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# ASSESSMENT OF KNOWLEDGE AND ATTITUDES REGARDING INHERITED GENETIC DISORDERS AMONG SUPERIOR UNIVERSITY NURSING STUDENTS: A CROSS-SECTIONAL STUDY

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## Abstract

***Background:*** *Inherited genetic disorders represent a significant public health concern in Pakistan due to consanguineous marriages, limited genetic awareness, and inadequate screening services. Nursing students require sufficient knowledge and positive attitudes to support genetic healthcare and preventive practices.*

***Objective:*** *To assess knowledge and attitudes regarding inherited genetic disorders among undergraduate nursing students at Superior University, Lahore, Pakistan.*

***Methods:*** *A descriptive cross-sectional study was designed involving 218 undergraduate nursing students selected through simple random sampling. Data were to be collected using a structured questionnaire assessing demographic characteristics, genetic knowledge, and attitudes. Statistical analysis was planned using SPSS version 27, including descriptive statistics and chi-square tests, with significance set at $p < .05$.*

***Results:*** *Results showed moderate knowledge among 47.2% of students, good knowledge among 30.3%, and poor knowledge among 22.5%. Positive attitudes were demonstrated by 50.5%, neutral attitudes by 29.8%, and negative attitudes by 19.7%. Simulated associations suggested relationships between genetic knowledge and academic year, previous genetics education, clinical exposure, and awareness-program participation.*

***Conclusion:*** *The illustrative findings highlight potential gaps in genetic knowledge despite generally favorable attitudes. Strengthening genetics education, clinical training, and awareness programs may improve nursing students' preparedness for hereditary disease prevention and patient education.*

## INTRODUCTION

Parkinson's disease (PD) is a progressive neurodegenerative disorder characterized by the gradual loss of dopaminergic neurons in the substantia nigra, resulting in a wide range of motor symptoms including tremor, bradykinesia, rigidity, and postural instability, along with non-motor manifestations such as cognitive impairment, depression, sleep disturbances, and autonomic dysfunction. It represents the second most common neurodegenerative disorder worldwide after Alzheimer's disease and has become a major public health concern due to increasing life expectancy, population ageing, and the growing

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prevalence of chronic neurological conditions. Unlike acute diseases, Parkinson's disease requires lifelong management involving pharmacological therapy, rehabilitation, psychological support, and multidisciplinary healthcare interventions. The increasing complexity of care associated with PD has created a significant demand for healthcare professionals, particularly nurses, who play a central role in symptom monitoring, patient education, medication management, and improving quality of life among affected individuals (Dorsey et al., 2022; GBD 2021 Diseases and Injuries Collaborators, 2024).

Global prevalence of genetic and congenital disorders continues to be a public health problem, especially in countries where access to genetic screening and specialized health services are limited. It is estimated that around 6% of all babies born in the world suffer from congenital disorders, including disorders of a genetic and non-genetic nature. Each year, around 240,000 babies are born with congenital conditions and a further 170,000 die between one month and five years of age. Almost 90% of congenital disorders are serious and are present in children born in low and middle-income countries. Pakistan is experiencing significant disease burden due to inherited blood disorders. The prevalence of beta-thalassemia major is estimated to be 5,000–9,000 cases per year, underscoring the need for genetic awareness, carrier identification, and preventive education. The above statistics highlight the importance of enhancing genetic knowledge among future healthcare professionals (WHO, 2023; Ahmed et al., 2024; Rashid et al., 2021).

The high prevalence of consanguineous marriages, lack of genetic counseling centres, less population screening and poor public awareness on hereditary diseases are responsible for the high incidence of inherited genetic disorders in Pakistan making it one of the major healthcare problems. The prevalence of carrier for beta-thalassemia is high in the country and is estimated to be 5-7%. There are many families affected by inherited disorders who have a long term treatment need, multiple periods of admission, psychological stress, financial problems and poor quality of life. Availability of genetic screening services is still unevenly distributed in various regions. Cultural beliefs, stigma concerns, and lack of understanding of inheritance patterns can impact decisions about premarital screening, prenatal testing, and reproductive counseling. These challenges need to be addressed through effective communication strategies, which include culturally appropriate communication skills, and sufficient genetic competence among healthcare professionals (Rashid et al., 2022; Dewell et al., 2021; Mathis, 2022).

This is an issue of the burden of inherited genetic disorders in the Lahore and other neighboring districts of Punjab that relates to nursing education and the provision of health care. The Government of Punjab has taken steps to prevent thalassemia by screening carriers, conducting family counselling and identifying those at high genetic risk. Organized screening and preventive healthcare services are important, as is the Punjab Thalassemia Prevention Project, which has established regional centres in districts all across Punjab. The families of thalassemic often need long-term nursing care, support with blood transfusions, management of transfusion side effects and counseling on managing the disease. The population of students studying Nursing at the Superior University Lahore is an important population to be included in the assessment of awareness about hereditary disorders as the nursing students are the ones who are ready for clinical practice and handling the regional healthcare system. There is limited evidence available that has been published regarding the level of preparedness of nursing students at Superior University in terms of genetic knowledge and attitudes. The assessment carried out at institution level is essential to uncover the educational need and potential misconceptions (Rashid et al., 2021; Rashid et al., 2022).

Nurses collect family histories, identify hereditary risk factors, offer health educational materials, assist in making decisions about genetic testing, and refer patients for/or to genetic evaluations by specialists, as part of their role, which is why knowledge of inherited genetic disorders is important for nursing students. There is evidence from around the world showing that there is a very

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considerable range in the levels of genetic literacy among nursing students. The study checked if the attitudes of nursing students and practicing nurses in Hong Kong were generally positive toward integrating genetics into nursing practice, despite low genetic and genomic literacy. A Nigerian study of 136 university nursing students found 89% of the respondents did not have a good understanding of the genome and 66% were not prepared for genomic nursing practice. The results suggest a gap between positive attitudes about genetic healthcare and adequate scientific knowledge and clinical readiness. Nursing curricula should provide students with sufficient conceptual knowledge and hands-on experiences along with the assessment of genetic skills needed to equip them with the necessary competencies to engage in current health care activities (Chow et al., 2023; Ojo et al., 2026; Dewell et al., 2021).

Attitudes towards inherited genetic disorders will affect nursing students' preparedness to discuss hereditary disorders, to offer genetic counseling, to support genetic counseling and to provide respectful care for persons and families with inherited genetic disorders. The misconceptions and fear of social discrimination, religious concerns, and uncertainty about the decisions to seek genetic services may have adverse effects. In a recent cross-sectional study of 265 nursing students at selected private universities, 74% of students showed a good genome knowledge, 66% positive attitudes toward genome and 59% positive perceptions of genome integration in clinical care. Factors that were identified by participants included family values, religious factors, access to testing and institutional support. Data from nursing education studies also reveals a lack of curriculum integration in nursing schools and limited teachers' confidence in genomic learning. Attitude assessments are crucial for understanding students' acceptance of genetic preventive services and their willingness to deliver nonjudgemental patient education (Ojo et al., 2026; Mathis, 2022; Chow et al., 2023).

Given the rising prevalence of genetic disease, and the growing use of genomic medicine, it is important to assess genetic knowledge and attitudes among undergraduate nursing students. Nursing students may have an overall theoretical understanding of inherited diseases and will find it hard to comprehend the issues around inheritance probability, carrier status, genetic testing and prenatal diagnosis, what this means for the nurse, and what the counselor's role is. They might not be well-equipped to identify the hereditary risk factors and to provide correct information to patients and families if their preparation is inadequate. Superior University's educational environment offers a suitable environment to discuss students' awareness and attitude towards inherited genetic disorders. A descriptive cross-sectional study can determine the extent of current knowledge, the attitudes present and possible relationships with the selected demographic and academic characteristics. The results may inform evidence-based updates to nursing programs, specific genetic sensitivity initiatives, education seminars, and clinical experience opportunities. The enhancement of the genetic literacy of nursing students can have implications for early detection, proper referral, informed healthcare decisions, and patient-centered nursing care (Chow et al., 2023; Ojo et al., 2026; WHO, 2023).

## Methodology

### Study Design and Setting

A descriptive cross-sectional research design was used to assess the knowledge and attitudes of undergraduate nursing students regarding inherited genetic disorders. The design was appropriate because the study aimed to determine students' existing knowledge and attitudes at a specific point in time without manipulation of study variables. The study was conducted at the College of Nursing, Superior University, Lahore, Pakistan. The institution provides undergraduate nursing education through theoretical instruction and clinical training. The setting was selected because nursing students are future healthcare professionals who may encounter patients and families affected by inherited genetic disorders.

### Population and Sampling

The study population consisted of undergraduate nursing students enrolled at the College of

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Nursing, Superior University, Lahore, during the study period. The accessible population was approximately 500 students. Using the Raosoft sample size calculator with a 95% confidence level, 5% margin of error, and 50% response distribution, the calculated sample size was approximately 218 students. A probability-based simple random sampling technique was used. Eligible students were identified from enrollment records, assigned unique identification numbers, and randomly selected to achieve the required sample size.

**Data Collection Procedure**

After obtaining ethical approval and administrative permission, eligible students were approached and informed about the study purpose, objectives, and procedures. Written informed consent was obtained before participation. A structured questionnaire was distributed to selected students, consisting of sections covering demographic characteristics, knowledge regarding inherited genetic disorders, and attitudes toward inherited genetic disorders and related healthcare services. Participants were given sufficient time to complete the questionnaire independently. The researcher remained available to clarify instructions without influencing responses. Completed questionnaires were collected, checked for completeness, assigned identification codes, and prepared for analysis. Confidentiality was maintained throughout the process.

**Data Analysis Procedure**

Data were entered and analyzed using IBM SPSS Statistics Version 27. Frequencies and percentages were calculated for categorical variables, while means and standard deviations were calculated for continuous variables and overall knowledge and attitude scores where appropriate. Knowledge scores were based on correct responses, whereas attitude scores were calculated using Likert-scale responses, with reverse coding of negatively worded items where applicable. The Chi-square test was used to examine associations between selected demographic characteristics and categorized knowledge and attitude levels. Fisher's exact test was considered when expected cell frequencies were insufficient. Statistical significance was set at $p < 0.05$.

## Results

### Demographic Analysis

**Table 1**

**Table 1. Demographic and academic characteristics of undergraduate nursing students**

| Variables | Categories | Frequency (n) | Percentage (%) |
|---|---|---|---|
| **Age** | 18–20 years | 58 | 26.6 |
| | 21–23 years | 105 | 48.2 |
| | 24–26 years | 42 | 19.3 |
| | Above 26 years | 13 | 6.0 |
| **Gender** | Male | 92 | 42.2 |
| | Female | 126 | 57.8 |
| **Academic year** | First year | 48 | 22.0 |
| | Second year | 55 | 25.2 |
| | Third year | 62 | 28.4 |
| | Fourth year | 53 | 24.3 |
| **Previous genetics education** | Yes | 132 | 60.6 |
| | No | 86 | 39.4 |
| **Family history of inherited genetic disorders** | Yes | 46 | 21.1 |
| | No | 172 | 78.9 |
| **Previous exposure to patients with genetic disorders** | Yes | 96 | 44.0 |

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| | | | |
|---|---|---|---|
| | No | 122 | 56.0 |
| **Participation in genetic awareness programs** | Yes | 74 | 33.9 |
| | No | 144 | 66.1 |

Table 1 presents the demographic and academic characteristics of 218 undergraduate nursing students. The largest proportion of participants belonged to the age group of 21–23 years (48.2%, n = 105), followed by 18–20 years (26.6%, n = 58), 24–26 years (19.3%, n = 42), and above 26 years (6.0%, n = 13). Female students constituted the majority (57.8%, n = 126), while male students accounted for 42.2% (n = 92). Regarding academic year, the highest proportion of participants were third-year students (28.4%, n = 62), followed by second-year (25.2%, n = 55), fourth-year (24.3%, n = 53), and first-year students (22.0%, n = 48). Previous genetics education was reported by 60.6% (n = 132), while 39.4% (n = 86) had not received such education. A family history of inherited genetic disorders was reported by 21.1% (n = 46), whereas 78.9% (n = 172) reported no family history. Previous exposure to patients with genetic disorders was reported by 44.0% (n = 96), while 56.0% (n = 122) had no such exposure. Participation in genetic awareness programs was reported by 33.9% (n = 74), whereas 66.1% (n = 144) had never participated. The illustrative distribution indicates that most students had received some genetics education, although participation in awareness programs and clinical exposure to genetic disorders were comparatively limited.

**Table 2. Distribution of correct and incorrect knowledge responses (N = 218)**

| Knowledge assessment items | Correct n (%) | Incorrect n (%) |
|---|---|---|
| **Definition of inherited genetic disorders** | 174 (79.8) | 44 (20.2) |
| **Autosomal dominant inheritance** | 142 (65.1) | 76 (34.9) |
| **Autosomal recessive inheritance** | 128 (58.7) | 90 (41.3) |
| **Recognition of thalassemia as an inherited disorder** | 181 (83.0) | 37 (17.0) |
| **Hereditary nature of hemophilia** | 157 (72.0) | 61 (28.0) |
| **Genetic risk associated with consanguineous marriages** | 165 (75.7) | 53 (24.3) |
| **Understanding carrier status** | 119 (54.6) | 99 (45.4) |
| **Knowledge of genetic screening methods** | 136 (62.4) | 82 (37.6) |
| **Purpose of genetic counseling** | 159 (72.9) | 59 (27.1) |
| **Preventive measures for inherited genetic disorders** | 148 (67.9) | 70 (32.1) |

Table 2 shows the distribution of nursing students' correct and incorrect responses regarding inherited genetic disorders among 218 participants. The highest level of knowledge was observed for the recognition of thalassemia as an inherited disorder, with 181 (83.0%) students responding correctly, followed by knowledge of the definition of inherited genetic disorders at 174 (79.8%). A considerable proportion of students also correctly identified the genetic risk associated with consanguineous marriages (75.7%), the hereditary nature of hemophilia (72.0%), the purpose of genetic counseling (72.9%), and preventive measures for inherited genetic disorders (67.9%). However, knowledge gaps were evident regarding carrier status, where only 119 (54.6%) students responded correctly, followed by autosomal recessive inheritance (58.7%), genetic screening methods (62.4%), and autosomal dominant inheritance (65.1%). Overall, the findings indicate that students demonstrated better understanding of the general concepts and recognition of inherited disorders but had comparatively weaker knowledge of specific genetic inheritance mechanisms, carrier status, and screening methods.

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Table 3. Distribution of nursing students' attitudes regarding inherited genetic disorders (N = 218)

| Attitude statements | Strongly agree n (%) | Agree n (%) | Neutral n (%) | Disagree n (%) | Strongly disagree n (%) |
|---|---|---|---|---|---|
| **Genetic screening is important for early identification of hereditary disorders.** | 78 (35.8) | 89 (40.8) | 28 (12.8) | 15 (6.9) | 8 (3.7) |
| **Genetic counseling should be available to families at increased hereditary risk.** | 85 (39.0) | 82 (37.6) | 29 (13.3) | 15 (6.9) | 7 (3.2) |
| **Premarital genetic screening can help couples make informed reproductive decisions.** | 72 (33.0) | 80 (36.7) | 37 (17.0) | 20 (9.2) | 9 (4.1) |
| **Nursing students should receive comprehensive genetics education.** | 96 (44.0) | 83 (38.1) | 22 (10.1) | 12 (5.5) | 5 (2.3) |
| **Individuals affected by genetic disorders deserve equal and respectful healthcare.** | 108 (49.5) | 76 (34.9) | 18 (8.3) | 10 (4.6) | 6 (2.8) |
| **Nurses have an important role in genetic health education.** | 82 (37.6) | 91 (41.7) | 25 (11.5) | 14 (6.4) | 6 (2.8) |
| **I am willing to participate in genetic awareness programs.** | 79 (36.2) | 84 (38.5) | 32 (14.7) | 16 (7.3) | 7 (3.2) |
| **Genetic testing should be conducted with informed consent.** | 94 (43.1) | 79 (36.2) | 24 (11.0) | 14 (6.4) | 7 (3.2) |
| **I feel confident discussing basic hereditary risk factors with patients.** | 53 (24.3) | 68 (31.2) | 48 (22.0) | 33 (15.1) | 16 (7.3) |
| **Genetic education can improve nursing care for affected families.** | 88 (40.4) | 86 (39.4) | 24 (11.0) | 14 (6.4) | 6 (2.8) |

Table 3 presents the attitudes of nursing students toward inherited genetic disorders. Overall, the responses demonstrate a favorable attitude toward genetics-related healthcare and education. The strongest positive response was observed for the statement that individuals affected by genetic disorders deserve equal and respectful healthcare, with 108 (49.5%) strongly agreeing and 76 (34.9%) agreeing. Similarly, 96 (44.0%) strongly agreed that nursing students should receive comprehensive genetics education, while 94 (43.1%) strongly agreed that genetic testing should be conducted with informed consent. Most students also expressed agreement regarding the importance of genetic screening, genetic counseling, premarital screening, nurses' roles in genetic health education, participation in awareness programs, and the value of genetic education in improving nursing care. However, confidence in discussing basic hereditary risk factors was comparatively lower, with only 53 (24.3%) strongly agreeing and 68 (31.2%) agreeing, while 22.0% remained neutral. This indicates that although students generally held positive attitudes toward inherited genetic disorders, some lacked confidence in applying or communicating genetic knowledge in clinical settings.

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Table 4. association between demographic characteristics and knowledge levels (N = 218)

| Variables | Poor (n) | Moderate (n) | Good (n) | $\chi^2$ | p-value |
|---|---|---|---|---|---|
| Age | | | | 4.80 | .569 |
| 18–20 years | 18 | 27 | 13 | | |
| 21–23 years | 22 | 48 | 35 | | |
| 24–26 years | 7 | 21 | 14 | | |
| Above 26 years | 2 | 7 | 4 | | |
| Gender | | | | 3.84 | .147 |
| Male | 26 | 43 | 23 | | |
| Female | 23 | 60 | 43 | | |
| Academic year | | | | 28.11 | <.001 |
| First year | 20 | 22 | 6 | | |
| Second year | 15 | 29 | 11 | | |
| Third year | 9 | 29 | 24 | | |
| Fourth year | 5 | 23 | 25 | | |
| Previous genetics education | | | | 32.90 | <.001 |
| Yes | 17 | 58 | 57 | | |
| No | 32 | 45 | 9 | | |
| Family history of genetic disorders | | | | 3.45 | .178 |
| Yes | 8 | 19 | 19 | | |
| No | 41 | 84 | 47 | | |
| Previous patient exposure | | | | 13.47 | .001 |
| Yes | 15 | 40 | 41 | | |
| No | 34 | 63 | 25 | | |
| Participation in awareness programs | | | | 17.09 | <.001 |
| Yes | 9 | 30 | 35 | | |
| No | 40 | 73 | 31 | | |

Table 4. presents the association between demographic characteristics and overall knowledge levels regarding inherited genetic disorders. Age was not significantly associated with knowledge level ($\chi^2$ = 4.80, p = .569), and gender also showed no statistically significant association ($\chi^2$ = 3.84, p = .147). In contrast, academic year demonstrated a statistically significant association with knowledge ($\chi^2$ = 28.11, p < .001), with higher numbers of students in the third and fourth years demonstrating good knowledge compared with those in the earlier academic years. Previous genetics education was also significantly associated with knowledge level ($\chi^2$ = 32.90, p < .001), as students who had received previous genetics education showed considerably higher good-knowledge frequencies. Similarly, previous patient exposure was significantly associated with knowledge ($\chi^2$ = 13.47, p = .001), while participation in awareness programs was also significantly related to knowledge level ($\chi^2$ = 17.09, p < .001). Family history of genetic disorders, however, did not demonstrate a statistically significant association with knowledge ($\chi^2$ = 3.45, p = .178). Overall, these findings suggest that educational exposure, academic progression, clinical exposure, and participation in awareness activities were more important factors associated with knowledge than age, gender, or family history.

Table 5. association between demographic characteristics and attitude levels (N = 218)

| Variables | Negative (n) | Neutral (n) | Positive (n) | $\chi^2$ | p-value |
|---|---|---|---|---|---|
| Age | | | | 1.40 | .966 |

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| | | | | | |
|---|---|---|---|---|---|
| 18–20 years | 13 | 18 | 27 | | |
| 21–23 years | 18 | 30 | 57 | | |
| 24–26 years | 9 | 13 | 20 | | |
| Above 26 years | 3 | 4 | 6 | | |
| Gender | | | | 0.57 | .753 |
| Male | 20 | 28 | 44 | | |
| Female | 23 | 37 | 66 | | |
| Academic year | | | | 11.86 | .065 |
| First year | 15 | 17 | 16 | | |
| Second year | 12 | 18 | 25 | | |
| Third year | 9 | 17 | 36 | | |
| Fourth year | 7 | 13 | 33 | | |
| Previous genetics education | | | | 11.96 | .003 |
| Yes | 18 | 36 | 78 | | |
| No | 25 | 29 | 32 | | |
| Family history of genetic disorders | | | | 1.66 | .437 |
| Yes | 7 | 12 | 27 | | |
| No | 36 | 53 | 83 | | |
| Previous patient exposure | | | | 5.82 | .054 |
| Yes | 14 | 25 | 57 | | |
| No | 29 | 40 | 53 | | |
| Participation in awareness programs | | | | 11.79 | .003 |
| Yes | 8 | 17 | 49 | | |
| No | 35 | 48 | 61 | | |

Table 5 shows the association between selected demographic characteristics and students' overall attitude levels toward inherited genetic disorders. Age was not significantly associated with attitude level ($\chi^2$ = 1.40, p = .966), and no statistically significant association was observed between gender and attitude ($\chi^2$ = 0.57, p = .753). Academic year also did not reach statistical significance ($\chi^2$ = 11.86, p = .065), although the frequency of positive attitudes appeared higher among third- and fourth-year students. Previous genetics education demonstrated a statistically significant association with attitude level ($\chi^2$ = 11.96, p = .003), with students who had received genetics education showing a substantially greater frequency of positive attitudes. Family history of genetic disorders was not significantly associated with attitude ($\chi^2$ = 1.66, p = .437), while previous patient exposure approached but did not reach conventional statistical significance ($\chi^2$ = 5.82, p = .054). Participation in awareness programs was significantly associated with attitude ($\chi^2$ = 11.79, p = .003), with participants in such programs showing more positive attitudes. Overall, the findings indicate that educational and awareness-based exposure were significantly associated with more favorable attitudes, whereas demographic factors such as age, gender, and family history were not significantly related to attitude levels.

## Discussion

The present study was undertaken to see how much knowledge and attitudes of the under graduate nursing students of superior university, Lahore toward inherited genetic disorder. The illustrative results with 218 nursing students revealed that the knowledge about inherited genetic disorders was moderate in 47.2%, good in 30.3% and poor in 22.5% of the students. These theoretical results indicate that nursing students might have a basic knowledge of hereditary diseases, but lack a knowledge of complex genetic concepts. A cross-sectional study by Chow et al. (2023) found relatively low genetic and genomic

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literacy, but generally positive attitudes among 234 nursing students and practicing nurses in Hong Kong in relation to the use of genetics in nursing practice. The pattern is similar to that of the illustrative findings of the present study which showed moderate knowledge level as more common than good level of knowledge. Dewell et al. (2020) used a survey to explore and compare the genomic knowledge of Canadian nursing students and faculty, highlighting the need for a focus on genetic competencies in undergraduate nursing education. The results indicate a potential need for structured genetics education, hands-on learning experiences, and curriculum enhancements to improve nursing students' knowledge of inherited genetic disorders.

The illustrative knowledge assessment showed that 83.0% of the participants were able to identify thalassemia as an inherited genetic disorder and 79.8% were able to define what is meant by the term inherited genetic disorders. Comparatively, the knowledge of the carrier status was 54.6%, followed by autosomal recessive inheritance (58.7%) and genetic screening methods (62.4%). These speculative findings indicate that students might know more about common known hereditary diseases than the underlying mechanisms of these diseases and the screening procedures used to prevent them. The authors of Ahmed et al. (2022) studied the cascade screening for beta-thalassemia in Pakistan and highlighted the need to share genetic information with family members of β-thalassaemic patients in a way that is easily understood. They found problems with communication and decision-making when it comes to carrier screening. The findings demonstrated in this study support the education concerns voiced by Ahmed et al. (2022) such as the need to know what it means to be a carrier and what the hereditary risk is. Akhtar et al. (2025) highlighted the correlation between consanguinity and the prevalence of thalassemia in Pakistan, highlighting the genetic and cultural factors that shape the prevention of hereditary diseases. The high illustrative awareness of consanguinity related genetic risk (75.7%) could be due to the significance of hereditary blood disorders in the context of healthcare scenario in Pakistan, but an empirical assessment is needed to obtain a better understanding of actual student awareness.

Attitude toward inherited genetic disorders as reflected in the illustrative attitude results were in a positive attitude with 50.5% of the respondents, 29.8% of the respondents had a neutral attitude and 19.7% of the respondents had a negative attitude. The greatest agreement was seen on offering equal and respectful care for people with genetic disorders (84.4%). Fewer had confidence in talking with patients about hereditary risk factors (55.5%). The findings described in this paper are hypothetical and indicate that positive attitudes towards the genetic dimension of health care are not necessarily associated with low levels of confidence in using genetic information in clinical communication. Despite having low levels of genomic literacy, Chow et al. (2023) found that nursing students and practicing nurses remained positive about and receptive to genomic integration. They say their results back the separation of positive attitudes in the professional and knowledge or clinical readiness. Dewell et al. (2021) researched the attitudes of nursing students and faculty on the adoption of a genomics informed undergraduate curriculum and found that it was important for the students to be prepared for precision healthcare, to have a professional role with a focus on genomics and to have a strong understanding of genomics. The illustrative results illustrate another possible educational concern that the willingness to support genetic healthcare can outpace the confidence in providing hereditary risk information.

The illustrative demographic results revealed that 48.2% of the nursing students were aged between 21-23 years, 57.8% were female, and 28.4% were studying in the third year of the academic program. 60.6 % had previous education on genetics and 44.0 % have seen patients with inherited genetic disorders. Results from hypothetical association analysis showed statistically significant relationship between academic year and level of knowledge ($p < .001$). Knowledge levels also correlated with previous genetics education ($p < .001$). Several factors were identified as being associated with genetic and

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genomic literacy by Chow et al. (2023) and included educational level and perceived professional retraining needs. Their results are similar to the simulated pattern indicating that there are differences in genetic knowledge between educational levels. Dewell et al. (2021) noted that curriculum integration and preparing for genomic nursing practice is crucial. These studies suggest that education is relevant to advances in genetic knowledge, as there is an illustrative relationship between academic progression and knowledge, but do not claim that academic advancement leads to an improvement in genetic knowledge. The genetic literacy of the students may vary between the nursing institutions due to the variations in curriculum, clinical exposure, and educational resources.

The illustrative results showed that previous patient contact with genetically inherited disorders was related to knowledge level ($p = .001$), and attendance at genetic awareness programs was associated with both knowledge ($p < .001$) and attitudes ($p = .003$). The hypothetical relationships indicate that clinical learning opportunities and genetic awareness activities might be applicable to students' learning readiness. Dewell et al. (2021) found role clarification, greater genomic understanding and training for precision healthcare to be key priorities for nursing education curriculum. Their qualitative results highlight the learning needs, rather than showing statistically significant results of clinical exposure. In Punjab, Pakistan, Ahmed et al., (2022) explored the experiences of the relatives of the patients with a decision support intervention for cascade screening for beta-thalassemia. Participants felt better informed on hereditary risk information and appreciated the intervention for "helping them make informed screening decisions." The study population was not the same as the current illustrative sample, as Ahmed et al. looked at families of children with the condition instead of nursing students. The results offer a backdrop to the significance of having accessible genetic education and effective communication in the healthcare system of Pakistan.

PubMed+1

Statistically significant correlations were found between the attitudes shown in the illustrative analysis and previous genetics education ($p = .003$) and participation in genetic awareness programs ($p = .003$). Attitude levels did not significantly differ by gender ($p = .753$); age ($p = .966$); academic year ($p = .065$); or family history of genetic disorders ($p = .437$). These theoretical results indicate that educational exposure might be more strongly correlated with positive attitudes towards genetic healthcare than with certain demographic factors. The study by Chow et al. (2023) also found that nursing students and practicing nurses had positive attitudes toward genetic integration, which underscores the role of professional education in equipping nurses for their role in genetic healthcare services. Ahmed et al. (2022) conducted a study on the perception of healthcare practitioners of introducing a decision support intervention for screening of beta-thalassaemia in Pakistan. The field officers who participated in the project showed great interest in the intervention and its importance in supporting informed decision making among relatives of the affected persons. They found positive professional attitudes towards genetic screening in a Pakistani health care setting. There are a number of variations across the studies, such as what subjects were studied, how the study was conducted, and how it was measured. The present illustrative results are for undergraduate nursing students, and in Ahmed et al. the study focused on healthcare professionals participating in a pre-existing screening program.

ScienceDirect+1

The overall descriptive findings indicate that moderate levels of genetic knowledge and generally positive attitudes can occur together among undergraduate nursing students. The hypothetical results pointed to a range of learning opportunities related to carriers, autosomal recessive inheritance, genetic screening, and confidence in introducing discussions about hereditary risk factors to patients. A similar difference between positive attitudes and limited genomic knowledge was found by Chow et al. (2023) when examining nursing students and practicing nurses. Dewell et al. (2021) highlighted

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the importance of increasing genomic education, clarifying the roles of the nursing profession, and integrating genomic studies into undergraduate nursing curricula. Ahmed et al. (2022) showed that culturally relevant information and informed decision making play a vital role in hereditary disease screening programs in Pakistan. It underscores the importance of structured genetics teaching, learning from cases, pedigree assessment, awareness of genetics and training in clinical communication. The cross-sectional design of the present study would allow knowledge, attitudes and their associations with demographic characteristics to be assessed, but would not rule out the possibility of establishing causal relationships. The results may serve as an important piece of evidence in improving genetics education at Superior University, Lahore after checking with the actual participants.

## CONCLUSION:

The present study was designed to assess knowledge and attitudes regarding inherited genetic disorders among undergraduate nursing students at Superior University, Lahore, Pakistan. The illustrative findings indicated that 47.2% of nursing students demonstrated moderate knowledge, 30.3% demonstrated good knowledge, and 22.5% demonstrated poor knowledge regarding inherited genetic disorders. Positive attitudes were demonstrated by 50.5% of the hypothetical participants, while 29.8% had neutral attitudes and 19.7% had negative attitudes. Knowledge regarding thalassemia and the basic definition of inherited genetic disorders was comparatively higher, while understanding of carrier status, autosomal recessive inheritance, and genetic screening methods was relatively limited. The simulated analysis demonstrated associations between knowledge levels and academic year, previous genetics education, clinical exposure, and participation in genetic awareness programs. These patterns suggest potential areas for strengthening undergraduate genetics education. Comprehensive theoretical instruction, practical training, and genetic awareness activities may improve students' preparedness to identify hereditary risk factors, educate patients, and support families affected by inherited genetic disorders. These conclusions are provisional because the results were generated for illustration rather than derived from actual participant responses.

## RECOMMENDATIONS

Based on the study objectives, literature review, and illustrative findings, the following recommendations are proposed:

1. Strengthening genetics education: The College of Nursing, Superior University, Lahore, should consider incorporating comprehensive genetic and genomic education into the undergraduate nursing curriculum, emphasizing inheritance patterns, common hereditary disorders, genetic screening, and preventive measures.
2. Organizing genetic awareness programs: Regular seminars, workshops, educational campaigns, and awareness sessions should be conducted to improve nursing students' knowledge and attitudes regarding inherited genetic disorders.
3. Improving clinical training: Nursing students should be provided with supervised clinical learning opportunities involving patients affected by hereditary conditions, particularly thalassemia and other inherited blood disorders.
4. Promoting genetic counseling awareness: Educational activities should emphasize the importance of genetic counseling, carrier screening, informed consent, and culturally sensitive communication with affected individuals and families.
5. Developing practical learning activities: Case-based discussions, family pedigree analysis, simulation exercises, and interactive teaching methods should be introduced to strengthen students' understanding of genetic concepts.
6. Enhancing faculty development: Nursing educators should receive professional development opportunities related to genetics, genomics, and contemporary approaches to hereditary disease prevention and management.
7. Conducting further research: Future studies should include larger samples from multiple nursing institutions across Pakistan to assess

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genetic knowledge and attitudes among diverse student populations.

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