

Psychometric properties evaluation of the Indonesian version of the Beck Scale for Suicide Ideation (BSSI) questionnaire using a Rasch model

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Abstract. – OBJECTIVE: This study used the Rasch model to evaluate the psychometric properties of the Beck Scale for Suicide Ideation (BSSI) questionnaire in the case of College Students. The BSSI is a measure for assessing suicidal ideation. Despite being a widely used instrument to examine suicidality, there is a limited report about the psychometric evaluation of its Indonesian version.

SUBJECTS AND METHODS: The BSSI was given to 103 Indonesian university students selected through a simple random sampling technique from various faculties. The sample in this study was aged between 19 and 21.

RESULTS: The results showed that the BSSI's factor structure was unidimensional, based on the evidence from a confirmatory factor in combination with Rasch analyses. The unidimensional indicates that the BSSI questionnaire measures one dominant variable, namely suicidal ideation. Furthermore, the items fit the model, their response categories functioned well, and no local item dependence was identified. The results of the BSSI questionnaire reliability test using Winstep show that item reliability and person reliability are 0.96 and 0.86, respectively. These results indicate that the items in the BSSI questionnaire can measure suicidal ideation accurately.

CONCLUSIONS: The results indicated that BSSI's psychometric properties were reliable and valid for measuring Indonesian college students' suicidal ideation.

Key Words:

BSSI, Suicidal ideation, Psychometric properties, Rasch model.

Introduction

Most students at the university level are in the adolescence stage. During this period, students

are very vulnerable to experiencing mental health problems. Adolescents with good relationships, high learning motivation, and resource optimization exhibit better mental health¹.

The mental health of adolescents is affected by protective and risk factors. Protective factors are an adaptation to growth, positive self-concept, problem-solving ability, and socializing. The risk factors include the desire to be free, pressure to adjust to peers, exploration of sexual identity, increased access to technology, quality of life, peer relationships, bullying, and socio-economic problems².

It is estimated that 10-20% of adolescents experience mental health problems worldwide². In Indonesia, the prevalence of mental-emotional disorders is 9.8%, and the prevalence of depression is 6.1%³. Several studies⁴⁻⁶ on adolescents' mental health reported identity moratorium in 57.4% of 265⁴, suicide ideation in 55.2% of 422⁵, risk of suicide in 70% of 2296, and drugs in 10.17% of 796 students in Jakarta⁴. The low mental health of adolescents was observed in 53.7% of 972 adolescents⁵. The proportion of victims of bullying at junior and senior high school levels in big cities is 66.1% and 67.9%, respectively⁷. Meanwhile, data from "Universitas Indonesia" showed that 64.8% of 441 students had suicidal ideation⁸.

The Beck Scale for Suicide Ideation (BSSI)⁹ is the self-report version of the interviewer-administered SSI¹⁰. It is one of the most widely used instruments for assessing suicidal thinking. Furthermore, it helps to identify suicidal individuals when they are willing to acknowledge and share their thoughts. The BSS serves as a routine screening for existing suicidal thoughts (BSS-Screen) and can also aid in a more extensive exploration of the severity (total BSS score).

It can be administered in various settings, such as psychiatric-psychotherapeutic care, general medical services, and forensic psychiatry. The routine screening, consisting of only five items, can be considered very time-efficient.

The BSSI has proven¹¹ to be reliable across many different settings and samples, showing good internal consistency. Evaluations of the psychometric qualities of the BSSI questionnaire have been documented in previous research^{11,12}. Kliem et al¹¹, in their investigation of the German Beck Scale for Suicide Ideation, evaluated the psychometric properties of the BSSI questionnaire that had been translated into Persian. Ozelik et al¹² conducted a study to evaluate the reliability and validity of this questionnaire, which had been translated into Turkish. However, previous relevant studies^{11,12} still used the classical test theory approach to evaluate psychometric properties.

This study aims to analyze the psychometric features of the Indonesian version of the Beck Scale for Suicide Ideation (BSSI) questionnaire using a Rasch model: the case of college students' suicidal ideation at "Universitas Indonesia".

Subjects and Methods

Participants

The participants in this study consisted of 103 students from various faculties at Universitas Indonesia. There were 62 females and 41 males aged 19 to 21 (mean age = 19, SD = 0.602). The sample used in this study was obtained using the non-probability sampling method. Based on the references used, the sample size in this study meets the requirements to be analyzed using the Rasch model.

Data was collected through an online survey using Google Forms. The distribution of the Google Form link to faculties at the University of Indonesia was assisted by a student representative from each faculty. The research ethics approval was issued by the Faculty Of Nursing, University of Indonesia (No.: SK-212/UN2.F12.D1.2.1/ETIK2020). Participants who fill in the Google form link are first asked for their consent. The Google form link includes a brief explanation regarding the research objectives, instructions for filling in, and contact information for the research person. After filling in the Google Form link, participants will receive confirmation in the form of a reply email containing thanks for their participation.

Beck Scale for Suicidal Ideation (BSSI)

This 19-item scale measures the presence and intensity of suicidal thoughts one week prior to evaluation. It was developed by Kliem et al¹¹ in 1979. The BSSI and its screening items assess patients' thoughts, plans, and intent to commit suicide. Each is rated on an ordinal scale from 0 to 2, and the total score is 0 to 38. No cut-point was used to categorize the scores. Therefore, the scores of the screening part (first and fifth items) and the total scale for data analysis were used.

The first two clinical psychologists translated the instrument into Indonesian separately in this study. Subsequently, an independent person did a backward translation, and this version was compared with the original to detect any misunderstandings or errors.

Rasch Model

George Rasch introduced the Rasch model in 1960¹³. This model is probabilistic, which is revolutionary in the field of psychometrics. According to Wright and Masters¹⁴, this approach can overcome the weaknesses in classical test theory, which has been used globally. It is believed to increase the measurement accuracy of latent variables. The Rasch Model has been widely used in the development of measuring instruments in various fields, including mental health and psychology study¹⁵. Consequently, the Rasch Model was utilized in this study to examine the validity and reliability of the ideal instrument. This study makes use of the Rating Scale Model as the Rasch model (RSM)¹⁶ is very appropriate because it produces ordinal data that needs to be transformed into an interval scale to increase the measurements' accuracy¹⁷. RSM is a polytomous Item Response Theory model with the following mathematical equation^{18,19}:

$$P(X_{vi} = h) = \frac{\exp(h(\theta_v + \beta_i) + \omega_h)}{\sum_{l=0}^k \exp(l(\theta_v + \beta_i) + \omega_l)}$$

Where X is an ordinal items data matrix of size $n \times m$. K is items that have the same category. P(X) represents the probability that a v test taker will receive an h score on item i. θ_v represents the test taker parameter while β_i represents the item's location parameter. Each category h is symbolized by the ω_i parameter, which is constant across items. It implies that the differences are in the shift β_i between the items.

Statistical Analysis

Participants' response data to the BSSI questionnaire were analyzed using the Rasch Model. The Rasch analysis was conducted using WINSTEP Version 4.0.1²⁰. Data analysis tested the unidimensionality assumptions, items fit, reliability, and Differential Item Functioning (DIF). The unidimensional test uses criteria based on raw variance explained values with conditions > 20% (fulfilled), > 40% (good), and > 60% (special). Items fit explains whether the questionnaire items function normally in measuring suicidal ideation. The item fit criterion used is the outfit mean square (MNSQ) with an accepted value at the interval $0.5 < \text{MNSQ} < 1.5$. Furthermore, the criteria for an item that indicates bias is when its probability value is less than 5% (0.05).

Results

Dimensionality

The unidimensional assumption test was used to evaluate whether the BSSI questionnaire measured one dimension, namely the student's suicidal ideation. This is conducted with the Rasch model that uses principal component analysis of the residuals^{21,22} (Table I). The measurement model of the BSSI questionnaire was proved to be unidimensional, as shown in Table I. The value of raw variance explained by measures is 51%, and it has exceeded the minimum criteria, which are more than 20% (fulfilled), 40% (good), and 60% (special). In addition, the variance that cannot be explained by the instrument does not exceed 15%; therefore, it can be characterized as ideal.

Items Fit

Items fit explains the functionality of the items in measurement. There is a misconception on the

part of respondents about the items when a question is identified as unfit. The MNSQ outfit value range of 0.5 to 1.5 is a criterion that can be used to determine the level of the items fit^{14,17,23}.

It can be determined from the MNSQ column that all BSSI questionnaire items have MNSQ values between 0.48 and 1.50. Based on the evidence, it was confirmed that the BSSI items and response categories functioned well. Therefore, the questionnaire items have a decent quality for collecting data on suicidal ideation among students.

The item numbers are automatically sorted by difficulty level in Table II. This order is based on the measure column (Items Measure) value with logit units. The higher the logit value, the greater the difficulty of the questions. Finally, the score column shows the number of correct answers given by respondents. This logit calculation algorithm uses an odd ratio probability and logit transformation, which is believed to increase measurement accuracy.

Reliability

In the Rasch Model, reliability is estimated for both items and person¹⁷, as presented in Table III. The reliability of the BSSI questionnaire is 0.86 on a personal level. This shows that the respondents' answers are consistent. Therefore, this person's reliability value is in the excellent range.

Table IV indicates the item's reliability of the BSSI questionnaire was 0.96. This showed the consistency of the items/instruments in differentiating people on the measured variable (suicide ideation). This further indicated that the value is in the "special" category. Cronbach's Alpha value was also obtained, indicating the reliability of the interaction between the person and the items as a whole, which is 0.89 and in the "excellent" category.

Table I. The variance of standardized residual.

Standardized residual variance	Items informations units	
	Eigen value	Observed
Total raw variance in observations	38.75	100%
Raw variance explained by measured	19.75	51.0%
Raw variance explained by persons	6.722	17.3%
Raw variance explained by items	13.03	33.6%
Raw unexplained variance (total)	19.00	49.0%
Unexplained variance in 1 st contrast	3.8649	10.0%
Unexplained variance in 2 nd contrast	1.8639	4.8%
Unexplained variance in 3 rd contrast	1.7365	4.5%
Unexplained variance in 4 th contrast	1.5457	4.0%
Unexplained variance in 5 th contrast	1.2648	3.3%

Table II. Items Fit summary.

Entry No	Total Score	Total Count	Measure	Model S.E.	OUTFIT	
					MNSQ	ZSTD
9	10	103	1.62	0.35	0.99	0.2
17	11	103	1.50	0.34	0.59	-1.6
12	12	103	1.39	0.33	0.79	-0.7
16	15	103	1.10	0.30	0.55	-2.3
1	16	103	1.01	0.29	0.48	-1.4
14	19	103	0.77	0.27	0.68	-0.8
18	19	103	0.77	0.27	0.94	0.0
7	21	103	0.63	0.26	0.73	-0.3
3	22	103	0.56	0.26	0.70	-1.9
8	24	103	0.44	0.25	0.60	-2.0
15	30	103	0.10	0.23	0.52	-2.0
6	34	103	-0.10	0.22	0.81	-0.7
4	36	103	-0.19	0.21	0.52	-2.3
13	42	103	-0.45	0.20	1.00	0.1
2	58	103	-1.02	0.18	0.96	-0.2
5	58	103	-1.02	0.18	0.80	-1.2
10	84	103	-1.77	0.16	0.92	-0.5
19	106	103	-2.31	0.16	1.46	2.8
11	134	103	-3.00	0.16	0.79	-1.5

S.E.: standard error; MNSQ: mean-square or standardized fit statistics; ZSTD: value of Z standard.

Table III. Person reliability.

	Total Score	Count	Measure	Model S.E.	INFIT		OUTFIT
					MNSQ	ZSTD	MNSQ
Mean	7.3	19.0	-2.15	0.55	0.96	0.0	1.09
P.SD	5.9	0.0	1.20	0.13	0.37	0.9	1.49
S.SD	5.9	0.0	1.21	0.13	0.37	0.9	1.50
Max.	28.0	19.0	1.39	1.05	2.11	2.9	9.59
Min.	1.0	19.0	-4.53	0.37	0.36	-1.8	0.13

Real RMSE 0.59, True SD 1.05, Separation 1.77, Items Reliability 0.86. Model RMSE 0.56, True SD 1.06, Separation 1.88, Items Reliability 0.88, S.E. of Person Mean = 0.12.

Person raw score-to-measure correlation = 0.97. Cronbach alpha (KR-20) person raw score "test" reliability = .89 sem = 2.07. S.E.: standard error; SD: standard deviation; P.SD: population standard deviation; S.SD: sample standard deviation; RMSE: root mean square error; MNSQ: mean-square or standardized fit statistics; ZSTD: value of Z standard.

Table IV. Items reliability.

	Total Score	Count	Measure	Model S.E.	INFIT		OUTFIT
					MNSQ	ZSTD	MNSQ
Mean	39.5	103.0	0.00	0.24	0.86	-0.6	1.09
P.SD	33.6	0.0	1.28	0.06	0.46	2.8	1.57
S.SD	34.5	0.0	1.31	0.06	0.47	2.8	1.61
Max.	134.0	103.0	1.62	0.35	2.09	7.0	7.48
Min.	10.0	103.0	-3.00	0.16	0.38	-3.2	0.25

Real RMSE 0.26, True SD 1.25, Separation 4.86, Items Reliability 0.96. Model RMSE 0.25, True SD 1.25, Separation 5.01, Items Reliability 0.96, S.E. of Item Mean = 0.30.

S.E.: standard error; SD: standard deviation; P.SD: population standard deviation; S.SD: sample standard deviation; RMSE: root mean square error; MNSQ: mean-square or standardized fit statistics; ZSTD: value of Z standard.

Wright Map

The Wright Map is one of the hallmarks of the Rasch Model. According to Wang and Wilson²⁴, it shows the link between the levels of the “latent trait” of the person and also the “difficulty” of the items that can be directly compared. Figure 1 shows the Wright Map for the results of the BSSI questionnaire analysis.

The Wright Map on the left illustrates the ability of respondents. It is observed that respondents 01 and 07 had the lowest ability. This illustrated that they could easily agree with the given statement items. Meanwhile, those with high ability were indicated by 05 and 09, showing that they least easily agreed with the given item.

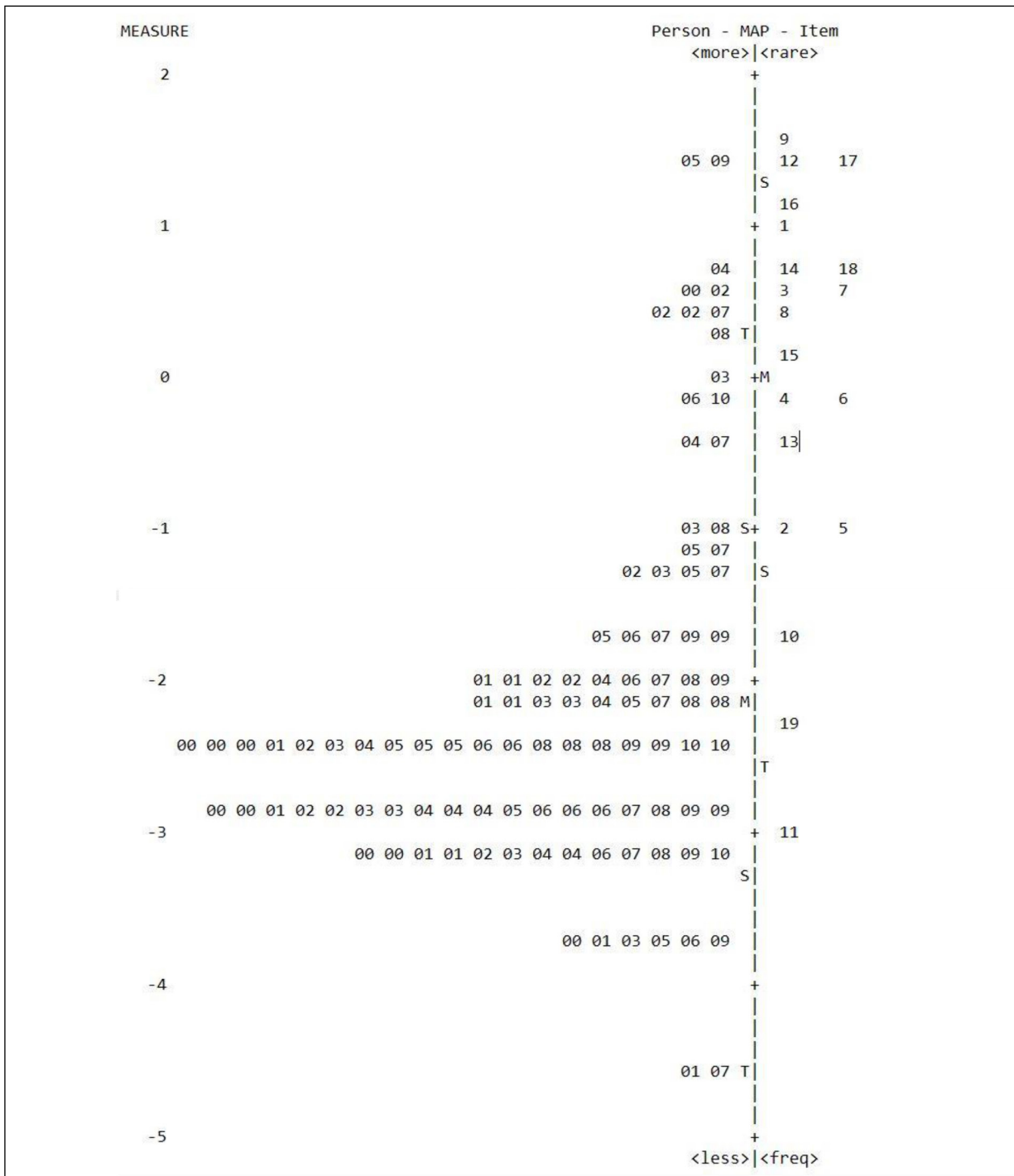


Figure 1. Wright Map.

The right-hand map showed the difficulty level of the items. The most challenging to answer for respondents is item 11, while the easiest is 9. By comparing the respondent's abilities and the level of difficulty of the items, the Wright Map reveals that the average logit item is 0.0 logit higher than the average logit person -2.1. This shows that the typical ability to answer questions is below the BSSI questionnaire's average difficulty level.

Differential Item Functioning (DIF)

A measure of the validity of an instrument is the items that do not contain let or known as DIF. An instrument or item is considered to be biased if the item does not provide an equal chance of answering correctly in two different groups of participants with the same ability²⁵.

The DIF analysis on the BSSI questionnaire was based on two groups of individuals divided by gender, namely L (male) and P (female). The following are the results of the DIF analysis with the Rasch Model.

Table V utilizes two data groupings based on gender. Bias detection was conducted in both groups. A piece is deemed biased when its probability value is less than 5%. According to the above table, all probability values are more than 0.05. The table above shows that all probability values are above 0.05. This indicates that the gender-based BSSI questionnaire has no item bias.

In addition to lifting probabilities, graphic visualization can detect item bias. Through graphs,

there is a significant difference between the distance between the two curves, indicating the presence of bias in certain items. Figure 2 shows the DIF graphic visualization.

Discussion

This study aims to analyze the psychometric features of the BSSI questionnaire, which has been translated into Indonesian and is used to quantify suicidal ideation among Universitas Indonesia students. Numerous prior research, such as a 2014 report by Esfahani et al²⁶, have assessed the psychometric qualities of BSSI questionnaires. In addition, Ozcelik et al¹² evaluated the reliability and validity of the Turkish-translated version of the Questionnaire. Previous evaluations still rely on the classical test theory approach. Increasing the level of accuracy in measuring suicidal ideation is important, through accurate measurements, it is expected to provide quality information. So that it can be used as a basis for compiling a strategy to prevent an increasing number of incidents. Research conducted by Kim et al²⁷ shows that suicide cases continue to increase, especially during a pandemic.

There has been no research that uses a modern test theory approach to evaluate the psychometric aspects of the BSSI Questionnaire in Indonesia, especially the modern Rasch Model test theory approach. The Rasch Model can increase the accuracy of measuring latent variables, specifically

Table V. DIF Class specification.

Person CLASSES	Summary DIF Chi-Square	D.F	Prob	Items Number	Name
2	.7726	1	.3794	1	1
2	.5060	1	.4769	2	2
2	1.5461	1	.2137	3	3
2	1.4848	1	.2230	4	4
2	1.3775	1	.2405	5	5
2	.0263	1	.8713	6	6
2	1.9113	1	.1668	7	7
2	.1432	1	.7051	8	8
2	1.2640	1	.2609	9	9
2	.0581	1	.8095	10	10
2	.7365	1	.3908	11	11
2	.4378	1	.5082	12	12
2	.3910	1	.5317	13	13
2	.0561	1	.8127	14	14
2	.1008	1	.7509	15	15
2	.1351	1	.7132	16	16
2	.2598	1	.6102	17	17
2	.0561	1	.8127	18	18
2	1.1430	1	.2850	19	19

D.F: Degrees of Freedom; Prob: Probability.

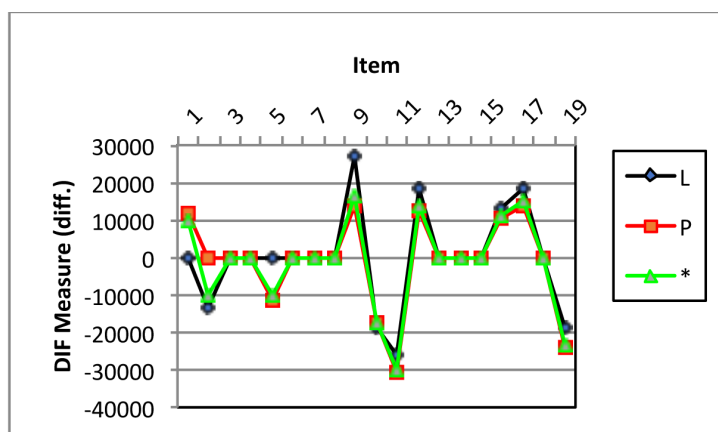


Figure 2. DIF graphic visualization. DIF: Differential item functioning.

suicidal ideation among students. It accommodates the probability approach in examining the attributes of a measuring object. This accommodation causes the Rasch Model to be non-deterministic, such that it can accurately identify the measured object²⁶.

Identification of measurement dimensionality helps in its optimization, such that the information provided is more focused on suicide ideation. The Rasch Model has a different perspective in identifying the dimensions of measurement. The existence of dimensions is not only identified based on the interrelationships between items because items with a high correlation may be a separate dimension. According to the Rasch Model perspective, a measure is stated to be multiple-dimensional when the analysis yields an inter-residual correlation (variance the model does not explain) of items above 0.3. There are other dimensional attributes that the model cannot explain when the correlation between the resulting residues is high.

Table I shows how much variance is explained by and outside the model. A value of unexplained variance in 1st contrast below 2 indicates that the unidimensionality of the measurements for the BSSI questionnaire was demonstrated.

The BSSI questionnaire items have an adequate validation value, as shown in Table II. Items fit summary reveals that the MNSQ value of the items ranges from 0.5 to 1.5. However, one item needs improvement, as its MNSQ score is 0.48 (item 1). However, if rounding is carried out, the MNSQ item 1 value is considered to have reached 0.5. Therefore, item 1 was still included for analysis in this study.

Rasch modeling provides a more thorough examination because it simultaneously evaluates the reliability of both items and person²⁷⁻³⁰. Outstanding reliability values for the BSSI questionnaire are 0.86 and 0.96. Establishing internal consistency to determine Cronbach's alpha coefficient is another

basic method utilized in the current investigation, giving a result of 0.89. This suggests that none of the scale items needs to be deleted to improve the values of the BSSI. However, there are limitations in this study. This research was conducted during the COVID-19 pandemic, so data collection was quite difficult, and the sample size used was still relatively small. This may have the potential to affect the accuracy of the measurements made. The COVID-19 pandemic also made permitting access to sampling at various universities more difficult.

Conclusions

Based on the results of the psychometric evaluation of the BSSI questionnaire in measuring students' suicidal ideation, it was concluded that the BSSI questionnaire met the criteria for validity, and reliability, and had no potential for item bias (DIF). Therefore, this questionnaire can be considered appropriate and recommended for suicidal ideation among University of Indonesia students. Future research could use other modern test theory approaches, such as item response theory, to evaluate the psychometrics of the BSSI questionnaire in an effort to increase the accuracy of measuring suicidal ideation.

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Authors' Contributions

All authors contributed equally to conceptualization and methodology, data analysis, and interpretation, drafted the manuscript, and agreed with the final version of the article.

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Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability

The datasets generated during and/or analyzed during the current study are not publicly available due to subject confidential information but are available from the corresponding author upon reasonable request.

Ethics Approval

The study protocol was approved by the Faculty of Nursing, University Indonesia (SK-212/UN2.F12.D1.2.1/ETIK2020).

Informed Consent

All participants provided written informed consent.

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