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Original Article

Evaluation of the Factor Structure and Validation of an Electronic Version of the Loneliness Scale for Iranian Youth: A Perspective Based on Aune's Framework

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Abstract

Background and aims: The increasing prevalence of loneliness in the digital age and its impact on social behaviors underscore the necessity for developing online tools to assess this phenomenon. The present study aims to evaluate the validity of the electronic version of the University of California, Los Angeles (UCLA) Loneliness Scale.

Methods: This methodological research employed psychometric techniques. The study population comprised youth in Tehran during the 2021-2022 period. The sample size was determined according to psychometric criteria, involving 100 participants for the assessment of convergent validity and 690 participants for construct validity. Participants were selected using cluster sampling. Data were collected through two scales: the loneliness scale developed by Aune and the loneliness scale created by Asher, Hymel, and Renshaw, administered in both printed and electronic formats via a questionnaire link sent to participants' mobile phones. To evaluate the validity of the scale, methods such as content validity, convergent validity, and factor analysis were employed. The reliability of the scale was assessed using internal consistency and split-half reliability methods.

Results: The exploratory factor analysis revealed that the researcher-developed questionnaire comprises three factors and demonstrates adequate validity and reliability. Confirmatory factor analysis further supported the three-factor model. This questionnaire was administered alongside the loneliness scale proposed by Aune, which exhibited satisfactory reliability and validity with 16 items ($P<0.001$).

Conclusion: The 16-item loneliness scale proposed by Aune is a valid tool for assessing feelings of loneliness among youth.

Keywords: Loneliness, Youth, Factor structure, Validation

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Introduction

Loneliness is defined by both objective and subjective conditions (1). Each type possesses distinct structural characteristics (2). Objective loneliness refers to the absence of meaningful relationships with others (3), while subjective loneliness pertains to the distressing personal experience that arises from the discrepancy between expected social relationships and actual relationships (4). It is important to note that individuals do not necessarily experience feelings of loneliness in the absence of a social network, nor do they inevitably feel lonely when they have a limited social network (5). Conversely, some individuals may experience loneliness despite having a genuine social network (6). Thus, it can be asserted that feelings of loneliness are strongly related to the quality and quantity of social interactions (7). Feelings of loneliness can lead to significant consequences, including an increased prevalence of various diseases and a reduced life expectancy (8, 9). Among these diseases are Alzheimer's disease (10), cardiovascular disorders (11), and cancer (12). Additionally, feelings of loneliness are associated with a heightened risk of depressive symptoms (13), daydreaming (14), suicidal behavior (15), and a decrease in overall happiness (16).

Extensive research has been conducted to examine the factors contributing to feelings of loneliness. Some studies indicate that the absence of social relationships can lead to emotional and social loneliness (17). Emotional loneliness manifests as the lack of emotional support from a partner or close friend (18), while social loneliness arises from inadequate supportive resources from social groups such as friends, colleagues, or neighbors (1). However, a

quantitative and objective lack of social relationships does not directly and inevitably result in loneliness (19). Instead, the subjective evaluation of relationships and expectations regarding those relationships significantly influences feelings of loneliness (20). It has been confirmed that individuals with unsatisfactory friendships are more likely to experience feelings of loneliness (21). In the etiology of loneliness, factors such as genetic predispositions (22), loneliness as an adaptive response that motivates social connection (23), and the interaction between genetic and social factors (24) have also been referenced.

Given the increasing prevalence of loneliness in the digital age and its effects on social behaviors, the development of online tools to assess this phenomenon presents a strategic opportunity for timely interventions. These tools not only facilitate confidential self-assessments for users but also leverage demographic data to identify broader patterns that can inform the design of public health programs. Consequently, identifying individuals at risk of experiencing loneliness is essential for implementing effective interventions and expanding research. Various instruments have been introduced to measure feelings of loneliness. One such tool is the Los Angeles Loneliness Scale, developed by Russell, Peplau, and Ferguson, which includes three versions: a 20-item scale, an 8-item scale, and a 3-item scale, all utilizing a four-point Likert scale (never, rarely, sometimes, often) and consisting of a unidimensional construct (25). Another scale is the De Jong Gierveld Loneliness Scale, available in three versions: a 34-item scale, an 11-item scale, and a 6-item scale. This scale employs a three-point Likert scale (no, somewhat, yes) and consists of a general unidimensional construct (26). Additionally, the Social and Emotional Loneliness Scale for Adults, developed by Spencer, Derlega, and Boulton, comprises 15 items on a seven-point Likert scale, encompassing dimensions of emotional loneliness (family and romantic) and social loneliness (27).

The scales mentioned above have been validated for their reliability and validity in numerous studies (28-30). However, these tools are at least 30 years old, and significant changes in social and familial relationships have occurred over this time. Contemporary life is a multifaceted amalgamation of evolving technology and social media, which have profoundly impacted individuals' lives (29, 31). Despite its numerous advantages, technology has also contributed to the increased prevalence of various ailments, including loneliness, within society (32). Furthermore, the transformations occurring in modern societies have altered the concept of loneliness, suggesting that older loneliness scales may lack the necessary validity to accurately assess feelings of loneliness in today's context. Therefore, the development of a valid tool that reflects current global conditions is essential.

A new instrument introduced by Aune in 2019 aims to address the limitations of previous scales and accurately assess loneliness in light of social and technological changes. This tool comprises three dimensions: 1) Intimate loneliness (items 1, 3, 5, 10, 12, 15, 16), 2) Relational/social loneliness (items 6, 8, 9, 11, 13, 14), and 3) Physical loneliness (items 2, 4, and 7) (33).

With the expansion of internet technology, the use of psychometric tools in electronic formats has become increasingly widespread. However, the paper-based and electronic versions of the Loneliness Scale developed by Aune et al have not yet been validated in Iran (33). Given the potential differences in response patterns, reliability, and validity between paper-based and digital formats, independent validation of the electronic version is essential—particularly within the cultural context of Iran, where limited studies have addressed this issue.

Considering the growing prevalence of loneliness among adults, as well as the advantages of electronic tools—such as easy access, cost-effectiveness, and scalability—this study aims to examine the factor structure and validate the electronic version of the brief assessment of loneliness scale (BALS) among this age group. In comparison to previously introduced tools, the BALS is concise, straightforward, and unidimensional. Its electronic format, while maintaining strong psychometric properties, offers practical applicability for large-scale screening and mental health interventions.

Materials and Methods

This study employed a methodological design to evaluate the psychometric properties of the Loneliness Scale developed by Aune et al targeting young adults in Tehran during the year 2021 (35). A convenience sampling method was utilized for data collection, which was conducted online. Given the study's emphasis on factor analysis, a sample size of 785 participants was selected to ensure statistical robustness (34-37).

To facilitate the completion of the questionnaires, they were initially prepared in electronic format on the Porsline website. The survey link was subsequently distributed through social media platforms, reaching individuals, groups, and other accessible channels. Ultimately, a total of 785 questionnaires were completed electronically. Demographic characteristics, including gender, age, education, employment, and marital status, were recorded and collected from the participants. The inclusion criteria for the study required voluntary participation, an age range between 18 and 35 years, and residency in Tehran. The exclusion criterion was the failure to complete the questionnaires.

Aune's Loneliness Scale

The scale consists of 16 items that assess various dimensions of loneliness, including feelings of not being understood by others, a lack of belonging to any specific group, thinking differently from others, fatigue from attempting to fit into groups, feelings of rejection, the experience of being understood by someone, and difficulties in interpersonal relationships. These items are rated on a 4-point Likert scale (not at all, a little,

quite a bit, always). Aune et al reported that the content validity, construct validity, and reliability of the scale, as measured by Cronbach's alpha, are at an acceptable level (0.80). Convergent validity was supported by a strong correlation (0.76) with the University of California, Los Angeles (UCLA) Loneliness Scale, while divergent validity was confirmed by a negligible correlation with socially desirable responding. Additionally, reliability coefficients, including Cronbach's alpha (0.80) and ordinal alpha (0.87), indicate high internal consistency of the instrument (33).

The Loneliness Scale by Asher, Hymel, and Renshaw

The scale comprises 24 items rated on a 5-point Likert scale (ranging from strongly agree to strongly disagree) and includes two dimensions: social loneliness (items 3, 6, 12, 14, 17, 18, 20, 21, and 24) and emotional loneliness (items 1, 4, 8, 10, 16, and 22) (38). Its validity and reliability have been confirmed in various studies (39), and these psychometric properties have also been established in the Iranian context (40). In the current study, the reliability coefficient was calculated using Cronbach's alpha, yielding values of 0.86 and 0.89.

Data analysis was conducted using SPSS version 22 and LISREL version 8. Descriptive statistics were employed to estimate frequencies and percentages. To assess content validity, the Content Validity Ratio (CVR) and Content Validity Index (CVI) were calculated. For evaluating convergent validity, Pearson correlation coefficients were computed between the scores of Aune's 16-item Loneliness Scale and the Asher, Hymel, and Renshaw Loneliness Scale. To examine construct validity and determine the factor structure of the scale under investigation, exploratory factor analysis was performed using principal component analysis with Varimax rotation. In this analysis, factors with eigenvalues greater than 1 were considered principal factors (35). Confirmatory factor analysis was also utilized to assess the fit of the scale.

Results

Descriptive information regarding the study samples is presented in Table 1 as follows.

During the content validity phase, all questions were reviewed and approved by three experts. The CVR for the 16 items of the scale ranged from 68% to 89% (41). According to the Lawshe table, a CVR greater than 0.62 is required when evaluating 10 experts (42). The CVI was estimated at 0.74, which is considered acceptable; the minimum acceptable value for the CVI is 0.70 (42).

To examine the correlation between participants' scores on each item and their total score on Aune's 16-item Loneliness Scale, Pearson correlation coefficients were utilized. The results indicated that all items exhibited a positive and significant correlation with the total score, ranging from 0.32 to 0.53. To assess convergent validity, the electronic version of Aune's 16-item Loneliness Scale was administered alongside the 24-item Loneliness Scale developed by Asher, Hymel, and Renshaw. The results

Table 1. Descriptive information of the study samples

Scale	Subscale	Number	Percentage	Cumulative Percentage
Gender	Male	390	49.68	49.68
	Female	395	50.32	100
Education	Less than a diploma	99	12.61	12.61
	Diploma	151	19.24	31.85
	Associate degree	96	12.23	44.08
	Bachelor's degree	328	41.78	85.86
	Higher than a bachelor's degree	111	14.14	100
Marital Status	Single	588	74.90	74.90
	Married	197	25.10	100
Job	Student	493	62.80	62.80
	Unemployed	139	17.71	80.51
	Employed	153	19.49	100
Age	Under 25 years old	579	73.76	73.76
	Over 25 years old	206	26.24	100

demonstrated a significant and positive correlation between the electronic form of Aune's 16-item Loneliness Scale and the 24-item Loneliness Scale ($r = 0.54$, $P < 0.001$).

To determine whether the correlation matrix among the items of the scale was suitable for factor analysis, both the measure of sampling adequacy and Bartlett's test of sphericity were employed (33). The results indicated that the value of Bartlett's test for the current study was 0.87, demonstrating an adequate sample size; thus, the sample was sufficient for this analysis ($P = 0.005$, $df = 120$, $\chi^2 = 3181.40$). The results confirmed that conducting factor analysis on the obtained data was justifiable. For effective factor analysis, values of 0.60 and above are required for the measure of sampling adequacy, and it can be concluded that the data are suitable for factor analysis if the Bartlett test is significant at an acceptable level (35).

The results of the factor loading analysis indicated that all items had factor loadings greater than 0.5, leading to the retention of all items. Furthermore, the results revealed that the scale comprises three factors, which collectively explain a total of 63.36% of the variance based on the principal component method with Varimax rotation. Specifically, the first factor accounts for 27.98% of the variance, the second factor for 22.88%, and the third factor for 12.50% of the variance. The identified factors are: 1) intrinsic loneliness (items 1, 3, 5, 10, 12, 15, 16), 2) supportive loneliness (items 6, 8, 9, 11, 13, 14), and 3) physical loneliness (items 2, 4, and 7) (Table 2, Table 3).

Subsequently, the overall fit indices for the 16-item Loneliness Scale are presented in Table 3. Based on the results of various fit indices, including the chi-squared to degrees of freedom ratio (Chi-squared/df), Goodness of Fit Index (GFI), Adjusted Goodness of Fit Index (AGFI), Normed Fit Index (NFI), Comparative Fit Index (CFI), Incremental Fit Index (IFI), Parsimony Normed Fit Index (PNFI), and Root Mean Square Error of Approximation

Table 2. Total explained variance of the loneliness scale in youth in Tehran in the year 2021 (n=437)

Dimensions	Factors that remain in the analysis			Extracted eigenvalues without rotation			Extracted eigenvalues with rotation		
	Final	Percentage of variance	Cumulative percentage	Final	Percentage of variance	Cumulative percentage	Final	Percentage of variance	Cumulative percentage
1	4.74	29.61	29.61	4.74	29.61	29.61	4.48	27.98	27.98
2	3.57	22.34	51.95	3.57	22.34	51.95	3.66	22.88	50.87
3	1.83	11.42	63.36	1.83	11.42	63.36	2.00	12.50	63.36
4	0.71	4.42	67.78						
5	0.61	3.81	71.59						
6	0.56	3.52	75.11						
7	0.52	3.26	78.37						
8	0.51	3.18	81.55						
9	0.46	2.86	84.41						
10	0.44	2.75	87.16						
11	0.41	2.57	89.74						
12	0.38	2.38	92.11						
13	0.37	2.30	94.42						
14	0.31	1.96	96.38						
15	0.30	1.86	98.23						
16	0.28	1.77	100.00						

Table 3. Rotational components of the loneliness scale for youth in Tehran in the year 2021 (n=437)

Question	Components		
	1	2	3
No one can understand me.	0.79	0.04	0.08
I do not feel a sense of belonging to any group or community.	0.10	0.06	0.80
My thoughts are different from those of others.	0.80	0.03	0.07
Trying to join different groups exhausts me.	0.09	0.05	0.79
I want to keep others satisfied, but I do not know how to please them.	0.81	0.02	0.05
Most people turn down my requests.	0.01	0.75	0.02
All of my social groups have rejected me.	0.09	0.06	0.84
I rely on many people around me.	0.05	0.80	0.08
If I fail, many people will help me.	0.03	0.79	0.03
I feel happy when someone understands me.	0.78	0.02	0.06
I am happy living with my family.	0.01	0.78	0.00
I talk to the people I love every day.	0.81	0.03	0.06
I receive a lot of affection from my loved ones.	0.03	0.76	0.05
Others reciprocate the affection I show.	0.03	0.79	0.06
My relationships with others are difficult and complex.	0.80	0.01	0.05
My family members are always fighting.	0.80	0.03	0.08

(RMSEA), it can be concluded that the data support the three-factor model (Table 4).

The model of standardized coefficients is presented in Figure 1.

In this study, to assess the reliability of the electronic version of the 16-item Loneliness Scale developed by Aune, internal consistency methods were employed. Specifically, the Cronbach's alpha coefficient for the research data was calculated, yielding an overall Cronbach's alpha of 0.83. The alpha coefficients for the subscales were 0.78 for intrinsic loneliness, 0.78 for supportive loneliness, and 0.74 for physical loneliness. Additionally, the reliability of the scale was evaluated using the split-half method. The split-half reliability for the first half of the data (8 items) was 0.71, while for the second half (8 items), it was 0.72, with a correlation between the two halves of 0.74. These findings indicate a satisfactory level of internal consistency for the electronic version of the 16-item Loneliness Scale developed by Aune (Table 5).

Discussion

This study represents the first effort to validate the

Table 4. Overall fit indices for the loneliness scale for youth in Tehran in the year 2021 (n=200)

Fit Index	Chi-squared to degrees of freedom ratio	GFI	AGFI	NFI	CFI	IFI	PNFI	RMSEA
Results	2.08	0.90	0.90	0.95	0.96	0.96	0.78	0.067
Acceptable Fit (36)	5	0.90	0.90	0.90	0.90	0.90	0.50	0.10

Table 5. Obtained split-half coefficients for the first half and the second half of the data

Overall scale	Intrinsic loneliness	Supportive loneliness	Physical loneliness	Split-half coefficient for the first half	Split-half coefficient for the second half	Correlation coefficient between the two halves
0.83	0.78	0.78	0.74	0.74	0.72	0.74

electronic form of Aune's Loneliness Scale. The findings indicate that Aune's Loneliness Scale possesses acceptable content validity. Additionally, its convergent validity was assessed in relation to the loneliness scale developed by Asher, Hymel, and Renshaw, with results demonstrating acceptable convergent validity. These findings align with those reported by Aune (23).

The results of the exploratory factor analysis revealed that Aune's Loneliness Scale consists of 16 items grouped into three factors: 1) intrinsic loneliness, 2) supportive loneliness, and 3) physical loneliness. This factor structure for the questionnaire is presented for the first time and has been corroborated by other studies (28, 30, 43-47).

Furthermore, since the factor loadings for each item are above 0.4, these loadings are considered adequate. Therefore, it can be concluded that all items in the subscale measuring youth loneliness are appropriately positioned within the factorial structure, indicating that there are no inconsistent or redundant items in the scale.

In terms of internal consistency, the results obtained for the overall scale and for each dimension indicated that the youth loneliness scale possesses adequate reliability. This finding is consistent with Aune's report of a Cronbach's alpha of 0.93 for the entire scale.

Conclusion

In this study, Aune's Loneliness Scale was validated for the virtual assessment of loneliness among youth, marking the first examination of its online reliability both in Iran and globally. The electronic format of this scale represents a significant strength of the research, facilitating efficient data collection. However, a limitation of the study is that the validation of Aune's tool was conducted specifically among youth in Tehran, which necessitates greater caution when generalizing the results to other youth populations across the country.

Additionally, 74% of the participants in this study were single, which may introduce bias in the results. It is recommended that future research validating this scale consider marital status as a variable. Similarly, since 74% of the participants were aged between 18 and 25, there is potential for age-related bias in the findings. Future research should aim to validate this scale across different age groups. Furthermore, 63% of the participants were students, which could also lead to bias. Thus, it is suggested that future research take into account employment status

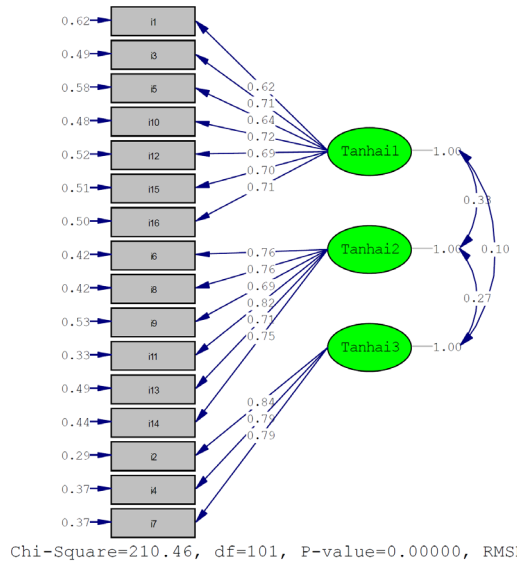

Figure 1. Model of standardized coefficients in the loneliness scale for youth in Tehran in the year 2021 (n=244)

when validating this scale.

It is recommended that the electronic form of Aune's Loneliness Scale be utilized in future studies assessing loneliness among youth. Additionally, this research should be expanded to include participants from other cities, particularly smaller towns and rural areas, to enhance the generalizability of the findings. The factor structure identified in this study can provide a more comprehensive assessment of loneliness among youth. Moreover, the findings of this research can offer a promising theoretical framework for examining loneliness in young people. Given that this scale is being applied to youth for the first time, it is advisable that this model be validated in other communities in future research endeavors.

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Competing Interests

The authors declare that there are no conflicts of interest concerning the publication of this article.

Ethical Approval

This research was conducted after obtaining informed consent from the participants, emphasizing that all information provided in the questionnaires would remain confidential to ensure that participants could select the most accurate responses. This article was derived from a doctoral dissertation and received ethical approval under the code IR.IAU.BA.REC.1401.010 from the Islamic Azad University, Bandar Abbas Branch.

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