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Improving nursing students' clinical experience with genetics: the influence of prior knowledge and leadership support through the Donabedian Model

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Abstract

Background As advancements in genetics and genomics continue to evolve, nursing students need to be equipped with prior knowledge and academic leadership support (ALS) to interpret genetic information, educate patients, and participate in clinical decision-making. ALS is actions or behaviors by leaders to support, guide, and empower their students. The incorporation of genetics/genomics into the nursing curriculum has been recognized on a global scale.

Aim To evaluate the impact of nursing students' prior knowledge of genetics/Genomics and genomics and academic leadership support on their clinical experience.

Method and design A cross-sectional study was conducted among nursing students at xxxxx University College of Nursing, Saudi Arabia, between December 2024 and February 2025 (IRB# KSU-HE-24-1055). A total of 169 participants completed an online survey.

Results Most participants were in their fourth year, internship year, or enrolled in postgraduate programs (BSN = 118; Master's = 46; PhD = 3). The average age was 26.6 years (SD = 5.8), and more participants were female (58.5%) than male (41.5%). Male participants reported receiving higher levels of leadership support than their female counterparts did. ALS on clinical experience ($p < 0.01$); and prior knowledge ($p < 0.008$); $R^2 = 0.440$ with large effect size = 0.78.

Conclusions Integrating genetics and genomics education into the nursing curriculum is needed to meet today's healthcare standards. Academic nursing leaders in educational settings play a key role in advancing nursing students' curriculum thereby increasing their knowledge and preparedness for clinical practice.

Implication for profession and/or patient care Educational settings that integrate nursing genetics and genomics courses into curricula and provide leadership support to students will improve their clinical experience and enhance patients' care.

Impact *What problem did the study address?* ALS is a key driver of improving students' clinical experience. *What were the main findings?* Male nursing students reported higher levels of leadership support than female nursing students highlighting the need for strategies that support equity and prevent disparities in educational settings on the basis

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of gender. *Who will benefit?* Nurse educators and nurse leaders could utilize these findings to improve educational environments. Nurses with up-to-date knowledge will benefit their patients' outcomes by being better informed.

Reporting method We adhered to the STROBE guidelines for cross-sectional research.

What does this paper contribute to the wider global clinical community?

- This paper data strongly supports integrating genetic education in the nursing curriculum to prepare future nurses to care for patients with complex cases.
- There is an essential role of leadership support within educational settings to improve nursing students' clinical experience and prepare them for safe patient care by emphasizing gender's equity and integrating genetics/ genomics education.

Keywords Genetics/genomics education, Nursing students, Leadership support, Clinical experience

Introduction

Genetics is defined as "the study of individual genes and their impact on single-gene disorders" [1], whereas genomics refers to "the study of all genes in the human genome together or as a subset, including their interaction with each other, the environment, and the influence of other psychosocial and cultural factors" [1]. In this paper, the term genetics is used to refer to both concepts. To provide an optimum clinical experience for nursing students in clinical settings when dealing with patients with genetic conditions, students are required to have basic knowledge about genetics and leadership support [2]. Within the current complex healthcare clinical environment, it is pivotal to integrate genetic/genomic education into the nursing curriculum. The incorporation of genetic/genomic knowledge into nursing education has become increasingly essential for contemporary healthcare practice. As genetics and genomics continues to advance, nurses are expected to interpret genetics/ genomics results, provide patient education, and contribute to clinical decision-making for patients with genetic conditions [3].

Background

The annual cost of treating genetics/ genomics conditions, such as sickle cell disease (SCD), is 1.4 billion USD with an average cost of USD 48,506 per patient [4]. Because of the high prevalence of genetic conditions, requiring highly specialized care, integrating genetics/ genomics courses into nursing education has become vital in enhancing nurses' clinical knowledge and effects patient outcomes. Global research has indicated that nursing students have positive attitudes toward including genetics/ genomics into clinical practice, despite their limited knowledge [5, 6]. Studies have shown that nursing students have moderate levels of genetic knowledge, as well as moderate levels of comfort in educating patients and families about genetics/ genomics conditions [7, 8]. Additionally, more than 80% of nursing students did not attend any courses related to genetics/ genomics [7], which potentially negatively affect their competence in clinical settings and patients' outcomes [5]. Better understanding of nursing students' prior knowledge about genetics/ genomics will assist academic faculties and leaders understand better methods to educate nursing students about genetics/ genomics; and how it will affect the students' clinical experience. Thus, academic leaders are highly encouraged to empower nursing students with proper genetics/ genomics knowledge to strengthen their clinical practice [2, 9] by including genetics/ genomics courses in the nursing curricula. Additionally, by recognizing students with special needs and create suitable teaching strategies to fit their needs and fostering community engagements [10].

Academic leadership support (ALS) refers to actions or behaviors by leaders to support, guide, and empower their students [11]. In academia, leadership support is a pivotal factor that improve students' clinical experience, and contributes to improved patient outcomes and organizational performance [12, 13]. Studies found that having empowering and effective ALS could assist in fostering a helpful environment to enhance nursing students' clinical experience and academic performance [14, 15], which eventually might improve patients' safety outcomes and healthcare quality. Given the evidence of the vital role of ALS in empowering nursing students, it is essential to assess the impact of ALS on students' clinical experience. To our knowledge, factors affecting nursing students' clinical experience with genetics/ genomics conditions, such as prior knowledge and academic leadership support, remain unexplored, guiding the gap that this study aims to address.

The current study is guided by the Donabedian Model [16], which was introduced in 1966 to examine the quality of healthcare services. The model has three main domains: structure, process, and outcomes. The structure referred to the characteristics of the healthcare settings, such as supportive administration or staffing to facilitate the delivery of the service. The process domain refers to the activities that have been used in providing patients' care, such as effective communication or knowledge level. Finally, the outcome domain represents the findings

of the provided intervention, for instance, clinical experience. The model suggested that the ALS and knowledge could enhance students' clinical experience, which would lead to high levels of quality of care, including patient outcomes. The domains interaction is illustrated in (Fig. 1).

This figure illustrates the Donabedian Model, which contains three inter-related domains: Structure, Process, and Outcomes. ***Structure***: refers to the healthcare settings attributes, such as supportive administration. ***Process***: refers to action could be taken to improve patients' care, such as knowledge levels. ***Outcomes***: refers to the final results of the provided intervention (e.g., clinical experience) [16].

Aim

This study aimed to assess the influence of prior knowledge of genetics/ genomics and leadership support on nursing students' experience in clinical settings. The directions among the variables were according to the Donabedian Model.

The research question in the current study is *how do academic leadership support and prior coursework in genetics/ genomics influence the clinical experience of nursing students?* We hypothesized the following (a) high levels of ALS is associated with high levels of clinical experience; (b) taking prior course about genetics/ genomics is associated with improved clinical experience.

Methods

Study design

This cross-sectional descriptive study examined the influence of prior knowledge of genetics/ genomics and leadership support on nursing students' experience in clinical settings. The research team followed the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) checklist for cross-sectional studies.

Study setting and sampling

Following institutional review board approval (approval number KSU-HE-24-1055), participants completed an anonymous online survey that contained an introductory page outlining the study aims and a consent question.

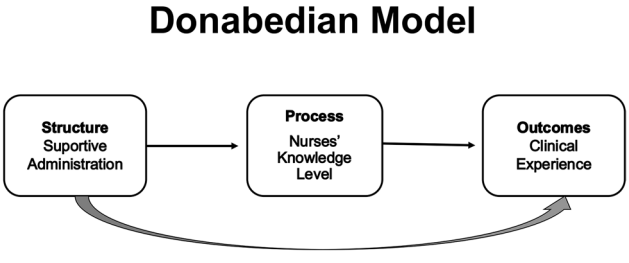

Fig. 1 Donabedian Model: structure, process, and outcome domains: AI Generated

Participants who selected "yes" proceeded with the survey; those who selected "no" exited the survey. This study used convenience sampling to recruit nursing students in year 4, internships in their bachelor's programs and those enrolled in postgraduate programs at a private College of Nursing. Students were selected because they combine academic and clinical exposure. Inclusion criteria is nursing students who are currently enrolled in nursing college. Exclusion: nursing students in years 1 to 3 were excluded because they had not completed courses in women's health nursing or child health nursing. The total population was 110 undergraduate students and 100 postgraduate students. A total of 169 nursing students, who agreed to participate, were included. The required sample size was estimated at 156 to achieve 80% statistical power, with a p value of 0.05, a medium effect size (Cohen's $f^2 = 0.15$), and 20 predictors.

Instrument with validity and reliability/data source

- **Sociodemographic variables**: Age, marital status, level of education, and hospital practice area.
- **Yes-or-no questions**:
  a) Have you taken a course fully dedicated to genetics/ genomics?
  b) Do you have a family member or friend with a known genetic disease or condition? (If yes, please specify.)
  c) Have you encountered a clinical patient with a known genetic disease or condition during your training at the hospital?
  d) Do you recommend including a genetics/ genomics course in the undergraduate nursing curriculum?

Independent variables

Leadership support This self-administered scale uses a 5-point Likert scale (5 = a great deal, 4 = a lot, 3 = a moderate amount, 2 = little, 1 = none at all). Higher scores indicate greater leadership support [2]. Cronbach's alpha for the current sample was 0.77. The mean scores ranged from 1 to 5, with higher means reflecting higher levels of leadership support. The original scale was validated [2]. This variable represents the structural domain in the Donabedian Model [16].

Genetics knowledge Twenty multiple-choice questions on genetics/ genomics were developed by a PhD (Student or professor?) in oncology and palliative care nursing. The questionnaire was reviewed by a genetics and genomics medical professor. The wording of the knowledge questions was reviewed by a certified oncology faculty member in the medical education department.

Each question had five possible answers (one correct option). Correct answers were given a score of 1, and incorrect answers were given a score of 0, for a total possible score of 20. Higher scores indicate higher levels of genetic knowledge. Reliability was assessed via Cronbach's alpha, which was calculated as 0.80. Validity was evaluated through a pilot test with 10 undergraduate nursing students. Convergent validity was assessed via Pearson's correlation between genetic knowledge and prior completion of a genetic course. This variable represents the process domain in the Donabedian Model [16].

Dependent variable

Experience with genetics concepts This self-administered scale assesses students' experience with genetics/ genomics concepts during clinical training via a 5-point Likert scale (5 = a great deal, 4 = a lot, 3 = a moderate amount, 2 = little, 1 = none at all) [2]. The mean scores ranged from 1 to 5, with higher means indicating greater experience. Cronbach's alpha for the sample was 0.86. This variable represents the outcome domain in the Donabedian Model [16]. The original scale was validated [2].

Data collection

The study was conducted over a 3-month period. Participants were recruited through an online announcement and flyers distributed at the nursing college. The inclusion criteria were (1) ability and willingness to provide written informed consent in English; (2) status as a nursing intern, fourth-year nursing undergraduate student, or postgraduate nursing student; and (3) clinical exposure. Nursing students in years 1 to 3 were excluded because they had not completed courses in women's health nursing or child health nursing.

Table 1 Participants characteristics (*N* = 169)

Descriptive	Number and percentage	Mean (+/- SD)
Educational level	BSN = 118 (70.5) Master = 46 (27.5%) PhD = 3 (1.8%)	
Gender	Male = 68 (41.5%) Female = 96 (58.5%)	
Age		26.67 (+/- 5.89)
Did you take nursing genetics course before	Yes = 30 (18.4%) No = 133 (81.6%)	
Do you have a family member or a friend with genetic disorder?	Yes = 30 (18.3%) No = 134 (81.7%	
Have you encountered a patient with genetic disorder during your clinical training?	Yes = 113 (69.3%) No = 50 (30.7%)	
Do you recommend include genetic course into undergraduate nursing curriculum?	Yes = 150 (88%) No = 19 (11%)	

N: Participants sample size

Data analysis

Data analysis was conducted via IBM SPSS Statistics 24 (IBM Corp, Armonk, NY, USA). Standard descriptive statistics (means, standard deviations, frequencies, and percentages) were used to summarize the variables. An independent-sample t test was used to examine differences in leadership support, knowledge, and clinical experience by gender. Pearson's correlation was used to describe the relationships among sociodemographic variables, knowledge, leadership support, and clinical experience. Multiple linear regression was conducted to evaluate associations between the dependent and independent variables. Adjusted R^2 values are reported. Internal consistency was assessed via Cronbach's alpha [17]. Convergent validity was examined via Pearson's correlation between genetics/ genomics knowledge and prior completion of a genetics/ genomics course. The effect size was calculated by using formula Cohen's f^2 [18].

$$f^2 = \frac{R^2}{1 - R^2}$$

Ethical considerations

This study was approved by the Institutional Review Board of King Saud College of Nursing. In compliance with the Declaration of Helsinki, the participation in the current study was voluntary, and nursing students had the right to withdraw at any time. The current study employed no invasive procedures or experimental protocols.

Results

Demographic characteristics of the participants

Most participants were enrolled in bachelor's programs (BSN = 118; master's = 46; PhD = 3). The average age was 26.6 years (SD = 5.8). Over half of the participants were female (58.5%), and 41.5% were male. Most participants had not received formal education in genetics/ genomics (81.6%). Few family members had a genetics/ genomics condition (18.3%), whereas the majority reported clinical exposure to patients with a genetics/ genomics condition (69.3%) (Table 1). Most participants recommended including a genetics/ genomics course in the undergraduate curriculum (88%). The mean scores for clinical experience level, leadership support, and knowledge level of genetics/ genomics were 2.8 (SD = 1.0), 2.9 (SD = 1.3), and 10.1 (SD = 4.5), respectively (Table 2). The Welch test revealed that males reported receiving higher levels of academic leadership support than females did (t (165) = 1.155, p = 0.011). No significant differences were

Table 2 Predictors description

	N	Mean (+/- SD)	Cronbach's alpha α
Experience level	**169**	2.8 (+/- 1)	0.86
Leadership support	**169**	2.98 (+/- 1.8)	0.77
Knowledge about Genetics	**169**	10.14 (+/- 4.5)	0.8

N = sample size

found between males and females in terms of genetic knowledge or clinical experience (Table 3). Convergent validity was supported by a positive correlation between genetics/ genomics knowledge levels and prior completion of a genetics/ genomics course ($r = 0.22$; $p < 0.01$) (Table 4).

Bivariate correlation

The data were normally distributed with no skewness. Leadership support was significantly correlated with clinical experience with genetics/ genomics condition ($r = 0.63$, $p < 0.001$). Knowledge level, age, education level, and prior completion of a genetics/ genomics course were also significantly correlated with clinical experience related to genetic condition (knowledge: $r = -0.17$, $p < 0.005$; prior genetics/ genomics course: $r = -0.27$, $p < 0.001$; education level: $r = -0.14$, $p < 0.05$; age: $r = -0.12$, $p < 0.05$) (Table 4).

Educational level, gender, having a family member with a genetics/ genomics condition, and having prior clinical exposure to a patient with a genetics/ genomics condition were not significantly correlated with clinical experience related to genetic disorders (gender: $r = -0.11$, $p = 0.067$; family member with a genetics/ genomics condition: $r = 0.46$, $p = 0.47$; clinical exposure to a patient with a genetics/ genomics condition: $r = 0.035$, $p = 0.23$). The convergent validity between genetics/ genomics knowledge level and prior completion of a genetics/ genomics course was significant ($r = 0.223$, $p = 0.007$) (Table 4).

Regression: experience with genetics/ genomics condition

In the full model, only two factors significantly predicted clinical experience related to genetics/ genomics condition: leadership support ($p < 0.01$) and prior completion of a genetics/ genomics course ($p = 0.008$). Age ($p = 0.85$) and genetics/ genomics knowledge level ($p = 0.339$) were not significant predictors. The model explained 44% ($R^2 = 0.440$, $F(4,158) = 32.83$, $p < 0.001$) of the variance in experience scores (Table 5). The model has a large effect size $f^2 = 0.78$, which indicated a significant impact of the ALS and prior knowledge on the clinical experience.

Discussion

The present study aimed to examine the associations among leadership support, nursing students' genetic knowledge, prior completion of a genetics/ genomics course and nursing students' clinical experience. These findings shed light on the essential role of effective leadership support in assisting students in growth, which

Table 3 Results of t-test Welch and descriptive statistics for leadership support, experience with genetics, and knowledge, by gender type

Predictors	Gender type						95% CI for mean difference	t	df
	Male			Female					
	M	SD	*N*	M	SD	*N*			
Leadership support	3.12	+/- 1	68	2.86	+/- 1.5	96	[-. 151 – 0.6]	1.23*	161
Experience	2.96	+/- 0.9	68	2.73	+/- 1	96	[-0.075- 0.543]	1.49	154.5
Knowledge	10.08	+/- 4.7	68	10.40	+/-4.15	96	[-1.72- 1.09]	– 0.446	132.3

Note: Independent *t*-test. CI = confidence interval. *Df* = degree of freedom. *N* = sample size

*<0.5.

Table 4 Variables matrix correlation

Measures	Experience	Leadership support	Knowledge	Age	Educational level	Gender	Gen-course	Gen-family	Gen-work
Experience	1								
Leadership support	**0.63****	1							
Knowledge	**-0.17****	-0.16	1						
Age	**-0.12***	-0.17	-0.03	1					
Educational level	-0.14	-0.19	0.090	0.654	1				
Gender	-0.11	-0.059	0.034	0.307	0.251	1			
Gen-course	**-0.27****	-0.122	**0.223****	0.062	0.090	0.192	1		
Gen-family	-0.046	0.08	-0.014	0.033	0.090	0.122	0.096	1	
Gen-work	0.035	0.034	-0.267	0.056	0.008	-0.098	-0.064	0.122	1

*Note. *p < 0.05 (2-tailed). **p < 0.01 (2-tailed). N = 169;Knowledge = level of knowledge about genetics; Gen-course = did you take genetic course before today? Gen-family = do you have a family or friend with genetic disorder? Gene-work = Have you encountered a patient with genetic disorder during your clinical training?*

Table 5 Predictors of nursing students' experience with genetic disorders

Variables	B	β	95% CI
(Constant)	2.43		[1.54–3.32]
Knowledge	−0.013	−0.058	[-0.041-0.014]
Leadership Support	**0.451**	**0.618****	**[0.362-0.539]**
Age	−0.002	-0.011	[-0.022-0.018]
Gen-course	**−0.419**	**−0.161***	**[-0.728-−0.110]**
R-square	**Adjusted R-square**		
0.45	0.44		

Note. ***N*** *= 169.* ***CI*** *= Confidence Interval.* ****p*** *< 0.05.* *****p*** *< 0.01.* ***B*** = unstandardized coefficient. ***β*** = standardized coefficient; ***Knowledge*** *= level of knowledge about nursing genetics;* ***Gen-course*** *= did you take genetic course before today?* ***Gen-family*** *= do you have a family or friend with genetic disorder?* ***Gene-work*** *= Have you encountered a patient with genetic disorder during your clinical training?*

could impact readiness to deliver effective patient care safely [19].

According to the Donabedian model, leadership support falls under the structural domain. This domain encompassed the available resources that could enhance the delivered care, such as a supportive environment and leadership support. The strongest association observed in the present study was between academic leadership support and nursing students' clinical experience. This finding was aligned with previous research showing that leadership empowerment and a supportive atmosphere fostered professional growth, improved clinical experience and adhered to the latest evidence-based practices to enhance patients' safety [2, 12, 13]. Additionally, our findings aligned closely with the construct of Donabedian Model. The results highlighted a significant association between ALS and clinical experience. Academic leaders may use seminars, workshops, ongoing education (especially genetics/ genomics), and mentorship programs to empower nursing students [13]. Academic leaders could also use *assessment surveys* to identify students' learning gaps and design targeted workshops accordingly.

In contrast, nursing knowledge levels and taking genetic course fell under the process domain in the Donabedian Model in the current study. These findings suggest that knowledge of genetics/ genomics condition among nursing students is not essential for informing their clinical experience within clinical settings. Yet, nursing students still recommended including genetics/ genomics courses in the nursing curriculum to strengthen their understanding. Academic leaders play a vital role in reshaping nursing education, especially as fields such as genetics/ genomics continue to evolve. To prepare nursing students to care for patients with genetics/ genomics conditions, comprehensive genetics/ genomics courses should be integrated into nursing programs. Equipping nursing students with a strong foundation in genetics/ genomics could help them manage complex cases, contributing to improved patient outcomes in a safe manner and a more informed healthcare workforce.

Finally, on the basis of the Donabedian Model, the clinical experience fell under the outcome domain, which can measure both the process and structure domains. Clinical experience is highly influenced by having prior knowledge and academic leadership support. Ignoring these factors could negatively affect students' clinical experience. Importantly, both male and female nursing students reported moderate levels of genetic knowledge, academic leadership support, and clinical experience. However, male students reported higher levels of academic leadership support than female students did, which was associated with improved clinical experience related to genetics/ genomics condition. Gender inequality may have contributed to the current findings. Female students may be less likely to seek help because of reluctance or limited leadership support for different reasons [20]. First, globally, women are more likely than men to be caregivers in the family, which could disrupt their career progression [21], and they have less formal leadership mentorship than men do [22]. In contrast, male students tend to receive more leadership support, which encourages them to pursue opportunities, take risks, and feel empowered [23]. Although the nursing profession is female dominated, leadership in senior or executive roles in global health is still largely held by men, potentially limiting opportunities for female students to thrive [24]. The implications of these findings shed a light on the disparities in career progression and future leadership opportunities between male and female students.

Thus, targeted programs (e.g., mentoring programs) that empower female nursing students are needed to foster gender equity in professional and educational settings.

Strengths, limitations, and recommendations for future research

The major strength of this study is that it focused on an under researched topic: nursing students' clinical experience with genetics/ genomics condition. Additionally, the study highlighted the importance of empowering female nursing students with the support and resources needed to succeed in their careers. Despite the novelty of this focus, the study has several limitations. First, the sample size limited the number of variables included in the model. The analysis focused on genetics/ genomics knowledge levels and leadership support, with covariates limited to prior completion of a genetics/ genomics course, age, and gender. Second, the cross-sectional design prevented the assessment of causality between the variables and students' clinical experience and limited the observation of changes over time. Further research is needed to explore the impact of these factors on a larger

scale. This study should be replicated at other nursing schools and universities, and the results should be compared with the findings of this study. Furthermore, longitudinal studies could assist in tracking the impact of leadership support on students' clinical experience over time and how it could influence patient's safety and outcomes. Educational institutes are recommended to initiate gender equity studies to assess barriers to receiving equal-gender leadership support and identify methods to increase equity within nursing colleges. It is crucial to recognize that self-reported measures may lead to social desirability bias, as students may feel compelled to share their experience positively. Additionally, data collection from a single- site may not represent the broader population, thus generalizability may be constrained.

Implications for nursing education, policy and practice

The implications of the current study are based on our findings regarding prior genetics/ genomics education and leadership support. This study suggested the integration of genetics/ genomics courses into nursing education. These courses could incorporate simulation-based scenarios to teach genetics/ genomics counseling and physical assessment skills to create safe and supportive environments [25]. Offering genetics/ genomics workshops and competency-based training during the internship year to better prepare and empower nursing students [26]. A study found that almost 50% of faculty members reported lack of confidence to teach genetics/ genomics related subjects [27]. Thus, academic leaders are highly encouraged to initiate leadership training workshops for faculty members to ensure the delivery of equitable support for all the students [28].

Conclusion

This is a cross-sectional study of 169 nursing students that found strong evidence of vital role of leadership support and taking genetics/ genomics courses in enhancing the students' clinical experience. The observation that male nursing students received higher levels of leadership support that female nursing students may indicate the presence of gender disparity, which reflects broader issues of gender equity in nursing education. Thus, there is a call to advocate for gender inclusive practice to ensure all students receive the needed mentorship during their academic and clinical journey. Our study aligned with the global need for equity in education to provide a foundation for targeted workshops and educational interventions aimed at improving female students to foster in their clinical experience.

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Author contributions
All authors contributed to the study conception and design. Material preparation, [Mashael Dewan], data collection [Ahmad M Rayani], and analysis were performed by [Mashael Dewan] and the manuscript was revised by [Dr.Jean Hannan] The first draft of the manuscript was written by [Mashael Dewan] and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

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Data availability
Data are not publicly available due to privacy and ethical considerations, but may be available from the corresponding author upon reasonable request.

Declarations

Ethical approval
This study was conducted according to the Declaration of Helsinki and the International Conference on Harmonization's Good Clinical Practice guidelines. Ethical approval was granted by King Saud University Institutional Review Board (approval number KSU-HE-24-1055).

Informed consent
The informed consent was obtained electronically from all the participants. They received an online information sheet explaining the study's aims, procedures, risk and benefits, and data security. The participation in the current study was voluntary, and nursing students had the right to withdraw at any time.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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