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The psychometric properties of the Persian version of the innovation support inventory (ISI-12) in clinical nurses: a methodological cross-sectional study

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Abstract

Background Innovation in nursing involves applying new knowledge to create novel ideas, methods, or technologies, resulting in higher-quality care and improved patient outcomes. Adequate support for innovation is crucial for progress in nursing. This study aimed to translate the Innovation Support Inventory (ISI-12) into Persian and assess its psychometric properties specifically among clinical nurses.

Methods A methodological cross-sectional study was conducted from September 2022 to July 2023 to evaluate the face, content, and construct validity of the ISI-12. Construct validity was assessed through confirmatory factor analysis (CFA) and convergent and discriminant validity evaluation using data obtained from 321 clinical nurses. The test–retest stability and internal consistency of the ISI-12 were also evaluated to assess its reliability.

Results The Persian version of the ISI-12 validation through confirmatory factor analysis has confirmed its fit with the proposed three-factor model. The ISI-12 demonstrated high reliability, as evidenced by a Cronbach's alpha coefficient ($\alpha=0.969$), McDonald's omega coefficient ($\omega=0.922$), coefficient H ($H=0.979$), and mean inter-item correlation ($\rho=0.418$). Additionally, the stability of the ISI-12 during two weeks among 40 clinical nurses was found to be excellent, with an ICC of 0.951.

Conclusion The Persian version of the ISI-12 is a valid inventory for evaluating the innovation Support of clinical nurses.

Keywords Innovation support, Nurse, Inventory, Validity, Reliability

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Introduction

Innovation is crucial for long-term success and for providing more effective, efficient, and affordable health services [1]. In health services, innovation refers to the process of incorporating new and valuable ideas to improve health promotion, disease prevention, and the quality of patient care [2]. Therefore, nursing innovation involves developing new nursing practices to replace traditional methods and improve existing nursing protocols [3, 4].

The concept of nursing innovation involves a comprehensive approach that includes generating knowledge, demonstrating innovative behaviors, and disseminating new ideas and practices [5]. A study conducted by Weng et al. found that promoting innovative behaviors among nurses can lead to improvements in the efficacy of medical treatment, the overall quality of care provided, and the efficiency of work in healthcare environments [6]. A couple of research studies focused on evaluating the levels of innovation among nursing students and nurses yielded different results. One study found that the innovation levels of nursing students were high [7], whereas another study reported lower levels of innovation among nursing students [8]. Conversely, the study examined the innovative behaviors of nurses and revealed high levels of innovation [9]. This disparity in findings could potentially be attributed to various factors, such as the implementation of new products and techniques in nursing to maintain high standards of patient care, the consideration of innovation as a significant factor in assessing the performance of academic professionals and nurses, the tendency of nurses to venture into new areas of practice, and the rising influence of entrepreneurship within the nursing field [10].

The successful transformation of nurses' ideas for innovative products and methods in hospitals into valuable innovations depends on the support provided by organizations and managers to encourage nurses' innovative behaviors [11, 12]. Lukes and Stephan [13] identify managerial support, organizational characteristics, and national culture as the primary contextual factors influencing employees' innovative behaviors. Engle et al. [14] emphasize middle-level managers' crucial role in facilitating innovation implementation. Research shows that nurses who perceive their managers as supportive are more likely to exhibit innovative behaviors. Moreover, a meta-analysis conducted by Rosing et al. revealed significant correlations between managerial support and employees' innovative behaviors [15].

Organizations that consistently implement innovative concepts are usually recognized as innovative [16]. This involves creating a comfortable working environment where employees can express and implement their

creative ideas [17]. A study conducted by Xerri and Brunetto [18] revealed that the leader-member relationship indirectly influences nurses' innovative behaviors, highlighting the importance of organizational support for nurturing innovation among employees.

Lukes and Stephan [13] conducted a comprehensive study on the correlation between cultural support and organizational support and how these factors influence employees' innovative behavior. Their research revealed that managerial support had the most immediate impact on innovative behavior. Additionally, Sönmez and Yıldırım's study [9] demonstrated that a pro-innovation climate and supportive supervisors positively influenced the display of innovative behaviors by nurses. They also discovered that the autonomy of nurses played a significant mediating role in strengthening the impact of these relationships.

The Innovation Support Inventory (ISI), developed by Lukes and Stephan [13], has been extensively evaluated for validity and reliability in various countries and settings. Factorial validity was confirmed through confirmatory factor analysis, and convergent and discriminant validity were also established.

The ISI-12 comprises three key sub-dimensions: managerial support, which reflects the extent to which managers actively encourage and facilitate innovative behaviors among employees by providing necessary resources and emotional backing; organizational support, which captures the overall climate for innovation within the organization, including policies and cultural attitudes that either promote or hinder innovation; and cultural support, representing the broader societal norms and values influencing how innovation is perceived and supported within the workplace [9, 13].

Compared to existing tools like the Innovative Work Behavior Scale [19] and the Creativity Support Scale [20], the ISI offers a more comprehensive framework that integrates multiple dimensions of innovation support, providing a holistic view of the factors that foster innovation. Its validation across diverse cultural contexts further enhances its applicability in various organizational settings, addressing a common limitation found in other tools that often focus on singular aspects or specific populations [13].

The ISI was chosen for validation due to its robust development process, expert input, and pilot testing, ensuring relevance and reliability. It aligns closely with organizational objectives related to fostering innovation, making it a practical choice for validation in real-world settings [20]. This underscores the significance of the ISI in advancing our understanding of cultivating a supportive environment for innovation within organizations.

The nursing field is in need of modern assessment tools to measure nurses' support for innovation. The Innovation Support Inventory (ISI) was developed to assess organizational and managerial support for innovation. There is limited research in this area in Iran, so it is necessary to translate and validate the ISI into Persian for use among Iranian clinical nurses. This process will contribute to a deeper understanding of the factors influencing nurses' support for innovation.

Methods

Design and setting

This methodological study had a cross-sectional design, including translating the Innovation Support Inventory (ISI-12) from English to Persian and evaluating its psychometric properties. Data were gathered from clinical nurses employed in educational, therapeutic, and research centers affiliated with Ardabil University of Medical Sciences, Ardabil, Iran, from September 2022 to July 2023.

Participants

A research study involved 321 clinical nurses working in educational, therapeutic, and research centers associated with Ardabil University of Medical Sciences. Participants were selected through convenience sampling, specifically focusing on those with at least three months of clinical experience. This decision was made to capture the perspectives of novice nurses, who may encounter unique challenges in understanding organizational processes. While the ISI tool is typically considered more appropriate for nurses with at least three years of experience, including those with limited experience allows us to assess the tool's usability and relevance from a fresh viewpoint [21]. The only criterion for excluding clinical nurses from the study was if they provided incomplete responses to the questionnaire.

The recommended sample size for studies focusing on cultural adaptation and validation is typically 5–10 times the number of items in the scale [22]. Some studies suggest that the ideal sample size for confirmatory factor analysis (CFA) is around 200 [23], but in this study, 321 clinical nurses were involved in the data collection process. A total of 350 questionnaires were distributed, with a response rate of 91.7%. 321 completed questionnaires were returned, and the dropout rate was approximately 8.3%, which is within acceptable limits for survey research. No significant missing data issues were found, and valid data from 321 participants were analyzed.

Data collection

The questionnaire was distributed to participants through a structured approach to ensure maximum

participation and data integrity. Initially, researchers coordinated with the management of the educational, therapeutic, and research centers affiliated with Ardabil University of Medical Sciences to obtain permission to conduct the study. Once approval was secured, the following steps were taken: informational meetings, distribution method, and assistance and clarification.

The researchers recruited participants based on specific criteria and allowed them to complete the questionnaire either on-site or online. To encourage higher completion rates, they provided clear instructions, conducted follow-up reminders, and securely stored the completed questionnaires for confidentiality.

Instrument

Innovative support inventory (ISI-12)

Lukes and Stephan developed the Innovative Support Inventory (ISI) by thoroughly reviewing other scales [13]. The ISI includes three dimensions and 12 items rated on a 5-point Likert scale (1 = strongly disagree to 5 = strongly agree). The three dimensions of ISI are managerial support (items 1, 2, 3, 4, and 5), measures how management encourages and facilitates innovative practices, providing resources and guidance to foster employee creativity; organizational support (items 6, 7, and 8), evaluates the organization's structural and procedural aspects that promote innovation, including policies, training, and access to necessary tools and information; cultural support (items 9, 10, 11, and 12), assesses the organizational culture's openness to new ideas and risk-taking, reflecting how well the environment nurtures innovation and collaboration among team members.

Psychometric testing

Translation procedure

The translation process commenced with the researchers seeking approval from Dr. Martin Lukes, the inventory designer, to utilize the ISI-12. Adhering to the World Health Organization (WHO) guidelines [24], the questionnaire was translated into Persian using the forward-backward method. Two proficient translators, fluent in both languages, translated the original inventory into Persian. The research team then compared the Persian version with the English questionnaire. A third translator translated the Persian version back into English to ensure accuracy. The inventory developer subsequently reviewed the translated version to confirm the precise representation of key concepts, words, and meanings. After receiving feedback from the developer, the final version of the ISI-12 was created and evaluated to ensure its psychometric properties met the required standards.

Face validity

The face validity of the Innovation Support Inventory (ISI-12) was meticulously assessed through quantitative and qualitative methods. To ensure cultural appropriateness and relevance, we conducted pre-testing through cognitive interviewing, as outlined in the World Health Organization (WHO) guidelines. A diverse group of ten clinical nurses working across various units was selected for individual interviews. During these sessions, the nurses were prompted to evaluate the inventory's items, focusing on their perceived difficulty level, relevance to the concepts being measured, and any ambiguous language present.

This feedback was carefully recorded and analyzed to identify potential misunderstandings or cultural nuances that could affect interpretation. Based on the insights gained from these cognitive interviews, necessary adjustments were made to enhance clarity and ensure that the inventory accurately reflected the intended construct. This rigorous process validated the inventory's face validity and reinforced its cultural appropriateness for the target population.

During the quantitative stage of the ISI-12's face validity assessment, clinical nurses evaluated the importance of each item using a five-point scale, ranging from unimportant (1) to important (5). The impact score for each item was calculated by multiplying the percentage of occurrence with its assigned importance level. Any item with an impact score higher than 1.5 was considered significant [25]. This method allowed for a comprehensive assessment of the significance of each item based on a combination of occurrence and perceived importance.

Content validity

To determine the content validity of the ISI-12, we employed a comprehensive approach encompassing both qualitative and quantitative methods. For the qualitative aspect, we selected a sample of ten experts, all nursing faculty members, and administered the ISI-12 to them. Following the qualitative assessment, we solicited feedback from the experts on various elements of the ISI-12, such as grammar and terminology, to ensure a thorough evaluation of its content validity.

We evaluated the precision of the Persian version of the ISI-12 using the content validity ratio (CVR) and the content validity index (CVI). Experts rated each item on a 3-point Likert scale for CVR and a 4-point scale for CVI. The acceptable CVR value is 0.62 or higher, and items with CVIs greater than 0.79 were considered acceptable [26, 27].

To ensure a thorough and accurate evaluation, a comprehensive examination was conducted to identify any

floor and ceiling effects that may indicate potential issues with the assessment tool's content validity. If the floor or ceiling effects exceed 15%, they may point to insufficient content validity [28].

Construct validity

To further validate the inventory, Confirmatory Factor Analysis (CFA) was employed to assess the consistency of the identified factors and the overall construct validity. CFA is generally more effective than EFA for confirming specific hypotheses or constructs [29, 30]. The current research estimated the parameters using the maximum likelihood estimation method (MLE). To assess the goodness of fit of the model, various model fit indices were considered and evaluated by predefined criteria. When determining the Chi-square (CMIN) goodness of fit test, it is essential to consider the *p*-value, which should be greater than 0.05. Additionally, the Chi-square/degree of freedom (CMIN/DF) ratio should be less than 3. For the Root Mean Square Error of Approximation (RMSEA), a value less than 0.08 indicates a good fit. Furthermore, the Goodness of Fit Index (GFI) should be greater than 0.90. At the same time, the Comparative Fit Index (CFI), the Tucker-Lewis Index (TLI), and the Incremental Fit Index (IFI) should also exceed 0.90. Likewise, the Normed Fit Index (NFI) should be higher than 0.90. Moreover, the Parsimony Goodness of Fit Index (PGFI) and the Parsimony Comparative Fit Index (PCFI) should surpass 0.50. Checking for these criteria helps ensure a comprehensive evaluation of the model's goodness of fit [31, 32].

Convergent and discriminant validity

In our study, we conducted convergent and discriminant validity tests specifically for the sub-dimensions of the Innovation Support Inventory (ISI-12). Convergent validity was assessed to determine the extent to which items within each sub-dimension (managerial support, organizational support, and cultural support) correlated with one another, thereby confirming that they measure the same underlying construct. Discriminant validity was evaluated to ensure that the sub-dimensions are distinct from one another, indicating that they measure different aspects of innovation support. Accordingly, we used the Fornell and Larcker criterion and key parameters to evaluate the ISI-12's accuracy and consistency. Average Variance Extracted (AVE) values greater than 0.5, and Composite Reliability (CR) values greater than 0.7 with $CR > AVE$ establish convergent validity. AVE exceeding both Maximum Shared Squared Variance (MSV) and Average Shared Squared Variance (ASV) demonstrates reliable discriminant validity.

Reliability

The analysis for internal consistency was conducted using several reliability measures, such as Cronbach's alpha coefficient (α), McDonald's omega coefficient (ω), Coefficient H, and mean inter-item correlation (ρ). It is important to note that for the results to be considered satisfactory, the values of α , ω , and H should exceed 0.7. [33–38]. An inter-item correlation ranging from 0.15 to 0.5 is commonly considered optimal [39]. A high inter-item correlation exceeding 0.80 suggests potential redundancy among the items, which is generally considered undesirable as it may compromise the distinctiveness of the constructs being measured. Conversely, when inter-item correlations are consistently close to zero, it indicates a lack of meaningful structure within the instrument, suggesting that the items may not adequately capture the underlying construct [37].

The research utilized the Intraclass Correlation Coefficient (ICC) to assess the stability of the Persian version of the ISI-12. The data were obtained from a sample of 40 clinical nurses selected through simple random sampling over two weeks to evaluate test–retest reliability. The threshold for acceptability was set at an ICC value of 0.75 or higher [40].

Data analysis

The researchers conducted a thorough analysis to identify outliers in the dataset. The skewness and kurtosis of the data were examined for univariate distributions, with values outside the range of ± 3 for skewness and ± 8 for kurtosis considered potential outliers. Additionally, multivariate outliers were evaluated using Mahalanobis squared distance, with a significance level of $p < 0.001$. To assess the normality of multivariate variables, Mardia's coefficient was computed. A value exceeding 8 for Mardia's coefficient was interpreted as an indication of a departure from normal distribution [41].

In the study, we used IBM SPSS Statistics for Windows, version 26.0 (IBM Corp., Armonk, NY, USA) to conduct descriptive statistical analysis, including mean, standard deviation (SD), frequency, and percentage calculations. Additionally, we employed IBM SPSS AMOS, version 24.0, to conduct CFA and Structured Equation Modeling (SEM). It's important to note that we established the pre-determined statistical significance level at $p < 0.05$.

Results

Characteristics of the participants

In this study, 321 clinical nurses participated, with a mean age of 34.28 (7.05) years and a mean total work experience of 10.48 (7.03) years. Most participants

were female, accounting for over two-thirds of the total ($n = 251$, 78.2%), and 68.2% of the clinical nurses were married ($n = 219$).

Translation phase

After completing the translation of the ISI-12 into Persian, each professional expert conducted a thorough and independent re-evaluation of the translated Persian version compared to the original English version. The findings of the re-evaluation process demonstrated that the Persian version of the ISI-12 effectively retained the original meaning while integrating essential adaptations to ensure cultural relevance and linguistic clarity. The language used in the Persian version was deemed clear, explicit, and understandable, facilitating its applicability for Persian-speaking nurses.

Face validity

Following an in-depth review of feedback provided by clinical nurses as part of the face validity process, we have made thorough revisions to the Persian version of the ISI-12. These revisions addressed any identified issues related to difficulty, relevancy, and ambiguity to ensure the questionnaire accurately captures the intended information. After careful evaluation, it was found that all items achieved a score of 1.5 or higher. The scores varied from 2.5 to 3.7, as indicated in Table 1. The results showed that each item in the Persian version of ISI-12 was considered crucial for Iranian clinical nurses. As a result, we concluded that all of the items were essential for the following process stages. Accordingly, we decided to retain each one.

Table 1 Results of ISI-12 face and content validity testing ($n = 321$)

Item	Impact score	CVI			CVR
		Relevance	Clarity	Simplicity	
1	3.4	1	0.9	1	1
2	2.5	1	1	1	1
3	3.8	0.9	0.9	0.9	0.8
4	2.5	1	1	0.9	0.9
5	2.7	1	1	1	1
6	3.7	1	0.8	1	1
7	2.7	0.9	0.9	1	1
8	2.5	1	1	1	1
9	3.4	1	1	0.8	1
10	2.7	0.9	0.8	1	0.7
11	3.4	1	1	1	0.9
12	3.4	1	0.9	1	0.8

Abbreviations: CVI Content Validity Index, CVR Content Validity Ratio

Content validity

The content validity of all items was excellent, with a CVR value greater than 0.62. Additionally, as determined by the Waltz and Bausell method, the CVI for all items exceeded 0.79 (Table 1). During the qualitative phase of content validity, each of the 12 items was deemed acceptable based on these evaluations. The total score and three subscales of the ISI-12 did not exhibit any floor or ceiling effect. The scores for all subscales remained below 15%, indicating that the questionnaire effectively captured a wide range of innovative support levels (Table 2).

Descriptive statistics of the ISI-12

The ISI-12 mean score was 31.31 (9.97). The highest mean score among the dimensions was related to managerial support, 2.80 (0.95), and the lowest was related to cultural support, 2.50 (0.91). More details about descriptive statistics are summarized in Table 2.

Construct validity

A CFA was conducted on the three-factor model to assess the model's fit (Fig. 1). The results indicated that all observed variables (items) had factor loadings exceeding 0.3, signifying that no items required exclusion ($p < 0.001$). Additionally, the results revealed significant relationships between the latent factors and the observed variables, as indicated by T-values that exceeded the threshold of 1.96. The decision to establish covariance between the error terms of items 11 and 12 was based on theoretical and empirical considerations. Both items are closely related in content, as they assess similar dimensions of innovation support within clinical nursing. This similarity can lead to shared variance due to unmeasured factors affecting both items. By allowing for covariance, we aim to capture this shared variance, which can enhance the model's overall fit. Before setting the covariance of the error terms, the fit indices were as follows: CMIN=120.453, DF=52, p -value < 0.001, CMIN/DF=2.317, RMSEA=0.065, GFI=0.934, CFI=0.975, TLI=0.968, NFI=0.950, PGFI=0.598, and PCFI=0.731. After establishing the covariance between the error terms of items 11 and 12, the fit indices improved to: CMIN=104.953, DF=50, $p < 0.001$, CMIN/DF=2.099, RMSEA=0.059, GFI=0.949, CFI=0.982, TLI=0.977,

IFI=0.982, NFI=0.967, PGFI=0.608, and PCFI=0.744. The adjustment significantly improved the model fit indices, particularly in the CMIN/DF ratio and RMSEA, both of which are critical indicators of model fit. The p -value remained significant, indicating that the model fit improved statistically following the covariance adjustment.

Convergent and discriminant validity

In Table 3, the results show that the composite reliability (CR) and average variance extracted (AVE) values both exceeded the recommended thresholds of 0.7 and 0.5, respectively. This indicates strong convergent validity for all dimensions, as the CR values were higher than the AVE values. Additionally, the mean shared variance (MSV) and average shared variance (ASV) values for the dimensions were lower than the AVE, providing even more supporting evidence of discriminant validity.

Reliability

The results show that the Persian version of the ISI-12 has a high level of reliability, with $\alpha = 0.928$, $\omega = 0.922$, coefficient H=0.979, and $\rho = 0.418$. The dimensions of managerial support, organizational support, and cultural support also exhibit high internal consistency, with α ranging from 0.902 to 0.926, ω from 0.905 to 0.927, coefficient H from 0.909 to 0.954, and ρ from 0.449 to 0.495. Overall, the internal consistency of the ISI-12 is high, indicating that the items are consistent and reliable in measuring the constructs they are intended to assess (Table 3).

The stability of the Persian version of the ISI-12 was assessed using a test–retest method. The findings showed that the ISI-12 exhibited strong reliability, as evidenced by an Intraclass Correlation Coefficient (ICC) of 0.924 (with a 95% confidence interval of 0.911–0.936), indicating high stability over the measurement periods. Additionally, the results indicate that all three dimensions of the ISI-12 demonstrated an ICC value greater than 0.75. This finding provides strong evidence for the stability and reliability of the ISI-12 across its three dimensions (Table 3).

Table 2 Results of descriptive statistics, floor and ceiling effects of the ISI-12 ($n = 321$)

Dimensions	No. of item	Possible range	Mean item score	Total score	Skewness	Kurtosis	Floor effect (%)	Ceiling effect (%)
Managerial support	5	1–5	2.80±0.95	13.83±4.72	-0.61	-1.52	20 (6.2%)	4 (1.2%)
Organizational support	3	1–5	2.52±1.01	7.39±3.22	1.48	-1.25	43 (13.4%)	7 (2.2%)
Cultural support	4	1–5	2.50±0.91	10.07±3.89	1.41	-0.79	36 (11.2%)	3 (0.9%)
Total (ISI-12)	12	1–5	2.61±0.83	31.31±9.97	1.19	-0.51	9 (2.8%)	2 (0.6%)

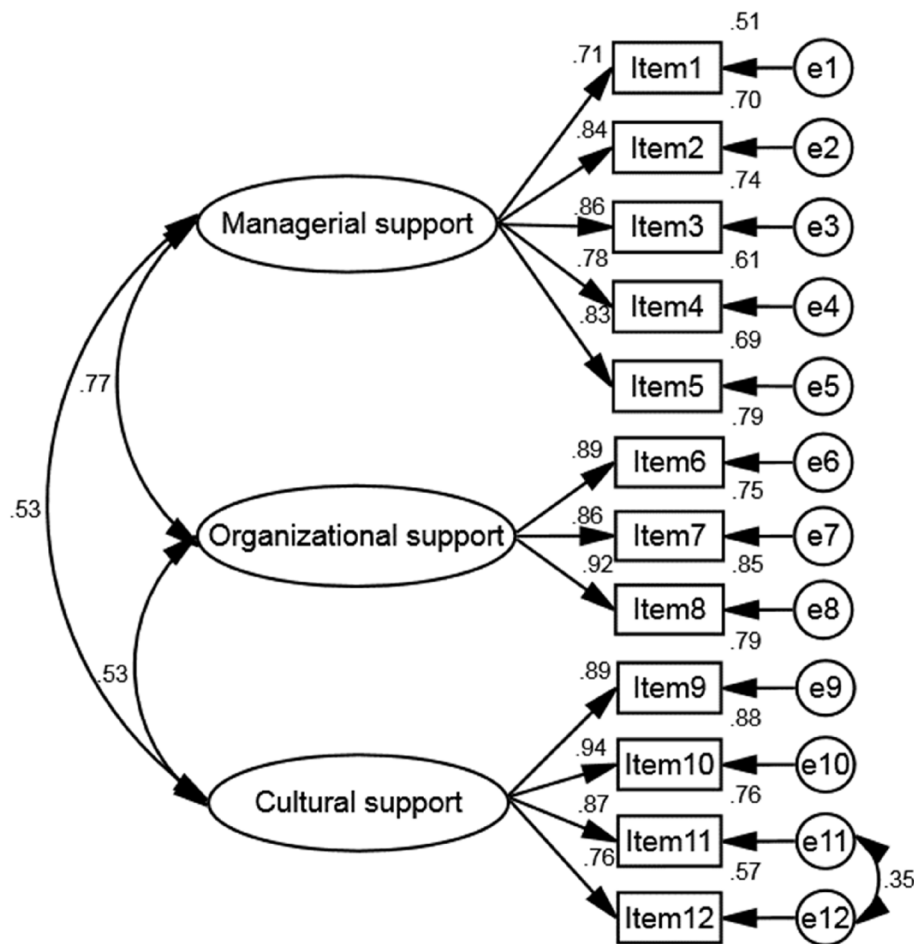


Fig. 1 The confirmatory factor analysis model of the Persian version of the ISI-12 (n = 321)

Table 3 Results for the convergent, discriminant validity, and reliability of the ISI-12 (n = 321)

Dimensions	CR	AVE	MSV	ASV	α	ω	H	ρ	ICC (95% CI)
Managerial support	0.931	0.649	0.592	0.436	0.902	0.905	0.909	0.449	0.896 (0.875–0.914)
Organizational support	0.945	0.618	0.592	0.436	0.921	0.922	0.954	0.495	0.911 (0.905–0.935)
Cultural support	0.923	0.705	0.281	0.281	0.926	0.927	0.94	0.46	0.923 (0.907–0.936)
Total (ISI-12)					0.928	0.922	0.979	0.418	0.924 (0.911–0.936)

Production of the final model

Following the assessment of psychometric testing, the Persian version of the Innovative Support Inventory (ISI) underwent finalization. It comprises 12 items that were categorized into three distinct factors: "managerial support," which encompasses five items; "organizational support," which consists of three items; and "cultural support," which includes four items.

Discussion

In this research study, our primary objective was to translate the 12-item Innovative Support Inventory (ISI-12) into Persian and assess its psychometric characteristics among 321 clinical nurses employed in the public hospitals of Ardabil University of Medical Sciences. The findings indicate that the Persian version

of the ISI-12 is a reliable and valid tool for evaluating innovative support in clinical nursing contexts.

The concept of validity pertains to how a measurement instrument effectively and accurately assesses the specific characteristics or behaviors it is designed to measure in real-world scenarios. It evaluates the degree to which the instrument corresponds with the genuine aspects of the world and precisely captures the phenomenon under investigation [42]. The content validity of the items was assessed by experts and determined to be above 0.79, with a range from 0.8 to 1. This finding aligns with previous studies by Lukes et al. [13] and Sönmez et al. [43]. It is widely recognized in the literature that a content validity score for a scale should be greater than or equal to 0.79, indicating high content validity of the inventory [26, 27]. This finding underscoring the importance of rigorous validation processes to ensure that the tool accurately captures the intended constructs.

To enhance the relevance and applicability of the ISI-12, we engaged clinical nurses, the target population, in assessing its face validity. Their feedback was invaluable in refining the inventory, ensuring it resonates with the experiences and perceptions of those who will utilize it in practice. This participatory approach not only strengthens the validity of the instrument but also fosters a sense of ownership among the nurses, which can lead to greater acceptance and implementation of innovative practices in their work environments [44].

The construct validity of a scale is crucial as it assesses whether the scale effectively captures the intended concept and produces reliable results. This involves ensuring that the scale measures what it is designed to measure without unintentionally measuring something else [45]. Our assessment found a robust three-factor structure, confirming that the ISI-12 effectively measures managerial, organizational, and cultural support for innovation. These constructs are essential for fostering an environment conducive to innovative behaviors among nurses. The results align with the original version of the ISI-12 [13] and its Turkish version [43], reinforcing the scale's applicability across different cultural contexts. Importantly, we established covariance between the error terms of items 11 and 12, which significantly improved model fit indices. This adjustment enhanced the model's explanatory power and highlighted the interconnectedness of these items, suggesting they may capture similar underlying constructs related to innovation support. Identifying these factors provides a framework for healthcare organizations to understand the key areas where support is needed. For instance, enhancing managerial support can influence nurses' willingness to engage in innovative practices, ultimately improving patient care and outcomes [13]. This underscores the importance of targeted

interventions to bolster support structures within clinical settings, ensuring nurses feel empowered to innovate. Overall, this study's findings contribute valuable insights into the dynamics of innovative support in nursing, suggesting that a nuanced understanding of these constructs can lead to more effective strategies for fostering innovation in healthcare environments.

Moreover, after conducting a thorough reliability analysis, it has been established that for a scale to be deemed reliable, it must consistently and accurately reflect the intended underlying structure it seeks to measure. This entails the scale yielding consistent and dependable results over time, effectively evaluating the construct it is designed to measure [42]. Based on several measurements, it has been found that the Persian version of the ISI-12 has a higher degree of reliability than the original version, with alpha values ranging between 0.77 and 0.82 [13]. Additionally, the Persian version shows higher reliability than the Turkish version, as indicated by alpha values ranging between 0.85 and 0.88 [43]. These findings indicated that the ISI-12 consistently reflects the underlying constructs it aims to measure. This reliability is critical for all researchers, as it assures them that the tool can be utilized confidently in clinical settings and further research. The ability to measure innovative support accurately can help identify specific areas for improvement within nursing teams, allowing for targeted interventions that enhance the overall quality of care.

The implications of our findings extend beyond the validation of the ISI-12. By utilizing this instrument, healthcare managers can gain insights into the factors that foster or hinder innovation among clinical nurses. This understanding can guide the development of tailored training programs and initiatives to enhance innovative behaviors. For example, if the assessment reveals low scores in organizational support, targeted strategies such as workshops or mentorship programs could be implemented to bolster this area.

Furthermore, the ISI-12 can serve as a benchmark for evaluating the impact of educational and training initiatives on innovative support among clinical nurses. We can inform targeted program development and identify optimal training approaches by providing specific evidence and detailed explanations of how these initiatives influence innovative practices. This aligns with the growing recognition of the need for continuous professional development in nursing, particularly fostering a culture of innovation.

In conclusion, the Persian version of the ISI-12 significantly advances our understanding of innovative support in clinical nursing. It offers a reliable and valid tool for assessing the contextual factors that influence innovation. By encouraging innovative practices among

clinical nurses, the ISI-12 can contribute to improved patient outcomes and enhanced healthcare services. Future research should focus on exploring the correlation between innovative support and innovative behavior among clinical nurses across diverse settings, as well as the implications for the reliability and generalizability of our findings. Emphasizing the need for further research with a more diverse range of experience levels will enhance the applicability of the ISI tool across different nursing contexts.

Limitations

The researchers have identified several limitations in evaluating the accuracy and consistency of the ISI-12. The study used convenience sampling, which may not accurately represent the entire population of clinical nurses in Iran. This approach could lead to biased findings and limit the applicability of the results. Despite these limitations, it's important to note that the study included a significant sample size of 321 clinical nurses. This larger sample size improved the reliability of the results and increased the statistical power, strengthening the study's findings. As a result, the current research on the psychometric properties of the ISI-12 highlights the need for further investigation, especially concerning its relevance to individuals from diverse cultural backgrounds.

Conclusions

This research significantly enhances our understanding of the complex nature of innovative support provided by clinical nurses and the contextual factors that foster innovation. The psychometric evaluation introduces a reliable measurement tool—ISI-12—with robust face, content, and construct validity. The ISI-12 offers concise yet insightful perspectives on the various dimensions of innovative support among clinical nurses.

The proposed theoretical model serves as a comprehensive framework that underpins this study, allowing researchers to gain a deeper understanding of the innovative support provided by clinical nurses. This model is applicable across various forms of innovation and different categories of nurses, thus broadening its utility. Notably, the ISI-12 demonstrates potential for research endeavors focused on individual behavior as a core component of intrapreneurship.

Moreover, a nuanced understanding of the factors that promote innovation is crucial for managers and practitioners involved in innovation initiatives. This understanding can empower them to leverage strengths, address weaknesses, and effectively manage their innovation processes.

In future research, the Persian version of the ISI-12 can be instrumental in exploring the correlation between innovative support and innovative behavior among clinical nurses. Such studies could yield valuable insights into the most effective strategies for fostering innovation in healthcare settings. Additionally, the ISI-12 can be utilized to evaluate the impact of educational and training initiatives on innovative support among clinical nurses. By providing specific evidence and detailed explanations, we can illustrate how these findings contribute to informing targeted program development and identifying optimal training approaches.

Furthermore, it is essential to discuss the potential implications for the reliability and generalizability of our findings. Emphasizing the need for further research with a more diverse range of experience levels will enhance the applicability of the ISI tool across different nursing contexts. Ultimately, by encouraging innovative practices among clinical nurses, the Persian version of the ISI-12 can contribute to improved patient outcomes and enhanced healthcare services. The instrument will provide valuable insights to guide and facilitate data-driven decision-making in healthcare organizations.

Abbreviations

ISI	Innovation support inventory
CFA	Confirmatory factor analysis
WHO	World Health Organization
CVR	Content validity ratio
CVI	Content validity index
MLE	Likelihood estimation method
RMSEA	Root mean square error of approximation
GFI	Goodness of fit index
CFI	Comparative fit index
TLI	Tucker-Lewis index
IFI	Incremental fit index
NFI	Normed Fit Index
PGFI	Parsimony goodness of fit index
PCFI	Parsimony Comparative Fit Index
CR	Composite reliability
AVE	Average variance extracted
MSV	Mean shared variance
ASV	Average shared variance
ICC	Intraclass Correlation Coefficient

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Authors' contributions

All the authors participated in designing the study. Conceptualization was done by A. HM, R. I, and R. YS; methodology was contributed by R. NV, M. J, P. D, A. M; Data collection was conducted by M. J, P. D, and R. YS; investigation and formal analysis were performed by A. M and R. NV; Writing-review and editing were carried out by A. HM, R. NV, R. I, R. YS, M. J, P. D, A. M. All authors have reviewed and approved the final manuscript.

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Availability of data and materials

The datasets used and analyzed during the current study are available from the corresponding [A. M] author upon reasonable request.

Declarations**Ethics approval and consent to participate**

The research project at Ardabil University of Medical Sciences, Iran, has been approved by the Research Ethics Committee with the Approval ID: IR.ARUMS.REC.1401.153. Before beginning the study, all participants had to provide written informed consent. They were given comprehensive information regarding the study's goals, methodologies, potential advantages, and their right to withdraw from the study at any point.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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