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Original Article

Assessment of Knowledge and Perception of Telenursing Among Nursing Students in Islamabad, Pakistan

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ABSTRACT

Background: Rapid expansion of digital healthcare has increased the importance of telenursing as a strategy for improving access, continuity, and efficiency of care, particularly in settings with workforce and geographic barriers. The preparedness of nursing students is critical for successful future integration of telenursing into education and practice. Objective: To assess the knowledge and perception of telenursing among undergraduate nursing students in Islamabad, Pakistan, and to examine the relationship between knowledge and perception. Methods: A descriptive cross-sectional study was conducted among 186 third- and fourth-year BS Nursing students from four nursing colleges in Islamabad. Data were collected using a structured self-administered questionnaire comprising demographic items, 10 knowledge items, and 10 perception items. Knowledge scores ranged from 0 to 10, while perception scores ranged from 10 to 50. Descriptive statistics and Pearson correlation analysis were applied. Results: Most students demonstrated good knowledge of telenursing (87.1%), with a mean knowledge score of 8.50 ± 1.62. Positive perception was observed in 76.9% of participants, with a mean perception score of 38.50 ± 5.36. Strong support was found for integrating telenursing into undergraduate education and healthcare services in Pakistan, although concerns remained regarding technical feasibility, infrastructure, and reduced direct nurse-patient contact. Knowledge and perception showed a weak but statistically significant positive correlation (r=0.22, p=0.002). Conclusion: Nursing students showed high knowledge and generally favorable perceptions toward telenursing, indicating substantial conceptual readiness. However, effective implementation will require structured education, practical exposure, and infrastructural support to translate positive attitudes into competent clinical practice. Keywords: telenursing, telehealth, nursing students, knowledge, perception, digital health, Pakistan.

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INTRODUCTION

The rapid expansion of digital health technologies has transformed the way healthcare is delivered, accessed, and monitored across the world. Among these developments, telehealth has emerged as an important strategy for improving healthcare accessibility, continuity, and efficiency, particularly in settings where geographical, economic, and workforce-related barriers limit conventional service delivery. Telehealth broadly refers to the use of information and communication technologies to provide clinical care, patient education, public health support, and health information remotely, using platforms such as mobile phones, internet-based systems, video conferencing, and digital monitoring tools (1-4). Within this broader framework, telenursing has developed as a specialized application of telehealth that enables nurses to deliver assessment, education, follow-up, counseling, monitoring, and supportive care from a distance through technology-mediated communication (2,5,6).

The significance of telenursing has increased substantially in contemporary healthcare because nursing professionals are central to care coordination, chronic disease management, patient education, and continuity of care. Telenursing offers potential advantages in improving service reach, supporting patient self-management, reducing unnecessary travel, facilitating timely follow-up, and extending healthcare access to patients who live in underserved or remote areas or who face mobility-related

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challenges (3,5,7). Its value became even more visible during the COVID-19 pandemic, when restrictions on in-person contact accelerated the adoption of remote care models and reinforced the need for healthcare systems to maintain safe and effective communication with patients outside traditional clinical settings (3,8). At the same time, successful telenursing implementation depends not only on technological infrastructure, but also on the preparedness of the nursing workforce to understand, accept, and competently use digital modes of care delivery.

Nursing students represent the future professional workforce and therefore constitute a critical group in the transition toward digitally enabled healthcare systems. Their knowledge of telenursing, perceptions of its usefulness, and willingness to engage with telehealth-based practice are likely to influence the future uptake and sustainability of these models in routine healthcare. International evidence suggests that although nursing students often express favorable attitudes toward telehealth and telenursing, their formal exposure, practical experience, and structured educational preparation in this domain remain limited (9-13). Studies from Croatia, Austria, Korea, Nepal, Egypt, and other settings have shown a recurring pattern in which students demonstrate generally positive perceptions of telenursing, while simultaneously reporting insufficient curricular integration, inadequate practical training, or limited conceptual understanding of digital nursing care (9-15). This pattern suggests that positive attitudes alone may not be sufficient to ensure readiness for effective clinical implementation unless supported by organized educational and institutional frameworks.

The need to examine this issue is particularly important in Pakistan, where substantial disparities in healthcare access continue to affect populations living in rural and resource-constrained regions. A large proportion of the population resides in areas where specialist access, continuity of care, and healthcare infrastructure remain limited, making telehealth-based solutions increasingly relevant to national service planning (4,16). At the same time, digital health adoption in Pakistan has been constrained by infrastructural limitations, technological barriers, lack of training, and variable awareness among healthcare professionals and trainees (4,17). While some Pakistani studies have explored awareness and perceptions of telehealth among medical students and healthcare workers, the evidence specifically addressing telenursing among undergraduate nursing students remains extremely limited. This represents an important knowledge gap because nursing students are not only future users of telehealth systems but also likely frontline implementers of remote monitoring, patient counseling, and follow-up services in both hospital and community settings.

The available literature therefore points to a consistent international trend of positive student attitudes but uneven educational preparedness, while the Pakistani context remains underexplored despite its strong practical relevance. In addition, prior studies have often examined knowledge and attitude descriptively, with less emphasis on understanding how knowledge may relate to perceptions in a way that informs curricular reform and workforce planning. Establishing whether better-informed students hold more favorable perceptions toward telenursing may provide useful direction for nursing education, especially in settings where digital transformation is underway but not yet fully institutionalized. In this context, the present study was designed to assess the knowledge and perception of undergraduate nursing students regarding telenursing in selected nursing colleges of Islamabad and to examine the relationship between these two domains. It was hypothesized that higher knowledge of telenursing would be associated with more positive perceptions toward its future use in healthcare practice (4,9,14,15,17).

MATERIALS AND METHODS

A descriptive cross-sectional study was conducted to assess the knowledge and perception of telenursing among undergraduate nursing students enrolled in selected nursing colleges in Islamabad, Pakistan. This design was appropriate because the study aimed to measure the distribution of knowledge and perception at a single point in time and to explore the relationship between these variables within an

educational population. The study was carried out in four nursing institutions located in Islamabad: Bashir Institute of Health Sciences, Federal Government Nursing College, Dakson Institute of Health Sciences, and Islamabad Nursing College. The target population comprised third- and fourth-year BS Nursing students currently enrolled in these institutions, as these students were considered more likely to have sufficient academic and clinical exposure to meaningfully respond to questions related to contemporary nursing practice and emerging care technologies.

Participants were selected using a convenience sampling technique from an estimated population of 350 eligible students across the selected institutions. The final sample size was 186 students, calculated using Yamane's formula with a 95% confidence level and a 5% margin of error. Students were eligible for inclusion if they were enrolled in the third or fourth year of the BS Nursing program and were willing to provide written informed consent. Students not enrolled in these academic years or those unwilling to participate were excluded. Recruitment was conducted within the participating institutions, and students who met the eligibility criteria were approached and invited to participate voluntarily. Written informed consent was obtained before data collection, and participation was entirely voluntary.

Data were collected using a structured self-administered questionnaire adapted from the study by Samson and Zofiat on knowledge and perception of telenursing among nursing students in selected nursing institutions. The questionnaire was slightly modified to suit the context of nursing education in Pakistan and reviewed by experts for content validity before use (18). The instrument consisted of three components: demographic characteristics, knowledge of telenursing, and perception toward telenursing. The demographic section captured age, gender, academic year, and institute type. The knowledge section included 10 dichotomous items with response options of "Yes" and "No," designed to assess conceptual understanding of telenursing, perceived benefits, barriers, technological requirements, and common tools used in remote nursing practice. Each correct response was assigned a score of 1 and each incorrect response a score of 0, resulting in a total possible score ranging from 0 to 10. Participants scoring 7 or higher, corresponding to at least 70% of the total score, were categorized as having good knowledge, whereas those scoring below 7 were classified as having poor knowledge.

Perception toward telenursing was assessed using 10 items rated on a 5-point Likert scale ranging from strongly disagree to strongly agree. These items examined students' views regarding the usefulness of telenursing in undergraduate education, future clinical use, national need for telenursing services, availability of facilities, perceived effect on efficiency and cost, technical feasibility, concerns regarding loss of direct contact with patients, usefulness in outpatient monitoring, and opportunities for nurse-to-nurse professional collaboration. The perception items were scored so that higher total scores represented more favorable perceptions, producing a possible score range of 10 to 50. The overall perception score was used to classify respondents as having either positive or negative perceptions of telenursing.

Data collection was conducted through direct questionnaire administration in the selected institutions. To support data quality, the same structured tool was used across all participating colleges, and all participants completed the same item set in the same response format. Standardized operational definitions were applied during analysis, with knowledge treated as the cumulative score derived from the 10 factual items and perception treated as the cumulative score derived from the 10 Likert-scale items. Demographic variables were defined categorically according to the classifications reported in the study, including age group, gender, academic year, and public or private institutional status. Because the study used self-reported responses and non-probability sampling, potential sources of bias included selection bias, recall limitations, and social desirability in participant responses. These limitations were considered during interpretation of findings, particularly when drawing conclusions regarding generalizability beyond the sampled institutions.

Statistical analysis was performed to summarize respondent characteristics, describe knowledge and perception patterns, and examine the relationship between the two core study variables. Categorical

variables were reported using frequencies and percentages. Continuous summary measures were reported as mean and standard deviation for total knowledge and perception scores. Pearson correlation analysis was used to examine the association between knowledge and perception scores, and statistical significance was interpreted using a two-tailed threshold of $p < 0.05$. The study reported a correlation coefficient of 0.22 with a p-value of 0.002, indicating a weak but statistically significant positive relationship between knowledge and perception. The analytical approach was aligned with the descriptive and relational objectives of the study, which focused on quantifying overall levels of knowledge and perception and determining whether students with higher knowledge tended to hold more favorable views toward telenursing.

The study was conducted in accordance with ethical principles governing human participant research. Participation was voluntary, written informed consent was obtained from eligible students prior to inclusion, and only those willing to participate were enrolled. The use of a structured questionnaire, consistent scoring procedures, predefined operational thresholds for knowledge and perception categories, and uniform data collection across the four participating institutions supported methodological consistency and reproducibility of the study procedures.

RESULTS

A total of 186 undergraduate nursing students were included in the analysis. Most participants were aged 23–26 years (n=97, 52.15%), followed by 19–22 years (n=85, 45.70%), while only 4 students (2.15%) were aged 27 years or older. Male students constituted 59.68% (n=111) of the sample and female students 40.32% (n=75). Slightly more respondents were enrolled in the 4th year (n=102, 54.84%) than in the 3rd year (n=84, 45.16%). Most participants belonged to private institutions (n=134, 72.04%), whereas 52 students (27.96%) were enrolled in public institutions.

Table 1. Demographic Characteristics of Nursing Students (N = 186)

Variable	Category	Frequency (n)	Percentage (%)
Age	19–22 years	85	45.70
	23–26 years	97	52.15
	≥27 years	4	2.15
Gender	Male	111	59.68
	Female	75	40.32
Academic Year	3rd Year	84	45.16
	4th Year	102	54.84
Institute Type	Public	52	27.96
	Private	134	72.04

More than half of the respondents had previously heard about telenursing (55.9%), whereas 44.1% reported no prior exposure. This suggests that although baseline awareness was present in a slight majority, familiarity with the concept was not yet universal among nursing students.

Knowledge of telenursing was high across nearly all assessed domains. Almost all participants correctly identified telenursing as a combination of telecommunications services and nursing (n=178, 95.70%; 95% CI: 91.70–97.87; p<0.001). Strong majorities also recognized that telenursing increases service coverage and effectiveness (n=169, 90.86%; 95% CI: 85.88–94.16; p<0.001), requires training in technology resources (n=162, 87.10%; 95% CI: 81.52–91.15; p<0.001), and depends on technical and operational stability for successful implementation (n=164, 88.17%; 95% CI: 82.72–91.99; p<0.001). Substantial proportions further acknowledged its role in improving patient and family participation in self-management (83.33%) and increasing patient self-efficacy and awareness of healthy behaviors (86.02%). Although endorsement remained high, relatively lower agreement was observed for the statements that telenursing increases nurse and client safety (73.66%) and improves work productivity (74.73%), indicating comparatively greater uncertainty regarding operational outcomes than conceptual foundations.

When total knowledge scores were categorized, 162 participants (87.10%) demonstrated good knowledge, whereas 24 (12.90%) had poor knowledge. The proportion with good knowledge was significantly greater than the reference threshold of 50% (95% CI: 81.52–91.15; p<0.001). The mean total knowledge score was 8.50 ± 1.62 out of 10, reflecting a strong overall level of understanding regarding the principles, uses, and requirements of telenursing.

Table 2. Knowledge of Telenursing Among Nursing Students (N = 186)

Knowledge Item	Yes n (%)	No n (%)	95% CI for Yes (%)	P-value*
Telenursing is a combination of telecommunications services with nursing	178 (95.70)	8 (4.30)	91.70–97.87	<0.001
Telenursing increases service coverage and effectiveness	169 (90.86)	17 (9.14)	85.88–94.16	<0.001
Telenursing increases patient and family participation in self-management care	155 (83.33)	31 (16.67)	77.32–88.00	<0.001
Telenursing increases patient self-efficacy and awareness regarding healthy behaviors	160 (86.02)	26 (13.98)	80.27–90.29	<0.001
Barriers include inability to see patients, ethical dilemmas, and technological difficulties	156 (83.87)	30 (16.13)	77.93–88.37	<0.001
Training in technology resources is required for implementing telenursing	162 (87.10)	24 (12.90)	81.52–91.15	<0.001
Successful telenursing requires technical and operational stability	164 (88.17)	22 (11.83)	82.72–91.99	<0.001
Telenursing increases the safety of nurses and clients	137 (73.66)	49 (26.34)	66.87–79.50	<0.001
Work productivity increases with the use of telenursing	139 (74.73)	47 (25.27)	68.00–80.46	<0.001
Phones, TV, TeleECG, and audio/video systems are commonly used in telenursing	162 (87.10)	24 (12.90)	81.52–91.15	<0.001

*Exact binomial test against a 50% reference proportion.

Table 3. Overall Knowledge Level of Telenursing (N = 186)

Outcome	n (%)	95% CI	P-value*	Mean ± SD
Good knowledge (score ≥7/10)	162 (87.10)	81.52–91.15	<0.001	8.50 ± 1.62
Poor knowledge (score <7/10)	24 (12.90)	8.85–18.48	—	—

*Exact binomial test against a 50% reference proportion for the good-knowledge category.

Perception findings showed broad support for the educational and service-related value of telenursing, although students expressed more caution regarding infrastructural readiness and technological feasibility. The highest positive endorsement was observed for the need to introduce telenursing services in healthcare in Pakistan (n=162, 87.10%; 95% CI: 81.52–91.15; p<0.001), followed closely by the view that telenursing in undergraduate studies would be useful for future healthcare workers (n=161, 86.56%; 95% CI: 80.93–90.75; p<0.001). Positive endorsement was also high for nurse-to-nurse conferencing for knowledge sharing (81.72%), future use of telenursing as an additional care modality (79.57%), and timely monitoring and provision of care to outpatients (79.03%). In contrast, only 51.61% agreed that facilities for providing telenursing were available in their clinical area, and just 45.70% agreed that telenursing is possible without technical problems. The latter finding was not significantly different from the 50% reference proportion (p=0.275), highlighting technological readiness as the weakest domain of perception. Additionally, 62.37% agreed that telenursing may result in loss of direct contact between medical staff and patients, suggesting that interpersonal concerns remain relevant despite generally favorable attitudes.

Table 4. Perception Toward Telenursing Among Nursing Students (N = 186)

Perception Item	Positive n (%)	Neutral n (%)	Negative n (%)	95% CI for Positive (%)	P-value*
Telenursing in undergraduate studies would be useful for future healthcare workers	161 (86.56)	12 (6.45)	13 (6.99)	80.93–90.75	<0.001
I would like to use telenursing as an additional form of patient care in my future work	148 (79.57)	26 (13.98)	12 (6.45)	73.20–84.78	<0.001
There is a need to introduce telenursing services in healthcare in Pakistan	162 (87.10)	16 (8.60)	8 (4.30)	81.52–91.15	<0.001
Facilities for providing telenursing care are available in my clinical area	96 (51.61)	25 (13.44)	65 (34.95)	44.48–58.68	0.708
Telenursing can improve the efficiency of the medical staff	140 (75.27)	33 (17.74)	13 (6.99)	68.53–80.97	<0.001
Telenursing can reduce the cost of patient care	112 (60.22)	44 (23.66)	30 (16.13)	53.05–66.99	0.007
Telenursing is possible without technical problems	85 (45.70)	21 (11.29)	80 (43.01)	38.82–52.76	0.275
Telenursing may result in loss of direct contact between staff and patients	116 (62.37)	32 (17.20)	38 (20.43)	55.22–69.00	0.001
Telenursing allows timely monitoring and provision of care to outpatients	147 (79.03)	24 (12.90)	15 (8.06)	72.61–84.28	<0.001
Nurses can engage other nurses through telenursing conferencing to discuss and update knowledge	152 (81.72)	19 (10.22)	15 (8.06)	75.57–86.56	<0.001

*Exact binomial test against a 50% reference proportion for positive endorsement.

At the aggregate level, 143 participants (76.90%) were classified as having a positive overall perception, whereas 43 (23.10%) had a negative overall perception. The proportion with positive perception was significantly greater than 50% (95% CI: 70.33–82.39; p<0.001). The mean total perception score was 38.50 ± 5.36 out of a possible 50, indicating an overall favorable orientation toward telenursing. Correlation analysis further showed a weak but statistically significant positive association between knowledge and perception scores (r=0.22, 95% CI: 0.08 to 0.35; p=0.002). This suggests that students with higher knowledge tended to report more favorable perceptions, although the small effect size indicates that knowledge alone explained only a limited proportion of perceptual variation.

Table 5. Overall Perception and Its Correlation with Knowledge Scores (N = 186)

Measure	Statistic/Outcome	n (%)	Effect Size	95% CI	P-value	Mean ± SD
Overall perception level	Positive perception	143 (76.90)	—	70.33–82.39	<0.001*	38.50 ± 5.36
	Negative perception	43 (23.10)	—	17.61–29.67	—	—
Association with knowledge	Knowledge score vs perception score	—	Pearson r = 0.22 (weak positive)	0.08 to 0.35	0.002†	—

*Exact binomial test against a 50% reference proportion for the positive-perception category. †Pearson correlation test.

Table 1 shows that the study sample was dominated by students aged 23–26 years, male participants, 4th-year students, and those enrolled in private institutions. This indicates that the findings primarily reflect the views of a relatively senior and predominantly private-sector nursing student cohort.

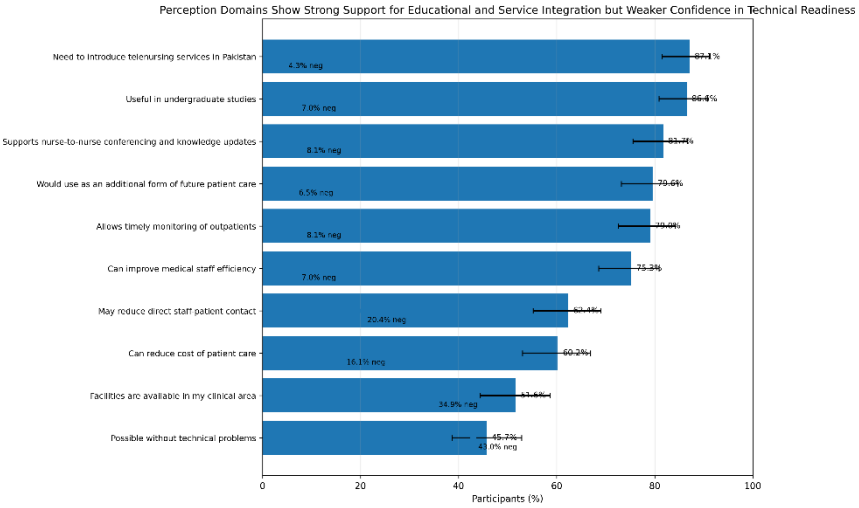

Figure 1 Perception Domains Show Strong Support for Educational and Service Integration but Weaker Confidence in Technical Readiness

Table 2 demonstrates that knowledge of telenursing was consistently high, with affirmative responses exceeding 83% for most items and reaching 95.70% for the basic definition of telenursing. The comparatively lower endorsement for safety and productivity, though still above 73%, suggests that students were somewhat less certain about downstream practice benefits than about conceptual and infrastructural requirements. Table 3 confirms that good knowledge was the dominant pattern in this sample, with 87.10% of respondents scoring at or above the predefined threshold and a mean knowledge score of 8.50 out of 10. The narrow confidence interval around this estimate supports the robustness of this finding.

Table 4 indicates that student perception was generally favorable, particularly regarding the educational usefulness of telenursing, its future role in clinical practice, its relevance for outpatient monitoring, and its importance for national healthcare integration. However, mixed responses regarding facility availability and the high level of uncertainty about technical feasibility show that students distinguished between conceptual support for telenursing and confidence in current implementation conditions.

Table 5 shows that more than three-quarters of respondents had an overall positive perception of telenursing, with a mean score of 38.50 out of 50. The same table also demonstrates that knowledge and perception were significantly related, but only weakly, indicating that better-informed students were somewhat more likely to hold favorable perceptions, while other contextual or experiential factors likely also influenced their attitudes.

The figure 1 demonstrates a clear gradient across perception domains, with the highest positive endorsement observed for introducing telenursing services in Pakistan (87.1%), usefulness in undergraduate studies (86.6%), and nurse-to-nurse conferencing (81.7%), while markedly lower support was seen for local facility availability (51.6%) and technical feasibility without hardware or internet problems (45.7%). Negative response burden was lowest for national introduction of telenursing (4.3%) and highest for the technical-feasibility item (43.0%), indicating that infrastructural reliability, rather than conceptual resistance, was the dominant barrier. The confidence intervals around the most strongly endorsed domains remained narrow and entirely above 75%, reinforcing the consistency of educational and service-level support, whereas the technical-readiness domain clustered around equipoise, highlighting it as the principal implementation vulnerability in this cohort.

DISCUSSION

The present study demonstrated that undergraduate nursing students in selected institutions of Islamabad had a high level of knowledge regarding telenursing and a generally favorable perception toward its integration into future healthcare practice. The overall mean knowledge score of 8.50 ± 1.62 and the finding that 87.10% of participants met the threshold for good knowledge indicate that the sampled students were not only conceptually aware of telenursing but also able to recognize its practical attributes, barriers, and implementation requirements. Similarly, the overall mean perception score of 38.50 ± 5.36, with 76.90% of respondents categorized as having a positive perception, suggests broad attitudinal readiness for the inclusion of telenursing in education and service delivery. However, the pattern of responses also showed that this favorable orientation was not uniform across all domains, as support for the concept of telenursing was stronger than confidence in its present infrastructural feasibility.

The demographic pattern of the sample provides useful context for interpreting these findings. Most respondents were aged 23–26 years, were male, and were enrolled in private institutions, with a slight predominance of 4th-year students. This distribution may reflect the institutional composition of the selected colleges and may also suggest that the views captured here are shaped by relatively advanced academic exposure and proximity to clinical training. The predominance of male students differs from the more traditionally female-dominated nursing populations reported in several international studies, indicating that the sociocultural and institutional context of nursing education in Pakistan may be evolving in a way that broadens participation in the profession. Such differences are important because they may affect patterns of technological exposure, professional expectations, and attitudes toward digitally mediated care, and future studies should explore whether knowledge and perception of telenursing vary by gender, academic year, and institutional sector in more analytically stratified designs.

The knowledge findings are notable because they suggest that students had already developed a strong conceptual understanding of telenursing despite the broader concern that telehealth-related content remains underrepresented in formal nursing curricula. Nearly all students correctly identified the basic definition of telenursing, and large majorities recognized its role in increasing service coverage, improving self-management support, enhancing self-efficacy, and requiring technical stability and training. This pattern aligns with the Lagos study by Samson and Zofiat, which also found a high proportion of students with good knowledge of telenursing, and it is broadly consistent with evidence showing that nursing students can display meaningful awareness even when structured curricular exposure remains limited (18). At the same time, the present results appear stronger than those reported

in some other settings, where lower awareness and more modest knowledge levels were observed among nursing students. Studies from Korea, Egypt, and Nepal, for example, have reported limited prior knowledge, lower educational exposure, or only moderate understanding of telehealth and telenursing concepts among students (14,15,16). This contrast may indicate increasing informal exposure to digital health concepts among Pakistani nursing students through media, academic discussion, or clinical observation, although the cross-sectional nature of the study does not permit identification of the precise sources of that knowledge.

Although knowledge was high overall, the item-level pattern suggests that students distinguished between foundational concepts and anticipated operational outcomes. Endorsement was strongest for definitional and implementation-oriented statements, whereas relatively lower agreement was observed for the ideas that telenursing improves productivity and increases safety. These lower proportions remained substantial, but they imply greater uncertainty about the measurable practice consequences of telenursing than about its theoretical basis. This nuance is important because it suggests that conceptual acceptance alone may not translate into full confidence in clinical utility. Educational initiatives should therefore not only introduce telenursing as a concept but should also provide case-based demonstrations, simulation experiences, and supervised exposure showing how digital nursing interventions affect patient follow-up, workflow efficiency, continuity of care, and risk reduction in real settings.

Student perception toward telenursing was also predominantly positive, particularly in relation to its educational usefulness, future application in care, relevance to outpatient monitoring, and importance for national healthcare integration. More than four-fifths of respondents endorsed the inclusion of telenursing within undergraduate studies and supported its introduction into Pakistan's healthcare system, indicating that students perceive digital nursing competencies as relevant to their future professional role. This finding is consistent with previous international literature showing that nursing students often hold positive views toward telehealth and express willingness to use such approaches in future practice, even when their practical exposure is limited (9,10,14). It also supports the argument that the next generation of nurses may be more receptive to digital models of care than older systems of training and service delivery are currently structured to accommodate.

At the same time, the perception results reveal a clear internal tension between ideological support for telenursing and concerns regarding its practical implementation. Only about half of the respondents agreed that facilities for providing telenursing were available in their clinical area, and fewer than half agreed that telenursing is possible without technical problems. This was the weakest perception domain and the only one not significantly different from a 50% reference proportion, indicating that students were not convinced that the existing infrastructure could reliably support effective telenursing practice. This finding is highly relevant in the Pakistani context, where digital health adoption continues to be constrained by inconsistent connectivity, limited equipment, institutional variability, and uneven access to training and technical support (4,17). The results therefore suggest that favorable attitudes toward telenursing should not be interpreted as evidence of implementation readiness in a narrow operational sense. Rather, they reflect a form of conceptual readiness that still requires infrastructural reinforcement and institutional preparation before it can be translated into stable clinical practice.

Another important finding was that a substantial proportion of students believed that telenursing may reduce direct contact between nurses and patients. This concern is consistent with the humanistic orientation of nursing care, which traditionally emphasizes presence, therapeutic communication, emotional support, and interpersonal trust. Similar tensions have been reported in prior telehealth literature, where students and practitioners recognize the efficiency and access-related benefits of remote care while remaining cautious about its potential to weaken the relational dimension of healthcare (9,14). In the present study, this concern did not negate overall support for telenursing, but it does indicate that future educational programs should frame telenursing as a complementary rather than

replacement model of care. Teaching should emphasize hybrid models in which remote monitoring, education, and follow-up are integrated with in-person nursing encounters in a way that preserves patient-centered communication and continuity.

The observed correlation between knowledge and perception further strengthens the educational relevance of the findings. The study identified a weak but statistically significant positive relationship between knowledge and perception ($r=0.22$, $p=0.002$), indicating that students with higher knowledge scores tended to hold more favorable perceptions toward telenursing. This pattern is consistent with prior studies reporting a positive relationship between greater understanding of telenursing and more supportive attitudes toward its use (10,14). However, the effect size in the present study was small, which indicates that knowledge alone accounts for only a limited proportion of attitudinal variation. This is an important point for interpretation. While educational improvement is likely to support more favorable perceptions, attitudes toward telenursing are probably also shaped by practical exposure, institutional culture, perceived technological reliability, personal confidence with digital tools, and beliefs about the nurse-patient relationship. For this reason, curricular interventions aimed at improving readiness for telenursing should move beyond knowledge transmission alone and incorporate applied learning, supervised experience, and structured reflection on ethical, relational, and technological dimensions of remote care.

From an educational perspective, the findings support the integration of structured telenursing content into undergraduate nursing curricula in Pakistan. Such integration should include theoretical instruction on telehealth principles, communication technologies, confidentiality, ethics, and legal frameworks, alongside practical components such as virtual case discussions, simulation-based teaching, digital documentation exercises, and supervised exposure to telehealth-enabled follow-up models. From a policy perspective, the strong student support for national introduction of telenursing suggests that future workforce planning may benefit from aligning educational reform with broader digital health strategies. Investment in internet connectivity, device access, clinical software, faculty preparation, and practice guidelines will be necessary if student readiness is to be translated into workforce capability. In this way, the study points to a meaningful opportunity: students appear willing to embrace telenursing, but health and education systems must create the conditions under which that willingness can become effective professional practice.

The findings should also be interpreted in light of the study's limitations. The cross-sectional design does not allow causal inference regarding the relationship between knowledge and perception. The use of self-reported data introduces the possibility of response bias, including social desirability and overestimation of knowledge. The convenience sampling approach and inclusion of only four institutions in Islamabad limit generalizability to the wider population of nursing students in Pakistan. In addition, although the study successfully quantified knowledge and perception, it did not explore how previous digital exposure, faculty support, clinical experience, or institutional infrastructure may have shaped these outcomes. Future research should therefore use multi-center designs with more diverse sampling frames, incorporate analytic comparisons across student subgroups, and consider longitudinal or mixed-methods approaches to better understand how educational exposure and clinical experience influence readiness for telenursing over time.

CONCLUSION

In conclusion, this study found that undergraduate nursing students in selected institutions of Islamabad had a high level of knowledge and a generally positive perception regarding telenursing, indicating substantial conceptual receptiveness to the role of digital nursing within future healthcare delivery. Students strongly endorsed the educational value of telenursing, its relevance to outpatient monitoring, and the need for its broader introduction into Pakistan's healthcare system. However, concerns regarding technological feasibility, infrastructural limitations, and reduced direct nurse-patient contact remained

evident, showing that positive perception does not necessarily equate to full implementation readiness. The weak but significant positive correlation between knowledge and perception suggests that improving student understanding may support more favorable attitudes, although broader institutional and experiential factors are also likely to influence preparedness. These findings support the integration of structured telenursing education, practical exposure, and policy-level digital health support to help transform conceptual acceptance into competent and ethically grounded clinical practice.

REFERENCES

1. Ahmed A, Ahmed M. The telemedicine landscape in Pakistan: Why are we falling behind? J Pak Med Assoc. 2018;68(12):1820-2.
2. Afik A, Pandin MGR. Telenursing as a new nursing paradigm in the 21st century: A literature review. Preprints. 2021. doi:10.20944/preprints202103.0704.v1.
3. Alipour J, Hayavi-Haghighi MH. Opportunities and challenges of telehealth in disease management during COVID-19 pandemic: A scoping review. Appl Clin Inform. 2021;12(4):864-76. doi:10.1055/s-0041-1735181.
4. Ansari RS, Alfakeer H, Arif F, Bashir MA, Zehra M, Rauf SA, et al. Exploring medical students' perceptions of telehealth in Pakistan: A cross-sectional study. BMC Med Educ. 2024;24(1):1093. doi:10.1186/s12909-024-06086-7.
5. Avais MA, Iftikhar A, Tahira A, Mobeen M, Shah H, Nasir S. Challenges faced by healthcare workers in adopting telemedicine technologies: Understanding barriers to digital health integration in clinical practice. J Health Allied Sci. 2025;3(3):648-54. doi:10.71000/sa5xqt47.
6. Bahari G, Alshammari A, Alanazi MF. Understanding the experiences of nursing students in the context of telenursing in Saudi Arabia: A cross-sectional study. BMC Med Educ. 2025;25(1):650. doi:10.1186/s12909-025-0650.
7. Catalyst NEJM. What is telehealth? NEJM Catalyst. 2018;4(1).
8. Collada AM, Silvestre A, Narvaez RA. Telenursing: A concept analysis. Online J Nurs Inform. 2023;26(3).
9. Čukljek S, Kurtović B, Hošnjak AM, Ledinski S, Smrekar M, Babić J. Nursing students' knowledge and attitudes towards telenursing. Croat Nurs J. 2024;8(1):5-16.
10. El-Said Abd Ellatif A, Mohamed Sobhy Elsayed D, Hamido Abosree T. Knowledge and attitude of faculty of nursing students regarding telenursing. J Nurs Sci Benha Univ. 2023;4(1):677-89.
11. Fahad M. Technological transformation in healthcare: A global perspective. J Digitainability Realism Mastery. 2024;3(12):73-84. doi:10.56982/dream.v3i12.294.
12. Glinkowski W, Pawłowska K, Kozłowska L. Telehealth and telenursing perception and knowledge among university students of nursing in Poland. Telemed J E Health. 2013;19(7):523-9. doi:10.1089/tmj.2012.0214.
13. Hussein N. Knowledge and perception of virtual nursing among undergraduate nursing students at Benha University. Menoufia Nurs J. 2024;9(4):239-51. doi:10.21608/menj.2024.411237.
14. Mun M, Choi S, Woo K. Investigating perceptions and attitudes toward telenursing among undergraduate nursing students for the future of nursing education: A cross-sectional study. BMC Nurs. 2024;23(1):236. doi:10.1186/s12912-024-01903-2.

15. Rettinger L, Putz P, Aichinger L, Javorszky SM, Widhalm K, Ertelt-Bach V, et al. Telehealth education in allied health care and nursing: Web-based cross-sectional survey of students' perceived knowledge, skills, attitudes, and experience. JMIR Med Educ. 2024;10(1):e51112. doi:10.2196/51112.

16. Thapa K, Ojha J. Knowledge and attitude regarding telemedicine among undergraduate nursing students of Pokhara. J Health Allied Sci. 2024;14(1):1-8. doi:10.37107/jhas.422.

17. White NS, Franklin SS, Juliet N, Amalanathan SAM, Kanagaraj P, Babu AS. Telemedicine and information technology in health care management: Perspectives and barriers among nursing students. J Educ Health Promot. 2024;13(1):416. doi:10.4103/jehp.jehp_1286_23.

18. Samson BS, Zofiat G. Knowledge and perception of telenursing among nursing students in selected nursing institutions, Lagos State. Int J Mod Sci Res Technol. 2024;2(12):1-31. doi:10.5281/zenodo.14304785.

19. Seixas AA, Olaye IM, Wall SP, Dunn P. Optimizing healthcare through digital health and wellness solutions to meet the needs of patients with chronic disease during the COVID-19 era. Front Public Health. 2021;9:667654. doi:10.3389/fpubh.2021.667654.

20. Sharma S. Telenursing: A new opportunity for nurses in the digital era. J Kathmandu Med Coll. 2018;7(2):45-6. doi:10.3126/jkmc.v7i2.21583.

21. Shehata Z, Ali S, Mahmoud S, Mahmoud D. Knowledge and attitude of nursing school students regarding telenursing in Sharkia Governorate. Zagazig Nurs J. 2024;20(2):219-35. doi:10.21608/znj.2024.380037.

22. Terkes N, Celik F, Bektas H. Determination of nursing students' attitude towards the use of technology. Jpn J Nurs Sci. 2019;16(4):17-24. doi:10.1111/jjns.12248.

23. Abdel-Aleem Megahed A. Effect of telenursing guidelines implementation on interns' knowledge and attitude toward its application at obstetrics and gynecological nursing. Assiut Sci Nurs J. 2019;7(19):107-16.

24. Nissen RM, Brockevelt BL. The effect of education on student perceptions about telehealth. Int J Health Sci. 2016;4(4):5-10.

25. Kim IJ, Kim MS, Jeon MK. Exploring nursing students' perspectives on telenursing using Q-methodology. Comput Inform Nurs. 2021;39(12):1007-14. doi:10.1097/CIN.0000000000000767.

26. Kumar S, Snooks H, editors. Telenursing. London: Springer; 2011. doi:10.1007/978-0-85729-529-3.

27. Leino-Kilpi H, Gröndahl W, Pekonen A, Katajisto J, Suhonen R, Valkeapää K, et al. Knowledge received by hospital patients: A factor connected with the patient-centred quality of nursing care. Int J Nurs Pract. 2015;21(6):689-98. doi:10.1111/ijn.12326.

28. Reierson IÅ, Solli H, Bjørk IT. Nursing students' perspectives on telenursing in patient care after simulation. Clin Simul Nurs. 2015;11(4):244-50. doi:10.1016/j.ecns.2015.02.006.

29. Khraisat OMA, Al-Bashaireh AM, Alnazly E. Telenursing implications for future education and practice: Nursing students' perspectives and knowledge from a course on child health. PLoS One. 2023;18(11):e0294711. doi:10.1371/journal.pone.0294711.