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Digital Health for All: Ensuring Equity in Global Patient Care in Ghana-A Case Study of Student Perceptions at Presbyterian Nursing and Midwifery Training College (PNMTC), Agogo

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ABSTRACT

Background

Digital health technologies, including telehealth, AI diagnostics, and mobile health applications, have transformed patient care allowing for accurate diagnostics, remote patient monitoring, reduced costs, and improved outcomes. However, these technologies risk exacerbating existing health disparities. At the same time, little is known about nursing students' perceptions of these tools in Ghana. This study assessed awareness, perceived benefits, barriers, and equity concerns regarding digital health tools among nursing and midwifery students at Presbyterian Nursing and Midwifery Training College (PNMTC), Agogo.

Methods

A descriptive cross-sectional survey of 99 students at their 2nd and 3rd year of learning was conducted using a structured questionnaire. Collected data was analyzed using SPSS v.23.

Results

The findings show that 63.6% of respondents had intermediate digital competence, but only 35.4% had received formal digital health training. 54.5% had grown in urban areas. The use of internet/AI to find health information was the highest among the students (mean=3.66/5). Advanced digital competence users scored significantly higher than beginners on using internet/AI for finding health information (p=0.034). Students agreed on benefits (means 3.38–3.45) but identified lack of connectivity (mean=3.65) and privacy concerns (mean=3.46) as major barriers. The infrastructural disparities between urban and rural areas is strongly perceived among all students regardless of where they grew up (mean=3.66).

Conclusions

Nursing and midwifery students strongly acknowledge the benefits and barriers of digital health. However, there are significant educational and preparedness gaps and infrastructural barriers. It is highly recommended that formal digital health training be integrated into the nursing curriculum as policymakers work on addressing existing infrastructural gaps in rural regions of Ghana to achieve equitable digital health adoption.

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Introduction

The information and technology revolution experienced in the 20th and 21st centuries have been transformative in all aspects of human life. Digital technologies have become an everyday necessity for daily living as people have grown more interconnected. Such technological advancements and global level adoptions have been the foundation for the adoption and development of digital health tools in healthcare settings. Digital health is a broad term that refers to electronically captured data including the information and communication technologies and the technical infrastructure used in the provision of quality, efficient, and accessible patient care [1]. Such information and communication technologies include upstream infrastructural systems including cloud computing, artificial intelligence, machine learning, blockchain, digital and artificial intelligence diagnostics and treatment, telehealth, and consumer-facing technologies such as smartphone apps, wearable devices with sensors, and telehealth platforms [2]. These tools are used in disease prevention, diagnosis, treatment, and patient monitoring and education.

The revolutionary advancement and adoption of the digital health tools have been pushed more by necessity to expand health care accessibility to all regardless of existing barriers associated with traditional health systems such as geographical and transportation limitations. Health system emergencies such as the COVID-19 pandemic created conditions that necessitated fast adoption of digital health tools with the aim of expanding access to care beyond physical hospital settings [3,4]. This digital transformation in healthcare pre- and post-COVID-19 pandemic has created significant opportunities that have had notable improvements in the quality, efficiency, and accessibility of patient care [5]. These digital health tools have also been noted to support early diagnoses and implementation of interventions, improve patient care outcomes, and lead to more patient engagement in the care process by enabling remote patient monitoring, AI-driven diagnostics, and remote collaborative teams [6].

Statement of Problem

Ghana, as in the case of Kenya, Nigeria, Rwanda, and South Africa, is among LMICs in the African continent and the sub-Saharan region that has put tremendous efforts to advance digital health adoption across country. Despite the efforts targeted at achieving 100 percent digital health adoption in Ghana, there exists significant gaps and disparities in the achievement of digital health for all. Certain portions of the Ghanaian populations especially those living in rural and semi-urban regions and those from low-income backgrounds experience significant barriers in the adoption and utilization of digital health.

Currently, the Ghanaian health system is experiencing multiple challenges amid the country experiencing an unprecedented increase in morbidity and mortality due to non-communicable diseases (NCDs) [7]. The need to improve population health outcomes through equitable access and utilization of health services has seen Ghana implement multiple health systems strengthening strategies including the rollout of digital health initiatives. For instance, the Ministry of Health through the eHealth Project has focus on digitalizing patient records across all hospitals in the country (Ministry of Health, Republic of Ghana), Ghana Health Service (GHS), the government agency under the Ghana MOH, responsible for implementing national policies focused on expanding primary health care services at regional, district and sub-district levels launched the Digital Health Policy and Strategy 2023–2027, a comprehensive framework that aims to transform healthcare through digital innovation to achieve universal and equitable coverage access through stronger health information systems [7,8].

Ghana has a huge infrastructural advantage for achieving digital health for all due to its increase mobile and internet penetration. A report by the National Communications Authority, Ghana shows that mobile subscription and mobile internet penetration rate was approximately 70% as of 2024 with 38.95 million recorded mobile connections available, representing 113% of the population [9]. However, resolving the unequal and inequitable adoption of digital health tools and achieving sustainable digital health for all requires utilization of the country's healthcare workforce especially the frontline health workers. This perspective requires the need to mold the future nurses and midwives into notable drivers of digital health equity. Arguably, training institutions can design integrated digital literacy curriculums which can help equip future nurses and other frontline health workers with the right digital literacy skills and attitudes.

To achieve the above, research is deemed necessary to explore the student nurses' and midwives' digital literacy levels, their awareness of digital health tools, their perceived benefits of digital health, and the barriers to achieving equitable adoption. Against this background, this study aims to explore student perceptions of digital health and health equity at the Presbyterian Nursing and Midwifery Training College (PNMTC), Agogo. Specifically, it aimed to

1. Determine the current levels of digital competence among student nurses and midwives at the PNMTC, Agogo;
2. Explore the student's awareness of digital health tools including telehealth, AI diagnostics, and mobile apps;
3. Explore the students' perceptions of benefits, barrier, and equity in relationship to adoption and use of digital health in Ghana.

Research Questions

The study is guided by three key research questions

1. What is the students' digital competence level?
2. How aware of digital health tools are the nurses' students?
3. What are the perceptions of the student nurses on the benefits, barriers, and equity in the use of digital health tools in Ghana?

Study Significance

The findings of this study are contributed to the broader efforts to achieve equitable digital health adoption and utilization in Ghana by providing evidence-based insights on nurse student digital literacy levels, digital health perceptions and attitudes. Such insights can adequately contribute to curriculum and policy development to integrate digital health literacy in nurse training. It also contributes to the body of literature on digital health literacy among nurses and pre-service training. The findings also have implications for future research as they identify areas not sufficiently covered by research including the need to focus research on formative educational stages of health professionals as a foundation to achieving equitable digital health within the Ghana context.

Literature Review

The technological explosion of the 21st century which has seen the development and adoption of advanced mobile technologies, information and communication systems and platforms, artificial intelligence, and cloud computing has significantly revolutionized the healthcare environment. Such technologies have been the foundation of digital health. Digital health has been the most transformative innovation in healthcare settings. It has created a paradigm shift in health care systems by completely changed how populations and patients interact with health delivery systems, and how healthcare providers plan for and delivery care [10]. This transformative force in healthcare was accelerated by the emergency of the COVID-19 pandemic as strategies adopted to curb the spread of the coronavirus required limited person-person [11]. The adopted technologies during the pandemic have come to be considered as essential in healthcare services delivery as they improved the accessibility, affordability, efficiency, and continuity of care delivery despite existing barriers and limitations. Although all health economies are currently facing various challenges, the quality of life is considerably linked to the advancements in healthcare technologies as they influence the capacity of a healthcare system to meet the financial, clinical, and ancillary needs of a population [10]. As global move ahead with widespread adoption of digital health tools due to their evident benefits, issues of persistent digital health inequalities continue to emerge. Research evidence is currently focused on understanding the

benefits of digital health technologies, digital health equity, and the role of frontline workers including nurses and midwives in achieving digital health equity.

Benefits of Digital Health Tools

Current literature on digital health identifies significant benefits with the adoption and utilization of digital health technologies such as telehealth, AI diagnostics, mobile health apps and wearables, and big data and cloud computing in healthcare settings [10]. Becevic et al., argued that that telehealth and telemedicine technologies had the potential to increase the accessibility of care services and efficiency of delivering such services while improving on the quality of care and patient outcomes [12]. Evidence shows that it has significantly expanded access to health care services; reduced costs of care associated with travelling, and also supported the continuity of care especially for chronic conditions such as diabetes despite existing barriers to access [13,14]. According to evidence from research conducted by Tsou et al., the use of telehealth significantly improve access to emergency health services in rural and remote areas by allowing remote access to specialist care [15]. Such use of telehealth remotely for emergency services helped mitigate the health disparities experienced by populations living in remote areas while also reducing pressure on the local receiving hospitals [15]. The use of telehealth during pandemic such as COVID-19 was noted to reduce the risk of exposure and transmission while still supporting the continuity of care [16]. Evidence from the use of telehealth services in remote and rural regions shows that such efforts led to improved patient monitoring and disease management with patients reporting high satisfaction levels with the use of telehealth services [17,18].

Emerging literature on digital technology has also explored the adoption of artificial intelligence and mobile health apps in clinical practice. The growing surge in data generation, storage, and processing has ushered in the age of big data and big data analytics (BDA) in healthcare have been phenomenal in supporting technologies that advance clinical practice and patient care, and overall health management [19]. Contextual AI models have been noted to overdo human capabilities and found applications in various medical fields including predictive modeling for neurological disorders and disease diagnostics, bioinformatics, surgical procedures, physical rehabilitation, medical robots, and management of clinical data in hospitals [20]. Research evidence further notes that AI-based learning algorithms integrated in healthcare have improved accuracy and effectiveness in medical practices including research outcome and diagnostics leading to early disease detection, early effective intervention, and the discovery of new treatments [20]. Zeb et al., further adds that the integration of AI's capabilities in diagnostics and disease management have proven potential to effectively analyze health data and create personalized care management plans leading to faster recovery and better patient outcomes.

Evidence on the use of mobile apps focused on health show that such applications found that mobile health apps have improved the management of chronic conditions by empowering patients to be a part of the care journey and self-management [22,23]. Such apps have also provided self-monitoring capabilities for patients especially those with chronic conditions, including diabetes and obesity, and in home monitoring in post-surgical care settings [23-25]. Sannino et al., argued that the integration of AI-based data analysis systems with mobile health apps will further improve the capability of digital health to provide more personalized care through better predictive insights, and interactive patient engagement for better health outcomes and user experience [26].

Digital Health Equity

Literature has also explored aspects of digital health equity from the perspectives of fairness and justice in access to the various tools and technologies and the benefits associated with digital health tools. High income countries in the Europe and the United States, and in countries such as the Australia and New Zealand have experienced tremendous adoption of these digital health tools [27]. The benefits for such widespread adoption have been widespread with notable improvements in health equity, as tools such as telehealth and telemedicine have increased access to health services among populations living in regions that had limited access [28]. Despite the advantages of these technologies, there exist legitimate concerns over the risk of the same tools exacerbating health and health care disparities especially in low income and low resource [29].

The adoption and utilization of digital health among providers and health consumers in low- and middle-income countries (LMICs) remains unequally distributed. This unequal and inequitable adoption of digital health tools is majorly driven by factors that go beyond the usual social determinants of health to include low digital literacy, the lack of broad access to digital infrastructure, and existing commercial and economic factors in the LMICs [30].

Regardless of the existence of a notable infrastructure to implement digital health, achieving digital health equity is dependent digital literacy among the users; both care receivers and caregivers. Notably, countries such as Ghana despite having a set infrastructure to support digital health initiatives, significant disparities still existing both in the adoption of digital health tools and utilization of related health services [31,32]. Evidence shows there are infrastructure alone is not a guarantee to achieving digital health equity; the human competence in the use of such technology is the major determinant of achieving such equity.

Nurses and Midwives in Driving Digital Health Equity

Nurses and midwives are the first line of contact within primary health settings. Nurses have the potential to become the bridge towards achieving equitable digital health adoption and utilization in local. However, promoting the adoption of digital health at the local levels requires improved education and systematic changes that shift the communities' views on traditional and digital health setups. Nurses and midwives have the potential to drive the Ghana health systems towards achieving digital health for all. Evidence from the COVID-19 pandemic showed that nurses at every level and across all settings are the main leaders of the health systems and the most positioned to lead community health initiatives and advocate for systems change and health policy [33]. From this perspective, nurses can help navigate the complexity brought about my multiple uncertainties of health systems, which can help gain professional and community engagement and accept changes to redesign health delivery systems to achieve digital health equity [34]. However, all of these are dependent on the nurses and midwives' digital health literacy, attitudes, and competencies. As perceptions and attitudes towards digital health are linked to the levels of digital literacy; further related to level of nursing education, it is arguably best to equip them with the necessary digital health skills and competencies early during their pre-service training [35,36].

Research Gap

Despite growing evidence of digital health's benefits, reviewed literature actually shows significant gaps in research in the field of digital health equity in Ghana and other African countries. Research appreciates the unequal access to internet connectivity and devices between rural and urban populations and the lack of comprehensive policies in Ghana that ensure equitable digital health integration. Research evidence has documented the digital divide pushing inequitable digital health utilization in most rural areas across Africa and other LMICs majorly due to income and other infrastructural deficiencies. However, there is minimal or no specific research that has focused on Ghana in the context of digital health equity, impacts of current digital health policies, and related policy efforts to resolve or achieve wider digital health adoption in rural and low-income populations. Another notable gap in research as identified from wider database search is the lack of literature related to student perspectives and perceptions of digital health equity. There is limited or no research focused on how nursing students perceive digital health and their readiness to adopt and promote related technology in their practice.

Case Studies (Comparative Context)

The Case for Rwanda

Rwanda is a country within the LMICs category that has made progress economically with significant improvements in the healthcare sector. The country has much invested in achieving universal health coverage across the country through a rigorous national telemedicine initiative [37]. The initiative has focused on connecting rural clinics to specialists through a through a hub-and-spoke network. It utilized the widely available 4G network supported by public-private partnerships with BABYl. The program that was launched in collaboration with Babyl allowed isnured individuals under the country's Mutuelle de Santé scheme to access nurse-led triage supported by remote physicians. The Babyl digital health program helped achieve over 75% of consultations remotely. The success of the program can be attributed to the 4G internet infrastructure, a people-centered insurance system, good political will, and partnerships. Despite its success, Babyl closed in 2023 creating new infrastructural challenges, loss of trust in the initiative, and the need for a sustainable approach.

The Case for India: Mobile Health Applications for Maternal and Child Health

India launched various mHealth interventions targeting pregnant women and children in in underserved regions. The service-oriented programs included the M-SAKHI and NeoRaksha. M-SAKHI, ShishuPoshan, ReMiND, and a JANANI (Journey of Antenatal, Natal and Neonatal Integrated Care) platform. All of these mHealth programs aimed at pregnant women, infants, and mothers of preterm babies provided reproductive and child health support through push text and voice messages, and danger- or complication-triggered alert messages to providers. The JANANI platform has helped capture key health data across the entire continuum of care. The use of these mHealth programs have seen an increase in the uptake of maternal care including antenatal care (ANC), vaccinations, and maternal health awareness while reducing risk of complications and costs of care. However, the initiatives faced challenges of unsustainable infrastructure with low smartphone and internet use, low digital literacy, and social-cultural barriers.

The Case for United States: AI-driven diagnostic Tools Improving Early Detection of Cardiovascular Disease

The U.S has remained a leader in tech innovation. Today the country has the largest AI systems.AI tools have been deployed in various settings economic and social settings including in healthcare. Currently, AI is integrated into cardiovascular care for cardiovascular disease diagnostics including ECG analysis, imaging interpretation, heart failure risk prediction, and population-level risk stratification. This has been supported by deployment of deep learning models and robust investments in AI development, the existence of a strong and sustainable infrastructure, and academic-market partnerships in research and development. The use of AI has improved cardiovascular diagnostic accuracy, early detection, care decision support, and risk stratification and early interventions. However, the use of AI in cardiovascular management faces the issue of racial bias in diagnostics, acquisition costs, and lack of explainable AI processes and output.

These examples highlight potential pathways for equitable adoption but underscore the need for Ghana-specific strategies.

Methodology

Design

This exploratory study employed a descriptive cross-sectional design using a quantitative survey. The exploratory descriptive cross-sectional design was selected as it allowed for the study to collect data from a specific population at a single point in time to establish preliminary evidence for a future advanced study [24]. This current study is presented as the foundation of an explanatory sequential mixed methods study combining quantitative and qualitative focus groups.

- **Participants and Setting:** The study were set at the Presbyterian Nursing and Midwifery Training College (PNMTC), Agogo. The setting provided a representative sample for the future frontline healthcare providers in Ghana, and their perceptions will influence adoption of digital health tools in clinical practice. The target population was the 2nd and 3rd year nursing students at the institution. A total of 100 students were purposive selected as the study's sample. However, only 99 participated in the full study.
- **Instruments and Data Collection:** Data was collected using a 20-item survey questionnaire specifically developed for this study to help assess the perceptions of digital health, barriers, and equity concerns. A comparative analysis with existing case studies was also conducted.
- **Data Analysis:** Descriptive statistics were used to analyze the quantitative data and independent samples t-tests using the Statistical Package for Social Sciences (SPSS) v. 23.0. Significance levels of $\alpha = 0.05$, 95% confidence intervals were set for all statistical tests.
- **Ethical Considerations:** Participation was voluntary. The participants were well-informed on all parts of the study and were only eligible for participation after giving written informed consent. Approval for the study was obtained from institutional ethics committees. High levels of confidentiality and data safety were maintained.

Results and Discussion

The analyzed data was collected from 99 respondents selected from nursing and midwifery students at Presbyterian Nursing and Midwifery Training College (PNMTC), Agogo, Ghana. Results are presented in relation to the research objectives and questions set above.

Characteristics of Participants

Table 1: Participant Characteristics

Characteristic	Category	Frequency	Percentage (%)
Age	18-22	48	48.5
	23-27	46	46.5
	28-32	4	4.0
	33 and above	1	1.0
Gender	Female	82	82.8
	Male	17	17.2
Year of Study	Year 2	35	35.4
	Year 3	64	64.6
Grew up	Urban	54	54.5
	Rural	24	24.2
	Semi urban	21	21.2
Digital competence	Beginner	21	21.2
	Intermediate	63	63.6
	Advanced	15	15.2
Formal training in digital health	Yes	35	35.4
	No	64	64.6

Table 1 depicts the demographic characterization of the respondents. 82.8% of the participants were female while 17.2% were male. The majority of the participants generally, representing 48.5% of the respondents were aged between 18 and 22 years, 46.5% were aged between 23 and 27, while those aged 28 and 32, and 33 and above were 4% and 1% respectively. On year of study, 35.4% were 2nd years and 64.6% were 3rd years. 54.5% reported to have grown in urban areas, 24.2% in rural and 21.2% in semi-urban regions. 21.2% reported to have a beginner's level in digital competence and 63% and 15.2% were at intermediate and advanced levels. Notably, 35.4% reported yes to receiving formal training in digital health while 64.6% reported not having any training. It is important to note that only 35.4% of students had received any formal training in digital health technologies, despite 63.6% rating themselves as having intermediate digital competence. This raises the argument that basic digital skills can be acquired informally through personal use of smartphones and the internet. However, formal training on telehealth, AI diagnostics, and mobile health applications is still inadequate in Ghana.

Awareness of Digital Health Tools (Telehealth, Ai Diagnostics, and Mobile Apps)

Table 2: Awareness of Digital Health Tools

Item	Strongly Disagree n (%)	Disagree n (%)	Neutral n (%)	Agree n (%)	Strongly Agree n (%)	Mean	SD
I am familiar with the concept of telehealth	6 (6.1)	12 (12.1)	37 (37.4)	31 (31.3)	13 (13.1)	3.33	1.03
I am aware of mobile health applications and their use	5 (5.1)	12 (12.1)	33 (33.3)	35 (35.4)	14 (14.1)	3.41	1.03
I can use health-related applications to follow up my patient's health status.	6 (6.1)	11 (11.1)	32 (32.3)	37 (37.4)	13 (13.1)	3.40	1.05
I can use the internet/AI to find more information on symptoms, health status and/or medication	6 (6.1)	7 (7.1)	27 (27.3)	34 (34.3)	25 (25.3)	3.66	1.12
My nursing education has well exposed me to current digital health technologies.	8 (8.1)	15 (15.2)	30 (30.3)	31 (31.3)	15 (15.2)	3.30	1.14

Table 2 shows the respondent responses based on how they agreed or disagree with an item testing their awareness of digital health tools. Majority of the students, 37.4% were mostly neutral or slightly agreed, 31.3% , to being familiar with the concept of telehealth (mean=3.33 sd=1.03). Notably, A majority either agreed (34.3%), or strongly agreed, 25.3% with using the internet and AI tools to find health information (mean = 3.66, sd 1.12). Many students remain neutral or disagree regarding their nursing education exposure to digital health (mean = 3.30), indicating a need to integrated digital health awareness into the training curriculum. This is in line with the findings of a study of by Ndibalema which link low digital literacy among students in sub-Saharan Africa to inadequate digital infrastructure and unprepared lecturers [38]. Despite the increased awareness of digital health tools, students sufficient and transferable knowledge of these tools [39,40].

Perceived Benefits (Access, Efficiency, Patient Outcomes)

Table 3: Perceived Benefits

Item	Strongly Disagree n %)	Disagree n %)	Neutral n (%)	Agree n (%)	Strongly Agree n (%)	Mean	SD
Telehealth improves access to care for patients regardless of location	5 (5.1)	11 (11.1)	33 (33.3)	35 (35.4)	15 (15.2)	3.45	1.03
Mobile health apps increase the efficiency of routine nursing tasks	6 (6.1)	12 (12.1)	33 (33.3)	34 (34.3)	14 (14.1)	3.38	1.07
AI-based systems improve efficiency of diagnostic decision-making	7 (7.1)	10 (10.1)	35 (35.4)	31 (31.3)	16 (16.2)	3.39	1.09
Digital health technologies empower patients to be active self-health management	5 (5.1)	12 (12.1)	34 (34.3)	34 (34.3)	14 (14.1)	3.40	1.04
Digital tools into nursing practice improve patient outcomes.	5 (5.1)	11 (11.1)	32 (32.3)	36 (36.4)	15 (15.2)	3.45	1.05

Table 3 depicts the perceived benefits with the use of digital health tools among nursing students in PNMTC, Agogo, Ghana. Majority of the students either agreed or strongly agreed with all the items assessing the benefits of digital health (means 3.38–3.45, sd 1.03-1.09). The students expressed moderate to strong belief in the potential of digital health tools to improve access to care, increase efficiency of nursing tasks, improve efficiency of diagnostic decision-making, support self-management, and improve patient outcomes. These perspectives align with evidence from research as presented Evidence from research on the benefits such as from [14].

Perceived Barriers (Cost, Connectivity, Literacy)

Table 4: Perceived Barriers

Item	Strongly Disagree n %)	Disagree n %)	Neutral n (%)	Agree n (%)	Strongly Agree n (%)	Mean	SD
Digital health tech is costly to implement	6 (6.1)	16 (16.2)	34 (34.3)	28 (28.3)	15 (15.2)	3.30	1.10
Most regions in Ghana lack the connectivity capacity (Internet, electricity) to support digital health	5 (5.1)	7 (7.1)	27 (27.3)	39 (39.4)	21 (21.2)	3.65	1.05
Digital health tech can cut health costs by a huge margin	6 (6.1)	18 (18.2)	36 (36.4)	26 (26.3)	13 (13.1)	3.22	1.07
Both nurses and patients across Ghana have low literacy levels in relation to emerging health tech like AI	8 (8.1)	18 (18.2)	39 (39.4)	22 (22.2)	12 (12.1)	3.12	1.08
I am usually concerned by my security and privacy when using digital health tools	7 (7.1)	10 (10.1)	31 (31.3)	32 (32.3)	19 (19.2)	3.46	1.13

Table 4 shows the students' perception of barriers to achieving digital health equity in Ghana especially around Agogo and its environs. The students showed a high rate or neutrality and agreement to the items on cost, lack of connectivity capacity, low literacy levels, and privacy and security concerns. The students view the lack of a connectivity infrastructure (mean= 3.65) the most strongly perceived barrier to achieving digital health equity. Concerns over privacy and security and cost of related technologies were also perceived as strong barriers (means = 3.46 and 3.30). However, the students majorly held a neutral view to low literacy as a barrier ij=n achieving digital health equity (mean = 3.12). Olayiwola et al., shares similar views on the low adoption and potential inequities in the utilization of digital health among providers and health consumers in low- and middle-income countries (LMICs) social determinants of health, low digital literacy, the lack of broad access to digital infrastructure, and existing commercial and economic factors in the low resource settings [30].

Equity Perceptions (Urban vs. Rural Access, Affordability)

Table 5: Equity Perceptions

Item	Strongly Disagree n %)	Disagree n (%)	Neutral n (%)	Agree n (%)	Strongly Agree (n%)	Mean	SD
Urban areas have more access to digital health infrastructure than rural areas	4 (4.0)	8 (8.1)	28 (28.3)	37 (37.4)	22 (22.2)	3.66	1.03
Telehealth can reduce health disparities between urban and rural populations	7 (7.1)	15 (15.2)	39 (39.4)	27 (27.3)	11 (11.1)	3.20	1.05
The cost of digital health technologies are largely unaffordable to low-income patients/populations	5 (5.1)	12 (12.1)	38 (38.4)	30 (30.3)	14 (14.1)	3.36	1.04
Digital health tools are complicated to people with low digital literacy	6 (6.1)	13 (13.1)	39 (39.4)	30 (30.3)	11 (11.1)	3.27	1.02
AI diagnostics have risk of using biased data producing biased outcomes and predictions which can widen existing health inequities.	6 (6.1)	14 (14.1)	37 (37.4)	28 (28.3)	14 (14.1)	3.30	1.09

Table 5 Shows the results of the assessed students' perceptions of digital health equity from the perspectives of urban and rural access, and affordability of technologies. The students tend to have a strong perception that urban areas have better access to digital health technologies as compared to rural settings (mean = 3.66) 37.4% agree and 22.2% strongly agree. The students also do not have a higher conviction on the capacity of telehealth services to reduce health disparities in Ghana. The students hold moderate views and concerns over costs, digital literacy levels, and AI bias in contributing to increased digital health inequalities.

Statistical Tests

Independent samples t tests were performed to compare key subgroups with a focus on digital competence levels and use of digital health tools for health information, type of training and exposure to digital health, and region of growing up and access to digital health infrastructure.

Significance set at $p < 0.05$ and CI at 95% CI for difference.

Digital Competence (Beginner vs. Advanced Ability to Use Internet/AI)

Table 6: t-test Competence Level (Beginner vs Advanced)

Group	Mean	SD	t-value	df	p-value	95% CI for Difference
Beginner	3.38	1.20	2.21	34	0.034	(0.05, 1.33)
Advanced	4.07	0.88				

Table 6 depicts the t-test comparing level of competence; beginner (n=21) vs advanced (n=15) on the capacity to use the internet/ AI to find more information on symptoms, health status and/ medication. Participants with advanced digital competence reported significantly higher ability to use internet/AI for health information on symptoms, health status and/or medication compared to beginners (mean difference = 0.69, 95% CI [0.05, 1.33]).

Formal Training in Digital Health and Exposure to Digital Health Technologies

Table 7: t-test Formal Trained vs Untrained

Group	Mean	SD	t-value	df	p-value	95% CI
Trained	3.49	1.09	1.33	97	0.187	(-0.18, 0.91)
Untrained	3.22	1.15				

Table 7 show a t-test comparing the formally trained (n=35) against untrained (n=64) students on their exposure to digital health tools. The difference in the perceptions among the students between formal training and lack of formal training and exposure to digital health tools was statistically insignificant (p-value=0.187, 95% CI [-0.18, 0.91]). Based on evidence from research, the perceptions and attitudes towards digital health are linked to the levels of digital literacy; further related to level of nursing education [35,36]. Therefore, it is arguably best to equip them with the necessary digital health skills and competencies early during their pre-service training.

Growing Up Area: Urban vs. Rural Perceptions on Accessibility

Table 8: Growing Up Area Perceptions on Accessibility (Urban Vs Rural)

Group	Mean	SD	t-value	df	p-value	95% CI
Urban	3.72	0.99	0.64	76	0.524	(-0.36, 0.70)
Rural	3.58	1.06				

Table 8 shows the comparative assessment of the perceptions of students growing up in rural areas compared with those from urban areas on the accessibility of digital health tools between urban and rural areas. There lacks significant difference on the perceptions of inequitable access to digital health tools in rural and urban areas. Both urban and rural participants equally acknowledge that urban areas have better digital health infrastructure and access.

Conclusion

This study provides a detailed view on digital health equity from the perspectives of student nurses from the PNMTC, Agogo. Students' perceptions of digital health tools and equity will provide valuable insights into the readiness, barriers, and strategies for equitable adoption in Ghana. Despite the benefits of digital health, the tools if not well implement risks further widening the healthcare access inequities and digital health disparities. This is mostly driven by the infrastructural differences between urban and rural regions, and differences in income among rural-urban and low- and high-income populations.

Majority of the nursing and midwifery students being you have a higher level of awareness and exposure to digital health tools. Students also agree on the benefits and barriers in the use of digital health tools, and the nationwide infrastructure challenges. The insights developed by this study can be utilized by policymakers to tailor nursing education curriculum and integrate digital health literacy. This can help cultivate a generation of frontline care providers who are both technologically competent and deeply committed to promoting the achievement of digital health for all through tailored solutions. By prioritizing equity and student readiness, Ghana can ensure digital health becomes a tool for universal healthcare rather than a driver of disparity.

Based on these findings, it is recommended that

- Nursing training institutions need to integrate digital health education into the training programs
- The Ghana government through the Ministry of Health and Ghana Health Services need to invest more into the digital health infrastructure with a focus on rural regions
- Further research using longitudinal study design or explanatory sequential mixed methods design is needed to explore how perceptions towards digital health equity grow and change over time among nurses.

This study is limited by its single-site approach and a small sample size (N=99). It is also reliant on self-reported measures and does not utilize any validated tools. Additionally, the cross-sectional design captures perceptions at one point in time.

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