, Reid RJ, Garcia-Reid P. Validation of the Brief Sense of Community Scale among youth of color from an underserved urban community. *J Community Psychol*. 2018;46(8):1062–74. <https://doi.org/10.1002/jcop.22091>.
- Griffin JA, Eldridge-Smith ED, Kridel MM, Draheim AA, Stepleman LM. Validation of the Brief Sense of Community Scale in a lesbian, gay, and bisexual sample. *J Community Psychol*. 2022;50(1):576–91. <https://doi.org/10.1002/jcop.22638>.
- Wombacher J, Tagg SK, Bürgi T, MacBryde J. Measuring sense of community in the military: cross-cultural evidence for the validity of the brief sense of community scale and its underlying theory. *J Community Psychol*. 2010;38(6):671–87. <https://doi.org/10.1002/jcop.20388>.
- Au A, Lai DWL, Yip H, Chan S, Lai S, Chaudhury H, Scharlach A, Leeson G. Sense of community mediating between age-friendly characteristics and life satisfaction of community-dwelling older adults. *Front Psychol*. 2020;11:86. <https://doi.org/10.3389/fpsyg.2020.00086>.
- Huang Y, Wong H. Impacts of sense of community and satisfaction with governmental recovery on psychological status of the Wenchuan earthquake survivors. *Soc Indic Res*. 2014;117(2):421–36. <https://doi.org/10.1007/s11205-013-0354-3>.
- Huang Y, Tan NT, Liu J. Support, sense of community, and psychological status in the survivors of the Yaan earthquake. *J Community Psychol*. 2016;44(7):919–36. <https://doi.org/10.1002/jcop.21818>.
- Zheng W, Huang Y, Fu Y. Mediating effects of psychological resilience on life satisfaction among older adults: a cross-sectional study in China. *Health Soc Care Community*. 2020;28(4):1323–32. <https://doi.org/10.1111/hsc.12965>.
- Kim JI, Kono A, Yoshiyuki N, Kang J. Korean translation and validation of the community commitment scale for preventing social isolation in older adults. *Geriatr Gerontol Int*. 2018;18(5):806–12. <https://doi.org/10.1111/ggi.13249>.
- Le TH, Nakagawa Y, Kobayashi Y. Conditions under which rural-to-urban migration enhances social and economic sustainability of home communities: a case study in Vietnam. *Sustainability*. 2021;13(15):8326. <https://doi.org/10.3390/su13158326>.
- Tadaka E, Kono A, Ito E, Kanaya Y, Dai Y, Imamatsu Y, Itoi W. Development of a community’s self-efficacy scale for preventing social isolation among community-dwelling older people (Mimamori Scale). *BMC Public Health*. 2016;16:1198. <https://doi.org/10.1186/s12889-016-3857-4>.
- Guo Y, Liu Y, Lu S, Chan OF, Chui CHK, Lum TYS. Objective and perceived built environment, sense of community, and mental wellbeing in older adults in Hong Kong: a multilevel structural equation study. *Landsc Urban Plan*. 2021;209: 104058. <https://doi.org/10.1016/j.landurbplan.2021.104058>.
- Wu Q, Chow JCC. Social service utilization, sense of community, family functioning and the mental health of new immigrant women in Hong Kong. *Int J Environ Res Public Health*. 2013;10(5):1735–46. <https://doi.org/10.3390/ijerph10051735>.

19. Zhang J, Yu NX, Zhang J, Zhou M. Sense of community and life satisfaction in Chinese older adults: moderating roles of personal and partner resilience. *J Community Psych*. 2017;45(5):577–86. <https://doi.org/10.1002/jcop.21878>.
20. Kuwayama A, Sasao T. The role of social-ecological correlates of psychological well-being and parenting self-efficacy among Filipino migrant mothers in urban Japan. *Educ Stud*. 2020;62:21–37. <https://doi.org/10.34577/00004652>.
21. Ishimori M. Community consciousness and citizen's participation in community building: through a development of a community consciousness scale. *Jpn J Community Psychol*. 2004;7(2):87–98. https://doi.org/10.32236/jscjournal.7.2_87.
22. Ishimori M, Okamoto T, Kato J. Development of the short version of the community consciousness scale. *Jpn J Exp Soc Psychol*. 2013;53(1):22–9. <https://doi.org/10.2130/jjesp.1113>.
23. Sasao T, Koyama A, Ikeda M. Toward a new generation of faculty development programs: a community psychological perspective. *Int Christ Univ Publ*. 2003;45:55–71.
24. Radloff LS. The CES-D scale: a self-report depression scale for research in the general population. *Appl Psychol Meas*. 1977;1(3):385–401. <https://doi.org/10.1177/014662167700100306>.
25. Bailey M, McLaren S. Physical activity alone and with others as predictors of sense of belonging and mental health in retirees. *Aging Ment Health*. 2005;9(1):82–90. <https://doi.org/10.1080/13607860512331334031>.
26. Parker EA, Lichtenstein RL, Schulz AJ, Israel BA, Schork MA, Steinman KJ, James SA. Disentangling measures of individual perceptions of community social dynamics: results of a community survey. *Health Educ Behav*. 2001;28(4):462–86. <https://doi.org/10.1177/109019810102800407>.
27. Wang J, Kawada T, Sasazawa Y, Shimada O. Geographical difference in sodium and potassium concentrations of noodle soups in Japan. *Jpn J Health Human Ecol*. 1999;65(2):92–103. <https://doi.org/10.3861/jshhe.65.92>.
28. Shinmura I. Kojien. 7th ed. Tokyo: Iwanami-Shoten; 2017.
29. Chavis DM, Lee KS, Acosta JD. The sense of community (SCI) revised: the reliability and validity of the SCI-2. In: 2nd International Community Psychology Conference. Lisboa: Portugal; 2008.
30. Community Science. Sense of community index 2 (sci-2): background, instrument, and scoring instructions. [http://www.communityscience.com/pdfs/Sense of Community Index-2\(SCI-2\).pdf](http://www.communityscience.com/pdfs/Sense%20of%20Community%20Index-2(SCI-2).pdf). Accessed 20 May 2022.
31. Ishimori M. Relationship between sense of community and motivation to participate in NPO activities. *Nonprofit Rev*. 2007;7(2):67–73. <https://doi.org/10.11433/janpora.7.67>.
32. Shima SS, Kitamura T, Asai M. New self-rating scale for depression. *Seisun-Igaku*. 1985;27:717–23.
33. Muthén LK, Muthén BO. Mplus user's guide. 8th ed. Los Angeles: Muthén & Muthén; 2017.
34. Hu LT, Bentler PM. Cutoff criteria for fit indexes in covariance structure analysis: conventional criteria versus new alternatives. *Struct Equ Model*. 1999;6(1):1–55. <https://doi.org/10.1080/10705519909540118>.
35. Kline R. Principles and practice of structural equation modeling (methodology in the social sciences). 3rd ed. New York: Guilford Press; 2011.
36. Chen FF. Sensitivity of goodness of fit indexes to lack of measurement invariance. *Struct Equ Model*. 2007;14(3):464–504. <https://doi.org/10.1080/10705510701301834>.
37. Rosay AB, Gottfredson DC, Armstrong TA, Harmon MA. Invariance of measures of prevention program effectiveness: a replication. *J Quant Criminol*. 2000;16(3):341–67. <https://doi.org/10.1023/A:1007527022941>.
38. Wang J, Wang X. Structural equation modeling: applications using Mplus. Hoboken: John Wiley & Sons; 2019.
39. Van de Schoot R, Lugtig P, Hox J. A checklist for testing measurement invariance. *Eur J Dev Psychol*. 2012;9(4):486–92. <https://doi.org/10.1080/17405629.2012.686740>.
40. R Core Team. R: a language and environment for statistical computing. 2021.
41. Kuwahara K, Kuroda A, Fukuda Y. COVID-19: Active measures to support community-dwelling older adults. *Travel Med Infect Dis*. 2020;36: 101638. <https://doi.org/10.1016/j.tmaid.2020.101638>.
42. Yeager DS, Krosnick JA, Chang L, Javitz HS, Levendusky MS, Simpser A, Wang R. Comparing the accuracy of RDD telephone surveys and internet

surveys conducted with probability and non-probability samples. *Public Opin Q*. 2011;75(4):709–47. <https://doi.org/10.1093/poq/nfr020>.

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