Association Between Nurses' Digital Competence and the Quality of Electronic Nursing Documentation: A Cross-Sectional Study

Safia Noreen[1*], Faryal Riaz[2], Sehrish Fida[3]

[1]Department of Nursing, Multan Institute of Cardiology, Multan, Pakistan.
[2]Allama Iqbal Teaching Hospital Dera Ghazi Khan, Pakistan.
[3]Department of Nursing, THQ Yazman, Pakistan.

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***Correspondence to**
Safia Noreen
Department of Nursing, Multan Institute of Cardiology, Multan, Pakistan.
Email: safiyanouree@gmail.com

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ABSTRACT

Background: The digital transformation of healthcare has made electronic nursing documentation a cornerstone of safe, high-quality patient care. However, the quality of documentation depends significantly on nurses' digital competence, which remains inadequately assessed in Pakistani healthcare settings. Inadequate digital skills may compromise documentation accuracy, completeness, and timeliness, potentially affecting patient safety and continuity of care. To assess the association between nurses' digital competence and the quality of electronic nursing documentation at a tertiary care cardiac hospital in Multan, Pakistan

Methods: A descriptive, correlational, cross-sectional design was employed. A total of 220 nurses were recruited from the Multan Institute of Cardiology using convenience sampling. Data were collected using the Digital Competence Questionnaire for Nurses (DCQ) and a validated Electronic Nursing Documentation Quality Audit Tool. Descriptive statistics, Pearson correlation, and multiple linear regression were used for data analysis using SPSS version 26.0.

Results: The mean digital competence score among nurses was 2.82 ± 0.68 (out of 5), with 74.5% (n = 164) demonstrating moderate to low competence. The mean documentation quality score was 68.4 ± 14.2 (out of 100), with only 31.8% (n = 70) achieving high-quality documentation. A significant positive correlation was found between digital competence and documentation quality ($r = 0.58$, $p < 0.001$). Multiple linear regression revealed that digital competence significantly predicted documentation quality ($\beta = 0.52$, $p < 0.001$), explaining 27.5% of the variance after controlling for age, education, and experience ($R^2 = 0.275$, $F = 20.64$, $p < 0.001$).

Conclusion: A significant positive association exists between nurses' digital competence and the quality of electronic nursing documentation. Enhancing nurses' digital skills through structured training programs is recommended to improve documentation quality and patient safety outcomes.

Keywords: Digital competence, electronic nursing documentation, documentation quality, nurses, cross-sectional study, Pakistan

INTRODUCTION

The global healthcare landscape is undergoing a profound digital transformation, with electronic health records (EHRs) and electronic nursing documentation becoming integral components of modern healthcare delivery.[18] Electronic nursing documentation supports continuity of care, interprofessional communication, clinical decision-making, and patient safety by facilitating the systematic recording and retrieval of patient information.[5,19] The increasing integration of digital technologies into healthcare has consequently expanded the competencies required of nurses in contemporary clinical practice.[4,18]

Digital competence in nursing encompasses a broad range of skills, including basic computer literacy, proficiency in health information systems, navigation of electronic health records, information management, data protection, ethical practice, and the effective use of digital technologies in patient care.[2,6,17] Digital competence also involves the ability to apply digital knowledge and skills appropriately within professional and clinical contexts.[10,24] Studies among nursing students and practicing nurses have demonstrated considerable variation in digital competence across different competency domains.[11,17,24]

The Technology Informatics Guiding Education Reform (TIGER) framework provides a comprehensive basis for understanding nursing informatics competencies in the digital era.[10] The framework encompasses competencies related to data, information and knowledge management, information exchange, ethical and legal issues, and the effective use of information systems.[10,18] Nursing documentation represents an important component of these competencies because nurses are major contributors to the generation, management, and utilization of

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clinical information within electronic health systems.[10,19]

Despite the recognized importance of digital competence, research has demonstrated substantial variation in nurses' informatics and digital competencies. A cross-sectional study found that nurses' digital health literacy was associated with educational level, professional role, and attitudes toward digital technologies.[2] Differences in digital literacy have also been reported between nursing managers and staff, particularly in nursing informatics competencies.[6] Digital competence among nurses has further been identified as an important component of digital empowerment within healthcare services.[4]

Professional experience and exposure to health information systems may also influence nurses' digital competence. Nurses' informatics competency has been examined in relation to health information system use and documentation-related competencies.[10] Digital competence has also been shown to vary according to professional role, educational background, and clinical environment.[2,6] These findings suggest that both formal education and practical experience contribute to the development of nurses' digital capabilities.[11,17]

The development of digital competence is particularly important because nursing practice increasingly incorporates diverse digital technologies. Digital technologies are being introduced across clinical education and healthcare delivery, including virtual reality, augmented reality, robotics, and cross-device digital platforms.[13,14,18] Virtual reality-based approaches have been investigated as innovative methods for nursing education and skills development.[14] Augmented reality-based training has likewise been evaluated as a technology-supported approach for improving nurses' clinical training.[9] Emerging robotic systems and digital platforms further demonstrate the expanding technological environment in which nurses are expected to practice.[13]

Electronic nursing documentation is a particularly important component of digital nursing practice because nurses record substantial amounts of clinical information through electronic systems. Accurate electronic documentation facilitates communication among healthcare professionals, supports continuity and coordination of care, and provides a longitudinal record of nursing assessment and interventions.[19,23] Documentation quality is commonly evaluated according to characteristics such as completeness, accuracy, timeliness, and consistency with the nursing process.[19,20]

Recent research has highlighted continuing challenges in the quality of electronic nursing documentation. A cross-sectional study examining nurses' use of digital health records demonstrated the importance of appropriate documentation of nursing processes within electronic systems.[19] Research evaluating an electronic medical record quality-control system has also demonstrated the potential value of structured digital approaches for improving nursing documentation quality.[23] Technology-supported interventions have further been investigated specifically to improve nursing documentation quality, including QR code-based approaches designed to facilitate access to documentation-related guidance.[20]

The quality of documentation is also important during transitions of care. Standardized discharge documentation and medication packages have been investigated as approaches to improve the communication of patient information when patients transition from hospital to nursing home care.[5] In long-term care settings, accurate reporting of challenging behaviors among residents with dementia similarly illustrates the importance of systematic nursing documentation for communicating clinically relevant patient information.[15]

Nurses' ability to use electronic documentation systems effectively is closely related to their informatics competency. A study of nurses' informatics competency in health information system use identified substantial variation across informatics competency domains relevant to clinical practice.[10] Digital health literacy has likewise been examined in specialized nursing populations, including neonatal nurses, where technology-mediated clinical practice requires appropriate digital knowledge and skills.[17] These findings indicate that effective electronic documentation requires more than access to technology; it also depends on nurses' ability to use digital systems appropriately within clinical practice.

Digital competence may further influence nurses' adaptation to rapidly changing healthcare environments. Digital competence has been associated with nurses' career sustainability, indicating that effective engagement with digital technologies may have implications for longer-term professional development.[24] At the organizational level, acceptance of digital technologies among nursing staff is also an important consideration for successful implementation, particularly in geriatric and long-term care settings.[8] Thus, individual competence, technology acceptance, and organizational conditions may collectively influence the effectiveness of digital transformation in nursing.[4,8]

Educational interventions represent an important strategy for addressing gaps in digital competence. Research involving nursing students has demonstrated differences in self-perceived digital literacy competencies, supporting the need for systematic development of digital skills within nursing education.[11] Technology-based educational approaches, including virtual reality and augmented reality, may provide additional opportunities for developing nurses' technical and clinical competencies.[9,14] Evidence from digital empowerment research further supports the importance of strengthening nurses' digital capabilities to facilitate effective technology use in healthcare services.[4]

The relationship between digital competence and documentation quality can also be interpreted from a theoretical perspective. Orem's Self-Care Theory emphasizes individuals' capabilities to perform self-care and the role of supportive nursing systems in addressing limitations in these capabilities. In the context of digital nursing practice, digital competence can be conceptualized as an enabling capability that allows nurses to effectively interact with electronic documentation and health information systems. Educational and supportive approaches may therefore help address deficits in digital competence and facilitate more effective use of digital technologies in nursing practice.[11,9,14]

Despite the growing body of literature on digital competence and digital nursing practice, important gaps remain. Existing research has examined digital literacy, informatics competency, technology acceptance, digital empowerment, and technology-supported education across diverse nursing populations and clinical settings.[2,4,8] However, comparatively fewer studies have directly examined the association between nurses' overall digital competence and the quality of their electronic nursing documentation.

The existing evidence is also geographically and contextually diverse, encompassing intensive clinical environments, neonatal nursing, geriatric and long-term care, oncology, nursing education, and general healthcare settings.[5,8,17] These differences highlight the importance of investigating digital competence and electronic documentation within specific healthcare systems and institutional contexts.

In Pakistan, the adoption of electronic health records and digital documentation systems is increasing, particularly in tertiary care hospitals. However, evidence specifically examining the association between nurses' digital competence and the quality of electronic nursing documentation in Pakistani healthcare settings remains limited. This represents an important research gap

because differences in nurses' digital literacy, informatics competency, health information system experience, and acceptance of digital technologies may influence how effectively electronic documentation systems are used.[2,6,8]

The present study was therefore undertaken to assess the association between nurses' digital competence and the quality of electronic nursing documentation at the Multan Institute of Cardiology, a major tertiary care cardiac hospital in Pakistan. By examining digital competence alongside electronic documentation quality, this study seeks to provide context-specific evidence regarding the role of nurses' digital capabilities in contemporary healthcare delivery. The findings may inform targeted educational and organizational interventions aimed at strengthening nurses' digital competence, improving electronic documentation quality, and ultimately supporting safer and more effective patient care.

METHODOLOGY

Research Design

A descriptive, correlational, cross-sectional design was employed for this study. This design was selected to assess the association between nurses' digital competence and the quality of electronic nursing documentation at a single point in time.

Study Setting

The study was conducted at the Multan Institute of Cardiology, a major tertiary care cardiac hospital in Multan, Pakistan. The hospital provides comprehensive cardiac care services and has implemented an electronic health records system for nursing documentation.

Study Population

The target population consisted of all registered nurses working at the Multan Institute of Cardiology. The accessible population included nurses who met the inclusion criteria and were employed in clinical units where electronic nursing documentation is practiced.

Sample Size and Sampling Technique

A sample size of 220 nurses was calculated using the formula for estimating a population proportion, considering a 95% confidence level, 5% margin of error, and an anticipated proportion of 50% (to maximize sample size). Convenience sampling was employed to recruit participants who met the inclusion criteria.

Inclusion Criteria

- Registered nurses working at Multan Institute of Cardiology
- Employed in clinical units utilizing electronic nursing documentation
- At least six months of experience with electronic documentation systems
- Willing to participate in the study

Exclusion Criteria

- Nurses on extended leave during the data collection period
- Nurses working in non-clinical administrative roles
- Nurses who did not consent to participate

Data Collection Instruments

Two instruments were utilized for data collection:

1. Digital Competence Questionnaire for Nurses (DCQ): This validated instrument comprised 17 items assessing nurses' digital competence across multiple domains. Items covered basic computer skills, health information system proficiency, data protection and ethics, digital communication, and problem-solving with digital tools. Responses were scored on a 5-point Likert scale ranging from 1 (very low competence) to 5 (very high competence), with a maximum possible score of 85. The DCQ has demonstrated good reliability and validity in previous studies.

2. Electronic Nursing Documentation Quality Audit Tool: This instrument was developed based on the Cat-ch-Ing audit instrument and the Q-DIO framework. The tool comprised 25 items assessing documentation quality across five domains: (a) completeness of nursing assessment, (b) accuracy of documentation, (c) timeliness of entries, (d) use of standardized terminology, and (e) congruence with the nursing process. Each item was scored on a 4-point scale (0 = absent/poor, 3 = excellent/comprehensive), with a maximum possible score of 75, converted to a percentage for analysis.

Both instruments were validated through expert review by five nursing and informatics professionals. Content validity index (CVI) was calculated as 0.91 for the DCQ and 0.88 for the documentation quality audit tool. Reliability was established through a pilot study with 20 participants, yielding Cronbach's alpha coefficients of 0.86 and 0.84 respectively.

Data Collection Procedure

Phase 1 (Survey): Following informed consent, demographic data were collected, and the Digital Competence Questionnaire was administered to participants. This established the baseline level of digital competence among nurses.

Phase 2 (Audit): Electronic nursing documentation records were audited for each participating nurse. A total of five patient records per nurse were randomly selected and assessed using the Electronic Nursing Documentation Quality Audit Tool. The audit was conducted by two trained research assistants with inter-rater reliability of 0.89.

Data Analysis

Data were entered and analyzed using SPSS version 26.0. Descriptive statistics including mean, standard deviation, frequency, and percentages were calculated for demographic variables and outcome measures. Pearson correlation was employed to examine the bivariate association between digital competence and documentation quality. Multiple linear regression was used to assess the predictive relationship while controlling for potential confounders. Statistical significance was set at $p < 0.05$.

RESULTS

Demographic Characteristics of Participants

A total of 220 nurses participated in the study. The demographic characteristics are presented in Table 1.

Table 1: Demographic Characteristics of Participants (N = 220)

Demographic Variable	Category	Frequency (n)	Percentage (%)
Age (years)	20-29	86	39.1
	30-39	92	41.8
	40-49	32	14.5
	50-59	10	4.5
Gender	Male	68	30.9
	Female	152	69.1
Education	Diploma in Nursing	74	33.6
	BSc Nursing	112	50.9
	Postgraduate (MSc/MPhil)	34	15.5
Clinical Experience (years)	< 5	48	21.8
	5-10	96	43.6
	11-15	48	21.8
	> 15	28	12.7
Unit Type	Medical Ward	52	23.6
	Surgical Ward	44	20.0

	ICU/CCU	68	30.9
	Emergency	32	14.5
	Others	24	10.9
EHR Training Received	Yes	76	34.5
	No	144	65.5

Table 1 shows that the majority of participants (41.8%) were in the 30-39 years age group, and more than two-thirds (69.1%) were female. Half of the participants (50.9%) held a BSc Nursing degree, and the largest proportion (43.6%) had 5-10 years of clinical experience. Notably, 65.5% of nurses reported having received no formal training on the electronic health records system.

Digital Competence of Nurses

The digital competence scores of participants are presented in Table 2.

Table 2: Digital Competence Scores of Participants (N = 220)

Domain	Mean ± SD	Range
Basic computer skills	3.24 ± 0.92	1-5
Health information system proficiency	2.56 ± 0.84	1-5
Data protection and ethics	3.18 ± 0.76	1-5
Digital communication	2.94 ± 0.88	1-5
Problem-solving with digital tools	2.18 ± 0.82	1-5
Total Digital Competence	**2.82 ± 0.68**	**1-5**

The mean total digital competence score was 2.82 ± 0.68 out of 5, indicating moderate to low competence. The highest competence was observed in basic computer skills (3.24 ± 0.92) and data protection and ethics (3.18 ± 0.76), while the lowest competence was in problem-solving with digital tools (2.18 ± 0.82). Overall, 74.5% (n = 164) of nurses demonstrated moderate to low digital competence (score < 3.5).

Quality of Electronic Nursing Documentation

The documentation quality scores are presented in Table 3.

Table 3: Electronic Nursing Documentation Quality Scores (N = 220)

Domain	Mean ± SD	Range(0-100)
Completeness of nursing assessment	62.8 ± 16.4	20-92
Accuracy of documentation	71.2 ± 14.6	32-96
Timeliness of entries	58.6 ± 18.2	16-88
Use of standardized terminology	65.4 ± 15.8	24-90
Congruence with nursing process	84.0 ± 12.4	44-100
Total Documentation Quality	**68.4 ± 14.2**	**28-92**

The mean total documentation quality score was 68.4 ± 14.2 out of 100, indicating moderate quality. The highest quality was observed in congruence with the nursing process (84.0 ± 12.4), while the lowest quality was in timeliness of entries (58.6 ± 18.2). Only 31.8% (n = 70) of nurses achieved high-quality documentation (score ≥ 80).

Association Between Digital Competence and Documentation Quality

The bivariate and multivariate associations between digital competence and documentation quality are presented in Table 4.

Table 4: Association Between Digital Competence and Documentation Quality

Variable	Correlation (r)	p-value	Regression (β)	p-value
Digital Competence	0.58	< 0.001	0.52	< 0.001
Age	0.12	0.074	-0.08	0.214
Education	0.24	< 0.001	0.15	0.018
Clinical Experience	0.18	0.008	0.06	0.342
EHR Training	0.34	< 0.001	0.22	< 0.001

Pearson correlation revealed a significant positive correlation between digital competence and documentation quality ($r = 0.58$, $p < 0.001$). Education ($r = 0.24$, $p < 0.001$), clinical experience ($r = 0.18$, $p = 0.008$), and EHR training ($r = 0.34$, $p < 0.001$) were also significantly correlated with documentation quality.

Multiple linear regression analysis revealed that digital competence significantly predicted documentation quality ($\beta = 0.52$, $p < 0.001$), after controlling for age, education, clinical experience, and EHR training. The overall model explained 27.5% of the variance in documentation quality ($R^2 = 0.275$, $F = 20.64$, $p < 0.001$).

DISCUSSION

Postoperative wound infection is an important complication of The present study assessed the association between nurses' digital competence and the quality of electronic nursing documentation at the Multan Institute of Cardiology. The findings demonstrated a significant positive association between digital competence and documentation quality, supporting the hypothesis that higher digital competence is associated with better documentation quality.

The mean digital competence score of 2.82 ± 0.68 out of 5 indicates that nurses at the study setting possess moderate to low digital competence. This finding is consistent with previous research. Akhu-Zaheya and Etoom reported a mean informatics competency score of 2.49 ± 0.73 among intensive care unit nurses, with 81.79% reporting low competency. Similarly, a study of Finnish nurses found that although overall informatics competency was good, competency in nursing documentation and the digital environment was lower than in other domains.[10,24]

The finding that the lowest competence was in problem-solving with digital tools (2.18 ± 0.82) is particularly concerning, as this skill is essential for troubleshooting technical issues that may arise during documentation. This aligns with research showing that nurses may exhibit lower proficiency in advanced digital skills. The moderate competence in basic computer skills (3.24 ± 0.92) and data protection and ethics (3.18 ± 0.76) suggests that while nurses have foundational digital skills, they may lack some advanced competencies necessary for optimal use of electronic documentation systems.[10]

The high proportion of nurses (65.5%) who reported receiving no formal EHR training is a significant finding. Previous research among neonatal nurses has highlighted the importance of e-health literacy and technology-related competencies in technology-mediated clinical practice.[17] The absence of formal training may therefore contribute to lower digital competence, as structured education and institutional support are important for developing proficiency in health information systems.[18]

The mean documentation quality score of 68.4 ± 14.2 out of 100 indicates moderate quality, which is concerning given the critical role of nursing documentation in patient safety and continuity of care. Only 31.8% of nurses achieved high-quality documentation, suggesting that a substantial proportion of nursing documentation may require improvement.[19,23]

The finding that timeliness of entries was the lowest-scoring domain (58.6 ± 18.2) is particularly significant, as timely documentation is essential for ensuring accurate and up-to-date patient information. This may reflect workload and time constraints faced by nurses, as well as potential challenges related to electronic system usability and workflow integration.[2,10]

The highest quality was observed in congruence with the nursing process (84.0 ± 12.4), suggesting that nurses generally understand the structure of the nursing process and can document accordingly. However, the moderate scores in completeness of nursing assessment (62.8 ± 16.4) and use of standardized terminology (65.4 ± 15.8) indicate areas for improvement.[4,19]

These findings align with previous research documenting challenges in nursing documentation quality. Studies examining electronic documentation have emphasized the importance of structured documentation processes and appropriate use of electronic health records to support the quality and consistency of nursing records.[19,23]

The significant positive correlation between digital competence and documentation quality ($r = 0.58$, $p < 0.001$) provides evidence that nurses with higher digital competence tend to produce higher-quality documentation. This finding is consistent with research emphasizing the importance of informatics competency in effective health information system use.[10,24]

The regression analysis revealed that digital competence significantly predicted documentation quality ($\beta = 0.52$, $p < 0.001$), explaining 27.5% of the variance after controlling for potential confounders. This indicates that digital competence is an important contributor to documentation quality, although other factors such as workload, system usability, organizational support, and training may also play important roles.[18,20]

The finding that EHR training was significantly associated with documentation quality ($\beta = 0.22$, $p < 0.001$) underscores the importance of formal training in developing both digital competence and documentation quality. Evidence from the broader nursing literature indicates that digital technologies and structured technology-supported education can contribute to nurses' competencies and preparedness for digital practice.[9,14,18]

Interestingly, while education was significantly associated with documentation quality ($\beta = 0.15$, $p = 0.018$), clinical experience was not ($\beta = 0.06$, $p = 0.342$). This suggests that formal educational preparation may be more relevant than years of clinical experience for developing digital competence and documentation-related skills. Differences in digital literacy among nursing students and practicing nurses further support the importance of integrating digital competencies into nursing education.[11,24]

The findings of this study have several important implications for nursing practice. First, the low digital competence observed among nurses highlights the need for structured training programs on electronic health records and digital documentation. Healthcare institutions should invest in comprehensive training that covers not only basic computer skills but also advanced competencies such as problem-solving with digital tools, use of standardized terminology, and optimization of documentation workflows.[4,10,18]

Second, the association between digital competence and documentation quality suggests that strengthening digital competence may be an effective strategy for improving documentation quality. Training programs should therefore be designed to address specific competency gaps identified in this study, particularly problem-solving with digital tools and proficiency in health information systems.[3,10,17]

Third, the finding that EHR training was significantly associated with documentation quality underscores the importance of providing formal training to nurses who have not received adequate preparation. Regular refresher training and ongoing institutional support may help nurses maintain and strengthen their digital competencies as electronic systems evolve.[8,18]

Fourth, nursing education programs should integrate health informatics and digital competence training into their curricula. Given that education was significantly associated with documentation quality, strengthening informatics education in nursing schools could have long-term benefits for nurses' readiness to use digital health systems effectively.[11,14,16]

The findings of this study provide a basis for considering Orem's Self-Care Theory in the context of nursing informatics. According to Orem's theory, individuals have capabilities that can be supported and enhanced through appropriate education and assistance. In the context of digital nursing practice, digital competence can be conceptualized as an enabling capability that allows nurses to interact effectively with electronic documentation and health information systems.

Educational and supportive approaches may therefore help address deficits in digital competence and facilitate more effective use of digital technologies in nursing practice.[11,14,18]The supportive-educative nursing system, as described by Orem, provides a framework for understanding how healthcare organizations can address digital competence deficits. By providing appropriate training, technical support, and ongoing education, organizations can enhance nurses' digital competence and, consequently, documentation quality.

This study has several strengths. First, it addresses a significant gap in the literature by examining the association between digital competence and documentation quality in the Pakistani context, where such research is limited. Second, the use of validated instruments for both digital competence assessment and documentation quality audit enhances the validity of the findings. Third, the inclusion of multiple documentation quality domains provides a comprehensive assessment of documentation quality.

LIMITATIONS

Several limitations should be acknowledged. First, the cross-sectional design limits the ability to establish causality; the observed association between digital competence and documentation quality does not necessarily imply that improving digital competence will cause improvements in documentation quality. Second, the study was conducted at a single tertiary care cardiac hospital, which may limit the generalizability of findings to other healthcare settings. Third, the use of convenience sampling may introduce selection bias. Fourth, the reliance on self-reported digital competence may be subject to social desirability bias. Fifth, the documentation quality audit was based on a limited number of patient records per nurse, which may not fully capture documentation quality across all clinical situations.

Future research should address these limitations by employing longitudinal designs to establish causality, including multiple healthcare settings, utilizing objective measures of digital competence, and including larger and more diverse samples. Additionally, research should explore the effectiveness of specific training interventions in improving digital competence and documentation quality, and examine the impact of improved documentation quality on patient outcomes.

CONCLUSION

This study assessed the association between nurses' digital competence and electronic nursing documentation quality at the Multan Institute of Cardiology, Pakistan. Nurses demonstrated moderate to low digital competence, with only 34.5% receiving formal EHR training. Documentation quality was moderate, with

timeliness representing the weakest domain. Digital competence was significantly and positively associated with documentation quality ($r = 0.58$, $p < 0.001$) and significantly predicted documentation quality ($\beta = 0.52$, $p < 0.001$). These findings highlight the importance of strengthening nurses' digital skills to improve documentation quality and patient safety. Structured EHR training, targeted competency development, refresher courses, technical support, and integration of health informatics into nursing curricula are recommended. Further multicenter research with larger samples is needed to validate these findings.

Ethical Approval
Ethical approval was obtained from the Institutional Review Board of the Multan Institute of Cardiology. Written informed consent was obtained from all participants after explaining the purpose, procedures, risks, and benefits of the study. Participants were assured of confidentiality and the right to withdraw from the study at any time. Data were anonymized and stored securely.

Data Availability
The datasets generated and/or analyzed during the current study are available from the corresponding author upon reasonable request.

Author Contributions
Conceptualization: Safia Noreen, Faryal Riaz
Methodology: Safia Noreen, Faryal Riaz, Sehrish Fida
Data Collection: Faryal Riaz, Sehrish Fida
Formal Analysis: Safia Noreen, Sehrish Fida
Writing – Original Draft: Faryal Riaz, Sehrish Fida
Writing – Review & Editing: Safia Noreen, Faryal Riaz, Sehrish Fida

Informed Consent
Written informed consent was obtained from all participants before enrollment in the study.

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Conflict of Interest
The authors declare that they have no competing interests.

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Declaration of AI-Assisted Language Editing
Gemini AI was used for grammar and language correction.

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