

*Original Article*

**RELIABILITY AND VALIDITY OF 29 QUESTIONS RELATED TO PERCEPTION OF RADIOLOGISTS REGARDING APPLICATION OF ARTIFICIAL INTELLIGENCE IN RADIOLOGY AND IMAGING UNITS OF TERTIARY PUBLIC HOSPITALS**

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**ABSTRACT**

**Background:** Artificial intelligence (AI) is progressively being adopted in radiology, enhancing diagnostic precision, workflow efficiency, and image interpretation. For a developing country like Bangladesh, integrating AI into radiology is essential to advance radiology departments. Therefore, this study aimed to evaluate the validity and reliability of a 29-item questionnaire developed to evaluate radiologists' perceptions regarding artificial intelligence applications in radiology and imaging units of tertiary public hospitals in Bangladesh

**Methodology:** A cross-sectional methodological study was conducted among radiologists working in tertiary public hospitals. Validity was evaluated through face validity, by review from the research supervisor and subject experts to ensure clarity, relevance, and representativeness of the items. Content validity was established by confirming that the questions comprehensively covered the key domains of radiologists' perception of AI and also by review from the research supervisor and construct validity was assessed by doing spearman rank correlation. Reliability of 29 questions was measured through internal consistency using Cronbach's alpha.

**Results:** The 29 questions which was designed to assess radiologist's perception regarding application of AI was subjected to face validity through expert review and pilot testing to ensure clarity and relevance. Content validity was established by ensuring the 29 questions adequately covered key domains of radiologists' perception of AI in radiology and imaging units. Construct validity of the questionnaire was supported by significant positive Spearman correlations between the domains of practice, opportunities, and challenges and the overall perception of radiologists. So, 29 questions were valid to assess radiologists' perception regarding application of AI in radiology and imaging units of tertiary public hospitals in Bangladesh. The 29 questions demonstrated good internal consistency. Subsection reliability was 0.832 for practice, 0.885 for opportunities, and 0.579 for challenges related to AI in radiology. Overall Cronbach's alpha of 0.761 So, 29 questions related to perception of radiologists regarding application of AI were reliable.

**Conclusion:** The developed 29-items in questionnaire was valid and reliable tool to measure radiologists' perceptions regarding application of AI in radiology and imaging units of tertiary public hospitals. This instrument can facilitate further research and guide policymakers in addressing challenges and opportunities associated with AI adoption in radiology practice.

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## **INTRODUCTION**

Ensuring the reliability and validity of a research instrument is vital for securing precise and significant outcomes. In investigations that assess perception or viewpoints, particularly in nascent areas such as Artificial Intelligence (AI) in radiology, employing a thoroughly validated questionnaire is essential to ensure the reliability, precision, and applicability of the results<sup>1</sup>. Reliability refers to the degree to which an instrument consistently measures what it intends to measure, whereas validity assesses whether the instrument truly captures the construct under investigation<sup>2</sup>. Commonly, internal consistency or reliability is assessed using Cronbach's alpha, which determines the extent to which items within a scale are correlated, indicating that they measure the same underlying construct<sup>3</sup>.

The integration of AI into medical imaging is set to revolutionize radiology due to its significant impact on human health and the broader healthcare system. By automating routine and time-consuming tasks, AI can enhance radiologists' efficiency, enabling them to focus on complex diagnostic challenges and improve communication with patients and healthcare professionals<sup>4</sup>. Tertiary public hospitals, which play a crucial role in providing specialized healthcare services, the successful implementation of AI in radiology requires a comprehensive understanding of the perceptions of radiologists and future radiologists such as post graduate trainees. To assess perception of radiologists regarding application of artificial intelligence in radiology and imaging units of tertiary public hospitals validated questionnaire is required. To achieve this goal, a semi-structured questionnaire consisting of 76 questions was created. Of these questions, 29 were designed to evaluate the general perceptions of radiologists concerning the use of AI in radiology and imaging units of tertiary public hospitals. In this research, the objective was to evaluate the reliability and validity of these 29 questions so that the data gathered accurately represents true perceptions without measurement errors. The questionnaire was modified and finalized after pretesting. In this study, face validity, content validity and construct validity were used to evaluate the validity of 29 questions related to perception of radiologists regarding application of AI in radiology and imaging units of tertiary public hospitals to ensure that the instrument adequately represents the concept of radiologists' perceptions toward AI applications in imaging practice. Establishing these psychometric properties strengthens the credibility of the questionnaire and supports its use in further

studies assessing AI adoption in medical imaging settings. Face validity refers to the extent to which an instrument appears effective in terms of its stated aims and is often judged subjectively by experts or respondents<sup>5</sup>. Content validity involves expert evaluation of whether the instrument adequately represents the construct being measured<sup>6</sup>. Construct validity indicates how well an instrument or questionnaire measures the theoretical construct or concept it is designed to evaluate<sup>7</sup>. It assesses whether the items in a scale genuinely reflect and correspond to the fundamental concept being examined, frequently using statistical methods like factor analysis or correlations with related constructs. Cronbach's alpha is a widely reported statistic in science education literature, frequently used to indicate the reliability of research instruments employed in various studies<sup>8</sup>. Cronbach's alpha is often regarded as one of the most essential and widely used statistical measures in research focused on test development and application<sup>9</sup>. In this study, Cronbach's alpha was used to ensure the reliability and internal consistency of 29 questions.

## **METHODS**

### **Questionnaire development**

The questionnaire was formulated based on a comprehensive review of relevant literatures and consultation with subject experts. It was initially prepared in English and subsequently translated into Bengali. The questionnaire was modified and finalized after pretesting. It contained 76 questions and had 5 sections. Section-1 contained information related to description of respondents, Section-2 contained 6 questions regarding the information related to socio-demographic characteristics such as locations of data collection, age, gender, category of profession, monthly family income and years of experience. Section-3 illustrated 28 questions regarding information related to perception of radiologists regarding practice of Artificial Intelligence (AI) in radiology, Section-4 had 6 questions related to information regarding perception of radiologists regarding opportunities of AI application in radiology, Section-5 consists of 36 questions containing the information related to perception of radiologists regarding challenges of AI application in radiology. Out of the total 76 items in the questionnaire, 29 items were selected for validity and reliability analysis because these items specially measured the core construct relevant to the study's hypothesis and research objectives, while the

remaining items served supportive, descriptive and contextual purposes. 29 questions had options such as “Agree”, “Strongly Agree”, “Neutral”, “Disagree” and “Strongly Disagree” and all options were individually scored with “1”. Among 29 questions, 8 questions were in the section related to perception regarding practice of AI in radiology and imaging units of tertiary public hospitals and these questions addressed area of AI practice includes image interpretation<sup>10</sup>, image denoising<sup>10</sup>, disease diagnosis<sup>11-12</sup>, disease prognosis<sup>13</sup>, disease classification<sup>12</sup>, decision making<sup>12</sup>, treatment planning<sup>10</sup>. Among 29 questions, another 6 questions were included in the section related to perception regarding opportunities of Artificial Intelligence (AI) application in radiology and imaging units and these questions were addressed variables such as image quality<sup>12</sup>, accuracy<sup>10-12</sup>, AI radiologists collaboration<sup>14</sup>, patient care<sup>11-12</sup>, workload, workflow efficiency<sup>11-12</sup>. Out of 29 questions, last 15 questions were in the section related to perception regarding challenges of artificial intelligence application in radiology and imaging units and these questions were related to the variables such as acceptance of AI<sup>12</sup>, operator dependency<sup>12</sup>, organizational guideline, expenses<sup>10</sup>, funding, expert manpower, ethical consideration<sup>12</sup>, legal regulations<sup>10</sup>, privacy concern<sup>12</sup>.

### **Pretesting**

Before going to process of data collection, pretesting was conducted at radiology and imaging unit of National Gastroenterology Institute and Hospital. During pre-testing respondents were asked if they fail to understand any specific words or sentences in the questionnaire. Any unacceptable or offensive words were also identified. Participants were also asked if they faced any language difficulties or if there were alternative wordings that would better suit their native language while filling out the questionnaires by them. The necessary modifications were made, and research instruments were finalized.

### **Questionnaire validation**

Face Validity: The face validity of the questionnaire, particularly the 29 questions were evaluated by the research supervisor and subject expert who served as the resource person for this study. The questionnaire was reviewed to assess whether the questions appeared appropriate, clear, and relevant to the objectives of the research. The supervisor examined the wording, language, and structure of the items to ensure they were understandable to radiologists and aligned with the intended constructs. Based on the suggestions provided, necessary modifications were made before administering

the questionnaire to the study participants.

**Content Validity:** The content validity of the 29 questions was established by ensuring that the questions comprehensively addressed the major domains of radiologists’ perception regarding artificial intelligence in radiology and imaging units of tertiary public hospitals. These domains included practice-related aspects (such as area of AI practice), perceived opportunities (such as quality, accuracy, AI-radiologists collaboration, patient care, workload, workflow efficiency), and perceived challenges (such as acceptance of artificial intelligence, operator dependency, organizational guidelines, required infrastructure, expenses, funding, expert manpower, ethical consideration, legal regulations, data privacy concern). The questionnaire was reviewed by the research supervisor and subject expert who confirmed that the questions were relevant, representative, and adequately covered the intended constructs. Based on their feedback, the questions were finalized to ensure that all important aspects of radiologists’ perceptions were included.

Construct validity: In this study, spearman rank correlation was done between domains and overall perception of radiologists related to their agreement with AI application to assess construct validity.

### **Reliability analysis of 29 items**

Cronbach’s alpha was used to assess the internal consistency or reliability of a set of questions that tells us how well the items in a questionnaire or test were correlated and whether they consistently measure the same concept. Cronbach’s alpha was also used to ensure quality of data because reliable instruments produce more stable and consistent results, which improved the credibility of the study. Since all 29 questions were self-developed, it was essential to evaluate their reliability to determine whether they were interrelated and measured the same underlying construct related to perception of radiologists regarding application of Artificial Intelligence (AI) in radiology and imaging units of tertiary public hospitals.

### **Ethical implications**

Ethical clearance for this study was obtained from the Institutional Review Board (IRB) of National Institute of Preventive and Social Medicine (NIPSOM). Memo no: NIPSOM/IRB/2025/32. Permission of administrative authority of the selected tertiary hospitals was taken. Written informed consent was taken from each and every respondent before collection of data. Objectives of the study were explained in brief to the respondents.

Privacy and confidentiality were ensured and maintained strictly.

Table 1 shows section level and overall Cronbach's alpha for 29 questions related to the perception of radiologists regarding application of artificial intelligence. Here, Total Cronbach's alpha was 0.761 for 29 items.

**RESULTS**

Table 1: Section level and overall Cronbach's alpha for 29 questions related to perception of radiologists regarding application of AI in radiology

<b>Cronbach's alpha for the perception of radiologists regarding application of artificial intelligence</b>	<b>Number of items</b>	<b>Cronbach's Alpha</b>
Section 1: Perception of radiologists regarding practice of artificial intelligence in radiology	8 items	0.832
Section 2: Perception of radiologists regarding opportunities of artificial intelligence application in radiology	6 items	0.885
Section 3: Perception of radiologists regarding challenges of artificial intelligence application in radiology	15 items	0.579
<b>Overall</b>	<b>29 items</b>	<b>0.761</b>

Table 2 shows that there was statistically significant positive relationship between credibility of AI systems and overall perception of radiologists.

Table 2: Spearman rank correlation between credibility of AI systems and overall perception regarding agreement with AI application (n=226)

<b>Attributes</b>	<b>Perception of radiologists regarding agreement with AI application</b>	
	<b>ρ</b>	<b>p (1 tailed)</b>
Credibility of AI systems	0.408**	<0.0001

\*\* Correlation is significant at the 0.01 level (1 tailed)

Table 3 shows that there was statistically significant positive relationship between the importance of necessary infrastructure and overall perception of radiologists.

Table 3: Spearman rank correlation between the importance of necessary infrastructure and overall perception regarding agreement with AI application (n=226)

<b>Attributes</b>	<b>Perception of radiologists regarding their agreement with AI application</b>

	<b>ρ</b>	<b>p (1 tailed)</b>
<b>Importance of necessary infrastructure</b>	0.124*	0.031

\*Correlation is significant at the 0.05 level (1 tailed)

Table 4 shows that there was statistically significant positive relationship between the importance of infrastructure cost and overall perception of radiologists.

Table 4: Spearman rank correlation between the importance of infrastructure cost and overall perception regarding agreement with AI application (n=226)

<b>Attributes</b>	<b>Perception of radiologists regarding their agreement with AI application</b>	
	<b>ρ</b>	<b>p (1 tailed)</b>
<b>Importance of infrastructure cost</b>	0.292**	<0.0001

\*\* Correlation is significant at the 0.01 level (1 tailed)

Table 5 shows that there was statistically significant positive relationship between the importance of clear ethical guidelines with overall perception of radiologists. Spearman rank correlation analysis showed a statistically significant positive association between the domains of practice, opportunities, and

challenges, and the overall perception, supporting the construct validity of the 29-item questionnaire.

Table 5: Spearman rank correlation between the importance of clear ethical guidelines and overall perception regarding agreement with AI application (n=226)

Attributes	Perception regarding agreement with AI application in radiology	
	$\rho$	p (1 tailed)
Importance of clear ethical guidelines	0.192**	0.002

\*\*Correlation is significant at the 0.01 level (1 tailed)

## DISCUSSION

The 29-item questionnaire designed to evaluate radiologists' perceptions of Artificial Intelligence (AI) application in radiology units of tertiary public hospitals in Bangladesh showed acceptable levels of validity and reliability. Face and content validity were established through expert consultation and an extensive literature review, ensuring that each item was relevant, comprehensive, and clearly stated. Construct validity, examined using spearman rank correlation, demonstrated significant positive relationships among the domains and the overall perception, supporting the conceptual framework of the instrument. The variables credibility of AI systems, importance of infrastructure, importance of infrastructure cost, importance of clear ethical guidelines were selected because these constructs were ordinal in nature and most critical themes influencing perception regarding the implementation and adoption of AI in radiology and imaging units of tertiary public hospitals. Construct validity was assessed using "Spearman rank correlation" rather than factor analysis because factor analysis typically assumes normally distributed data to produce reliable factor loadings. In this study, "Kolmogorov-smirnov test" was used to check normality of variables such as credibility of AI systems ( $p < 0.0001$ ), importance of infrastructure ( $p < 0.0001$ ), importance of infrastructure cost ( $p < 0.0001$ ) and importance of clear ethical guidelines ( $p < 0.0001$ ). The data were not normally distributed which made standard factor analysis potentially inappropriate. Spearman rank correlation, being a non-parametric method, allowed for the examination of associations among

questionnaire domains and overall perception without assuming normality, providing a robust approach to evaluate construct validity. The Cronbach's alpha coefficient reflected high internal consistency, indicating that the items reliably measured the intended constructs. In this study, the overall results confirmed that the 29-item questionnaire was a dependable and valid tool for assessing radiologists' perceptions of AI in radiology. In this study, out of 3 sections for 29 questions, 1st section had Cronbach's alpha score 0.832, 2nd section had 0.885 and 3rd section had Cronbach's alpha score 0.579. Total Cronbach's alpha score was 0.761 for 29 items which reflects acceptable internal consistency for the instrument. The practice and opportunities domains demonstrated good internal consistency, while the challenges domain showed a Cronbach's alpha of 0.579, indicating moderate reliability. This lower value may reflect the multidimensional nature of the items in this domain, which addressed multiple facets of AI-related obstacles, including ethical, professional, and technical challenges. Besides, several questions were added in this component for theoretical relevance and to explore the current situation regarding radiologists' perceptions of the challenges associated with implementing AI in radiology and imaging units of tertiary public hospitals, particularly in Bangladesh, where the adoption of AI in public healthcare settings is still a relatively new and emerging topic and this study was conducted as an exploratory investigation. In a study, Schmitt had suggested that there is no general level (such as 0.70) where alpha becomes acceptable, but rather that instruments with quite a low value of alpha can still prove useful in some circumstances<sup>15</sup>. In a study, Sijtsma had made the point more bluntly: "both very low and very high alpha values can go either with unidimensionality or multidimensionality of the data"<sup>16</sup>. It means that Cronbach's alpha alone cannot confirm whether a questionnaire truly measures a single construct or unidimensionality. A high alpha usually suggests good internal consistency, but it does not necessarily mean that all items measure only one underlying concept. Similarly, a low alpha doesn't always mean poor measurement, it could indicate the presence of multiple related dimensions or diverse aspects of a complex concept. Another study described alpha values as excellent (0.93–0.94), strong (0.91–0.93), reliable (0.84–0.90), robust (0.81), fairly high (0.76–0.95), high (0.73–0.95), good (0.71–0.91), relatively high (0.70–0.77), slightly low (0.68), reasonable (0.67–0.87), adequate (0.64–0.85), moderate (0.61–0.65), satisfactory (0.58–0.97), acceptable (0.45–0.98), sufficient (0.45–0.96), not satisfactory (0.4–0.55) and low (0.11)<sup>17</sup>. According to this study, the challenge related Cronbach's alpha value

of my study was acceptable. However, it is important to acknowledge certain limitations regarding the generalizability of the instrument. The questions were specifically developed and contextualized for radiologists working in the public tertiary healthcare sector of Bangladesh. As such, the findings may not accurately reflect the perceptions of radiologists operating in private hospitals and hospitals in different countries where the exposure to and implementation of AI may vary significantly. Furthermore, the instrument was designed with a focus on the Bangladeshi healthcare system, cultural context, and technological readiness. Differences in hospital organization, technology, workflow, and training between public and private settings may influence how radiologists perceive AI, affecting item relevance and responses. Similarly, variations in culture, regulations, and healthcare systems across countries could change the interpretation of items, particularly those related to ethical and professional issues. Therefore, although the questionnaire provides a strong foundation, it may need adaptation and re-validation before use in private hospitals or international contexts.

## CONCLUSION

The 29-item questionnaire was developed to assess radiologists' perceptions of Artificial Intelligence (AI) in radiology from the Bangladesh perspective demonstrated good internal consistency, with an overall Cronbach's alpha of 0.761, indicating acceptable reliability. Both face and content validity were evaluated through expert review, confirming the relevance and clarity of the items. However, the challenge section encompassed multiple dimensions such as technical, professional, and ethical challenges which may have influenced inter-item correlations and internal consistency within subdomains. Construct validity was assessed using spearman rank correlation analysis due to non-normal data distribution, while factor analysis and content validity index (CVI) were not performed, limiting the depth of validity evaluation. Despite these constraints, the instrument provides a useful foundation for assessing radiologists' perceptions of AI in the Bangladeshi context. Validation among radiologists from diverse settings such as private institutions, rural healthcare centers, and other countries would improve representativeness and reliability. Considering these broader contexts can provide a more comprehensive understanding of radiologists' perceptions, challenges and readiness for AI adoption. Overall, the findings indicated that the questionnaire was a robust and reliable tool, capable of effectively capturing diverse perspectives on AI in radiology and supporting future research and practical applications in this field.

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## REFERENCES

1. Taherdoost H. Validity and reliability of the research instrument: How to test the validation of a questionnaire/survey in a research. *International Journal of Academic Research in Management*. 2016;5(3):28–36.
2. DeVellis RF. Reliability and validity of scales. In: *Scale Development: Theory and Applications*. 4th ed. Los Angeles: Sage Publications; 2017. p. 75–102.
3. Tavakol M, Dennick R. Making sense of Cronbach's alpha. *International Journal of Medical Education*. 2011;2(1):53–55. doi: 10.5116/ijme.4dfb.8dfd
4. Gore JC. Artificial intelligence in medical imaging. *Magn Reson Imaging*. 2020;68: A1–A4. doi: 10.1016/j.mri.2019.12.006
5. Bolarinwa OA. Principles and methods of validity and reliability testing of questionnaires used in social and health science researches. *Niger Postgrad Med J*. 2015;22(4):195–201.
6. Polit DF, Beck CT. The content validity index: are you sure you know what's being reported? Critique and recommendations. *Res Nurs Health*. 2006;29(5):489–497.
7. Cronbach LJ, Meehl PE. Construct validity in psychological tests. *Psychol Bull*. 1955;52(4):281–302.
8. Cronbach LJ. Coefficient alpha and the internal structure of tests. *Psychometrika*. 1951;16(3):297–334. doi:10.1007/bf02310555
9. Cortina JM. What is coefficient alpha? An examination of theory and applications. *J Appl Psychol*. 1993;78(1):98–104. doi:10.1037/0021-9010.78.1.98
10. Abufadda MAI, Moud MO, Al-Khalidi IR. Perspectives of artificial intelligence in radiology in Jordan: A cross-sectional study by radiologists and residents' sides. *Inform Med Unlocked*. 2024;49(1):101538. doi:10.1016/j.imu.2024.101538
11. Ansari MI, Arfat M, Malik MMUD, Bansal R. A

- cross-sectional survey on an insight into the current perceptions of Indian radiologists, radiographers, radiology trainees & medical imaging students on the future impact of artificial intelligence (AI) on the profession. *J Pharm Negative Results*. 2023;14(Special Issue 2):1686–1698. doi:10.47750/pnr.2023.14.S02.205
12. Ahmed RN, Ahmed NW, Thanoon GM. Radiologists and medical students' perception and attitude towards AI use in radiology. *TQMJ*. 2024;28(2):245. doi:10.32792/jmed.v28i2.582
  13. Haque MA, Islam QTI. Artificial intelligence in medicine: A new frontier. *BJM*. 2024;35(2):54–60. doi:10.3329/bjm.v35i2.72811
  14. Ghafoor N, Parven JA. Artificial intelligence (AI) – some basics! *Bangladesh J Radiol Imaging*. 2022;30(1):1–2
  15. Schmitt N. Uses and abuses of coefficient alpha. *Psychol Assess*. 1996;8(4):350–353. doi:10.1037/1040-3590.8.4.350
  16. Sijtsma K. On the use, the misuse, and the very limited usefulness of Cronbach's alpha. *Psychometrika*. 2009;74(1):107–120. doi:10.1007/s11336-008-9101-0
  17. Taber KS. The use of Cronbach's alpha when developing and reporting research instruments in science education. *Res Sci Educ*. 2018;48(6):1273–1296. doi:10.1007/s11165-016-9602-2