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Knowledge, Awareness, and Perceptions of Genetic Testing Towards Hereditary Diseases among University Students in Lebanon: A Cross- Sectional Study

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Abstract

Background

Genetic testing has become an essential component of modern healthcare by facilitating the early detection, prevention, and management of hereditary diseases. Despite its increasing clinical application, public understanding and acceptance remain variable, particularly in countries where hereditary disorders are prevalent. This study assessed the knowledge, awareness, and perceptions of genetic testing for hereditary diseases among Lebanese university students.

Methods

A cross-sectional study was conducted among 339 university students enrolled in public and private universities across Lebanon during the 2025–2026 academic year. Participants completed a validated, self-administered online questionnaire assessing demographic characteristics, knowledge, awareness, and perceptions of genetic testing. Descriptive statistics summarized participant characteristics and responses. Chi-square, Mann–Whitney U, and Kruskal–Wallis tests were used to examine associations, with statistical significance set at $p < 0.05$.

Results

Overall, 77.9% of participants had previously heard of genetic testing, and 83.2% demonstrated an adequate level of knowledge. Female students were significantly more likely than males to have adequate knowledge (87.3% vs. 73.8%, $p < 0.001$). Previous awareness of genetic testing was strongly associated with higher knowledge (91.3% vs. 54.7%, $p < 0.001$) and with more favorable awareness and perception scores ($p < 0.001$). Most participants recognized the clinical value of genetic testing, supported its use for disease prevention and prenatal screening, and believed that genetic testing improves quality of life.

Conclusion

Lebanese university students demonstrated high knowledge and positive attitudes toward genetic testing for hereditary diseases. Prior exposure to genetic testing was the strongest determinant of knowledge, awareness, and perceptions. Expanding educational initiatives and strengthening public health policies may further improve genetic literacy and facilitate the responsible integration of genetic testing into healthcare practice in Lebanon.

Introduction

Advances in genetics and genomic medicine have transformed the prevention, diagnosis, and management of hereditary diseases. Genetic testing enables the identification of inherited conditions, carrier status, and disease susceptibility, facilitating early intervention, informed reproductive decisions, and personalized healthcare. As genetic testing becomes increasingly integrated into clinical practice, public knowledge, awareness, and perceptions of these technologies have become important determinants of their acceptance and utilization (Alotaibi et al., 2022).

Previous studies have shown that although the general population often demonstrates a basic understanding of genetic concepts and favorable attitudes toward genetic testing, significant gaps in knowledge and misconceptions remain (Alotaibi et al., 2022). Furthermore, positive attitudes do not always translate into preventive health behaviors. This discrepancy highlights the need to assess not only awareness but also perceptions and practices related to genetic testing

Evidence from several countries demonstrates varying levels of public awareness and acceptance of genetic testing. In the United States, national surveys reported that approximately 75–82% of adults were familiar with genetic testing, while only 19–29% had undergone testing, often for ancestry-related rather than medical purposes (Tiner et al., 2022; Memon et al., 2025). Although awareness was high, relatively few individuals reported adopting lifestyle modifications based on their results (Memon et al., 2025). Similarly, a South African study found that participants possessed adequate knowledge of hereditary diseases and favorable attitudes toward family health history, yet preventive practices such as early screening remained limited (Van der Merwe et al., 2022). These findings suggest that increased awareness alone may be insufficient to promote appropriate health-related behaviors.

Studies from Europe, Asia, and Oceania have also highlighted diverse perceptions toward genetic testing. In Denmark, most adults expressed willingness to undergo genetic testing when it could inform treatment decisions, although concerns about learning future disease risks remained a barrier (Leppin & Nielsen, 2022). In Australia, genetic testing uptake was relatively low despite increasing public awareness, particularly for disease-risk assessment (Goldsbury et al., 2025). In China, parents of children with inherited retinal diseases recognized the potential benefits of genetic testing for family planning and disease understanding; however, concerns regarding psychological distress, financial burden, and uncertainty surrounding test accuracy influenced acceptance (Hamamy, 2012).

In the Middle East, hereditary diseases represent a significant public health concern due to the relatively high prevalence of consanguineous marriages, which increase the risk of autosomal recessive disorders (Ben-Omran et al., 2020; Barbour & Salameh, 2009; Al Jassem et al., 2026). Consequently, several countries have implemented genetic screening and public health initiatives aimed at reducing the burden of inherited diseases. In Saudi Arabia, strong support has been reported for public awareness campaigns and governmental policies aimed at preventing the transmission of genetic disorders (Al Eissa et al., 2024). In the United Arab Emirates, willingness to undergo genetic testing was high despite limited genomic literacy among participants (Rahma et al., 2023). Similarly, public support for genomic initiatives such as the Qatar Genome Project has demonstrated growing interest in genetic testing while

emphasizing the need for enhanced public education (Abdul Rahim et al., 2020). In Palestine, higher levels of knowledge regarding genetic testing were associated with younger age, higher educational attainment, and greater socioeconomic status (Ghanim et al., 2025).

Lebanon faces similar challenges related to hereditary diseases and genetic literacy. To reduce the transmission of hereditary and infectious diseases, the Lebanese Ministry of Public Health implemented a premarital medical certificate requirement in 2015. The screening program includes testing for selected genetic disorders, such as sickle cell anemia and thalassemia, as well as infectious diseases including HIV, hepatitis, rubella, and toxoplasmosis (Ministry of Public Health Lebanon, 2015). Despite these efforts, evidence suggests that genetic literacy remains limited. A recent study among Lebanese physicians reported that although many participants perceived themselves as knowledgeable in genetics, only a small proportion demonstrated adequate objective knowledge (Zhang et al., 2019). Furthermore, consanguinity remains relatively common in Lebanon, with an estimated prevalence of 35.5%, further emphasizing the importance of public awareness regarding hereditary diseases and genetic testing (Tadmouri et al., 2009).

University students constitute a particularly important population for evaluating genetic literacy because they represent future parents, healthcare consumers, and professionals who may influence health-related decision-making within their families and communities. Young adults are also among the most likely groups to encounter genetic information through educational institutions, social media, and emerging genomic services. However, limited research has examined knowledge, awareness, and perceptions of genetic testing among university students in Lebanon.

Therefore, this study aims to assess the knowledge, awareness, perceptions, and sources of information regarding genetic testing and hereditary diseases among university students in Lebanon. By identifying knowledge gaps and misconceptions, the findings may contribute to the development of targeted educational interventions and public health strategies that promote informed decision-making and improve the utilization of genetic testing for disease prevention and early detection.

Materials and Methods

Participants and Study Design

A cross-sectional study was conducted among 339 lebanese university students to evaluate the knowledge, awareness, and perception toward genetic testing for hereditary diseases among university students in Lebanon using a structured questionnaire. The study population included university students enrolled in public and private Lebanese universities during the data collection period during the academic year 2025–2026. Participants from both health and non-health related majors all around Lebanon were recruited through convenience sampling. Data were collected using an online survey link hosted on Google Forms and circulated digitally via student groups and social media platforms. Prior to participation, all respondents were informed of the study objectives, the voluntary nature of participation,

and the anonymity and confidentiality of the data collected. Informed consent was obtained from all participants electronically.

Ethical Considerations

This study was conducted in accordance with the ethical principles of the Declaration of Helsinki, including respect for participants, beneficence, confidentiality, and the right to withdraw from the study at any time without any consequences (World Medical Association, 2013). Participation was entirely voluntary, and all responses were collected anonymously, with no personally identifying or sensitive data obtained from the participants. Prior to data collection, ethical approval was obtained from the Research Ethics Committee (REC) and the Human Research Protection Program (HRPP) at the Holy Spirit University of Kaslik (Approval Number: HCR/EC 2025-058). Informed consent was obtained from all participants before their inclusion in the study. For participants younger than 16 years of age, informed consent was obtained from their parents or legal guardians before participation. Participation was voluntary, and all responses were collected anonymously and treated confidentially.

Survey structure

The survey instrument employed in this study was adapted from a validated questionnaire to assess knowledge, awareness, and perception of genetic testing for hereditary disorders (Chin et al., 2020). The self-administered questionnaire comprised four sections: The first section focused on the demographic and academic characteristics of the respondents including age, gender, year of study, status of their knowledge about genetic testing, and wheither if they have family history that is related to genetic disorders. The second section consisted of 10 questions in a trichotomous format (yes/no/maybe) evaluating baseline knowledge of genetic testing. The third section (11 questions) and the fourth section (13 questions) focused on the participants' awareness, and perception of genetic testing, respectively. Responses for the third and fourth sections were assessed using a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree).

Data Collection and Storage

Data were collected using an online administration of the questionnaire hosted on Google Forms and distributed through digital communication networks. A final sample size of 339 completed responses was obtained for analysis. All participants provided informed consent prior to enrollment, and participation was entirely voluntary. No personally identifiable information was collected, and all responses were kept confidential and accessible only to the research team. Data obtained through the online survey were stored in password-protected electronic files and handled with strict confidentiality. The datasets generated and analyzed during the study are available from the corresponding author upon reasonable request.

Data analysis

Statistical analyses were performed using IBM SPSS Statistics version 27. Descriptive statistics were used to summarize the participants' demographic and academic characteristics as well as their responses to the genetic testing knowledge, awareness, and perception. Categorical variables were expressed as frequencies and percentages. The Chi-square test was used to evaluate differences and associations involving categorical distributions. For the comparison of continuous scores across groups, the Mann-Whitney U test was applied to assess differences between two independent groups, whereas the Kruskal-Wallis test was employed to analyze differences among three or more independent groups. A scoring system was used to analyze the knowledge domain: a score of 2 was awarded for a "yes" response, 1 for "maybe," and 0 for "no." Individual item scores were summed to generate an overall knowledge score for each respondent. These cumulative scores were stratified into percentage-based categories to determine knowledge levels: inadequate (0–53%), moderate (54–66%), and adequate (67–100%) (Haga et al., 2013). Statistical significance was set at $p < 0.05$.

Results

Table 1
Sociodemographic Characteristics of the Respondents (N = 339)

Variables	Sub-categories	Frequency (n)	Percentage (%)
Age	Under 18	32	9.4%
	18–21	263	77.6%
	22–25	44	13.0%
Gender	Male	103	30.4%
	Female	236	69.6%
Current Level of Study	Sophomore (First year)	100	29.5%
	Junior	103	30.4%
	Senior	74	21.8%
	Graduates	62	18.3%

Table 1 outlines the background characteristics of the 339 university students who participated in the study. The vast majority of the participants were young adults between the ages of 18 and 21 (77.6%), and 69.6% of the total group were female. In terms of their educational progress, the participants were fairly evenly distributed across their university years: first-year students made up 29.5% of the group, second-year students accounted for 30.4%, seniors made up 21.8%, and graduate students comprised the remaining 18.3%.

Table 2
Awareness of Genetic Testing, Family History of Genetic Disorders, and Knowledge of Hereditary Diseases Among Participants

Variable	n (%)
Have you heard of the term "genetic testing"?	
Yes	264 (77.9)
No	75 (22.1)
Do you have any family history related to genetic disorders?	
Yes	131 (38.6)
No	120 (35.4)
Not sure	88 (26.0)
Do you know if any of the following diseases are hereditary?*	
Diabetes	264 (77.9)
Cancer	188 (55.5)
Color Blindness	186 (54.9)
Hypertension	173 (51.0)
Hypercholesterolemia	158 (46.6)
Thalassemia	155 (45.7)
Down Syndrome	151 (44.5)
Sickle Cell Anemia	149 (44.0)
Hemophilia	116 (34.2)
I don't know	43 (12.7)

Table 2 summarizes the participants' basic awareness of genetic concepts and their own family medical backgrounds. 77.9% of participants had previously heard of genetic testing, and over a third (38.6%) knew of a genetic disorder within their family. When asked to identify which common medical conditions are passed down through families, diabetes was by far the most widely recognized (77.9%), followed by cancer (55.5%) and color blindness (54.9%). On the other hand, hemophilia was the least recognized hereditary condition among the choices provided (34.2%).

Table 3
A. Responses to Knowledge Questions About Genetic Testing

Knowledge Items	Yes n (%)	No n (%)	Maybe n (%)
Q1. Do you think that genetic testing allows the genetic diagnosis of vulnerabilities to inherited diseases?	219 (64.6%)	19 (5.6%)	101 (29.8%)
Q2. Is it possible that genetic testing can reduce the prevalence of genetic diseases?	210 (61.9%)	34 (10.0%)	95 (28.0%)
Q3. Do you think that genetic testing can help understand a genetic feature and its sequences?	280 (82.6%)	11 (3.2%)	48 (14.2%)
Q4. Is it true that a person's genetic profile can be used to check whether they are at risk of genetic or hereditary diseases?	263 (77.6%)	14 (4.1%)	62 (18.3%)
Q5. Do you believe that genetic testing can identify specific disease that runs in the family?	280 (82.6%)	15 (4.4%)	44 (13.0%)
Q6. In your opinion, can genetic diseases be passed on in a family?	275 (81.1%)	16 (4.7%)	48 (14.2%)
Q7. Is prenatal screening the testing for diseases or conditions of the fetus or embryo before it is born?	207 (61.1%)	33 (9.7%)	99 (29.2%)
Q8. Can genetic testing be done during pregnancy to find out whether the baby will develop diseases (e.g., sickle cell, thalassemia)?	237 (69.9%)	20 (5.9%)	82 (24.2%)
Q9. Do you think that blood tests and DNA analysis are some of the methods used in genetic testing?	264 (77.9%)	15 (4.4%)	60 (17.7%)
Q10. Is it possible that Genetic testing can identify various types of cancers, such as colon cancer and breast cancer?	206 (60.8%)	32 (9.4%)	101 (29.8%)

Table 3A shows how participants responded to ten specific statements evaluating what genetic testing can accomplish. Overall, understanding was strong across the group. The highest rates of correct answers were for the concepts that genetic testing can identify specific inherited diseases running in a family (82.6%) and help explain unique genetic traits (82.6%). The lowest certainty was observed on questions regarding whether genetic testing can identify specific cancers (60.8%) or perform screenings before a baby is born (61.1%), though a clear majority still answered these correctly.

Table 3
B. Distribution of Knowledge Level of participants

Measure	n (%)
Knowledge Level	
Inadequate (≤ 53%)	40 (11.8)
Moderate (54–66%)	17 (5.0)
Adequate (≥ 67%)	282 (83.2)

Table 3B categorizes the participants' overall performance based on their cumulative answers to the genetic knowledge questions. The results show that a large majority of the surveyed group possessed a strong understanding of the topic, with 83.2% scoring at an "adequate" level. Only a small minority of participants fell into the "inadequate" (11.8%) or "moderate" (5.0%) knowledge categories.

Table 3
C. Factors Associated with Knowledge Level of participants

Variables	Inadequate (≤ 53%) n (%)	Moderate (54–66%) n (%)	Adequate (≥ 67%) n (%)	p-value
Age				0.664
Under 18	6 (18.8%)	2 (6.3%)	24 (75.0%)	
18–21	30 (11.4%)	12 (4.6%)	221 (84.0%)	
22–25	4 (9.1%)	3 (6.8%)	37 (84.1%)	
Gender				< 0.001
Male	15 (14.6%)	12 (11.7%)	76 (73.8%)	
Female	25 (10.6%)	5 (2.1%)	206 (87.3%)	
Current Level of Study				0.847
Sophomore (First year)	10 (10.0%)	4 (4.0%)	86 (86.0%)	
Junior	15 (14.6%)	7 (6.8%)	81 (78.6%)	
Senior	8 (10.8%)	4 (5.4%)	62 (83.8%)	
Graduates	7 (11.3%)	2 (3.2%)	53 (85.5%)	
Heard of "Genetic Testing"				< 0.001
No	24 (32.0%)	10 (13.3%)	41 (54.7%)	
Yes	16 (6.1%)	7 (2.7%)	241 (91.3%)	

Table 3C examines whether specific background factors are reliably linked to how much a participant knows about genetic testing. The analysis highlights two factors with strong statistical significance: gender and prior awareness. Gender showed a highly meaningful connection ($p < 0.001$), with a clear majority of females achieving an adequate knowledge level (87.3%) compared to males (73.8%). Similarly, having previously heard of genetic testing was another powerful and significant factor ($p < 0.001$); among those with prior awareness, 91.3% achieved an adequate knowledge score, compared to just 54.7% of those who had never heard of the term before. In contrast, background factors such as a participant's age ($p = 0.664$) and their current level of study ($p = 0.847$) did not show any statistically meaningful relationship with knowledge levels.

Table 4
Respondents' Awareness Score Profile Towards Genetic Testing

Awareness Survey Items	SD n (%)	D n (%)	N n (%)	A n (%)	SA n (%)
Q1. I have sufficient knowledge of genetic testing.	13 (3.8%)	59 (17.4%)	161 (47.5%)	91 (26.8%)	15 (4.4%)
Q2. I am aware that I have a unique genetic feature compared with others.	12 (3.5%)	36 (10.6%)	94 (27.7%)	107 (31.6%)	90 (26.5%)
Q3. I would like to have genetic testing.	12 (3.5%)	17 (5.0%)	122 (36.0%)	142 (41.9%)	46 (13.6%)
Q4. Genetic testing tells me the risk of acquiring certain diseases.	7 (2.1%)	9 (2.7%)	58 (17.1%)	180 (53.1%)	85 (25.1%)
Q5. I am aware that not all genetic disorders can be cured.	7 (2.1%)	17 (5.0%)	58 (17.1%)	157 (46.3%)	100 (29.5%)
Q6. Genetic tests should only be performed in the hospital with a prescription.	5 (1.5%)	18 (5.3%)	81 (23.9%)	161 (47.5%)	74 (21.8%)
Q7. Genetic tests can be sold through the internet.	100 (29.5%)	107 (31.6%)	87 (25.7%)	40 (11.8%)	5 (1.5%)
Q8. Genetic tests can be sold in stores.	94 (27.7%)	109 (32.2%)	95 (28.0%)	37 (10.9%)	4 (1.2%)
Q9. Genetic testing is closely related to science and medicine.	6 (1.8%)	5 (1.5%)	64 (18.9%)	170 (50.1%)	94 (27.7%)
Q10. There are technologies in documenting genetic profiles for various genetic disorders.	8 (2.4%)	10 (2.9%)	109 (32.2%)	168 (49.6%)	44 (13.0%)
Q11. Public's view and awareness of genetic testing is important.	8 (2.4%)	9 (2.7%)	67 (19.8%)	156 (46.0%)	99 (29.2%)

Table 4 shows the participants' awareness profile regarding genetic testing. While a large portion of the sample expressed uncertainty about whether their personal knowledge of the topic was sufficient, with 161 participants (47.5%) responding neutrally, they demonstrated clear agreement regarding its scientific and medical relevance. Specifically, 170 respondents (50.1%) agreed and 94 (27.7%) strongly agreed that genetic testing is closely related to science and medicine. Regarding its clinical utility, 180 participants (53.1%) agreed and 85 (25.1%) strongly agreed that it reveals the risk of acquiring certain diseases, while 157 (46.3%) agreed and 100 (29.5%) strongly agreed that not all genetic disorders can be cured. Furthermore, participants heavily favored professional regulation, with 161 (47.5%) agreeing and 74 (21.8%) strongly agreeing that these tests should only be performed in hospitals with a doctor's prescription.

Conversely, there was noticeable opposition to commercial sales over the internet, where 100 participants (29.5%) strongly disagreed and 107 (31.6%) disagreed, or in retail stores, where 94 (27.7%)

strongly disagreed and 109 (32.2%) disagreed. Finally, clear majorities agreed that technology exists to document genetic profiles (168 participants, 49.6%) and that public awareness on this subject is highly important (156 participants, 46.0%).

Table 5
Respondents' Perception Score Profile Towards Genetic Testing

Perception Survey Items	SD n (%)	D n (%)	N n (%)	A n (%)	SA n (%)
Q1. Genetic testing is important.	5 (1.5%)	8 (2.4%)	55 (16.2%)	153 (45.1%)	118 (34.8%)
Q2. Genetic testing is mainly for preventive care purposes.	6 (1.8%)	14 (4.1%)	82 (24.2%)	169 (49.9%)	68 (20.1%)
Q3. Genetic testing should be offered to all newborn babies.	12 (3.5%)	13 (3.8%)	88 (26.0%)	142 (41.9%)	84 (24.8%)
Q4. Genetic tests should be offered to all pregnant women.	7 (2.1%)	15 (4.4%)	85 (25.1%)	148 (43.7%)	84 (24.8%)
Q5. Knowledge of the genetic background of a disease will help people to live longer.	11 (3.2%)	17 (5.0%)	93 (27.4%)	152 (44.8%)	66 (19.5%)
Q6. Genetic testing does more good than harm.	8 (2.4%)	8 (2.4%)	89 (26.3%)	173 (51.0%)	61 (18.0%)
Q7. Genetic testing will not influence one's health.	18 (5.3%)	59 (17.4%)	121 (35.7%)	100 (29.5%)	41 (12.1%)
Q8. Genetic tests aid in improving one's quality of life.	10 (2.9%)	11 (3.2%)	86 (25.4%)	183 (54.0%)	49 (14.5%)
Q9. Genetic testing tampers (interferes) with nature.	33 (9.7%)	64 (18.9%)	149 (44.0%)	76 (22.4%)	17 (5.0%)
Q10. Genetic testing opposes religion and beliefs.	49 (14.5%)	83 (24.5%)	117 (34.5%)	73 (21.5%)	17 (5.0%)
Q11. Lack of education and knowledge of genetics and genetic tests are what raised ethical issues in genetic testing.	5 (1.5%)	17 (5.0%)	107 (31.6%)	164 (48.4%)	46 (13.6%)
Q12. It is necessary to raise awareness of genetic testing.	8 (2.4%)	8 (2.4%)	56 (16.5%)	161 (47.5%)	106 (31.3%)
Q13. Implementation of government laws and policies is needed to ensure safe and effective use.	7 (2.1%)	10 (2.9%)	74 (21.8%)	154 (45.4%)	94 (27.7%)

Table 5 describes the participants' perceptions toward genetic testing. Overall, respondents held highly positive views, with 153 participants (45.1%) agreeing and 118 (34.8%) strongly agreeing that genetic testing is important, and 169 (49.9%) agreeing that its main purpose is preventive care. There was also

notable support for broad screening programs; 142 individuals (41.9%) agreed that testing should be offered to all newborn babies, and 148 (43.7%) agreed it should be made available to all pregnant women. In terms of long-term health outcomes, 173 respondents (51.0%) agreed that genetic testing does more good than harm, while 183 (54.0%) agreed it improves quality of life, and 152 (44.8%) agreed it helps people live longer. Moral and philosophical concerns showed less consensus, as 149 participants (44.0%) felt neutral about whether testing interferes with nature, and 117 (34.5%) were neutral on whether it opposes religious beliefs.

Lastly, a clear majority linked ethical concerns to educational gaps, with 164 respondents (48.4%) agreeing that a lack of public knowledge raises ethical issues, 161 (47.5%) agreeing that raising awareness is necessary, and 154 (45.4%) agreeing that government laws are required to ensure safe use.

Table 6
Factors Associated with Awareness and Perception Scores

Variable	Awareness p-value	Perception p-value
Gender	0.243	0.175
Age	0.969	0.511
Level of study	0.511	0.166
Heard of genetic testing	< 0.001	< 0.001

Table 6 evaluates the background factors associated with the participants' overall awareness and perception scores. The analysis revealed that standard demographic variables did not have a meaningful or reliable relationship with how participants understand or view genetic testing. Specifically, gender showed no significant link with awareness ($p = 0.243$) or perception ($p = 0.175$). Similarly, age did not demonstrate a meaningful relationship with awareness ($p = 0.969$) or perception ($p = 0.511$), and the participant's level of study was likewise non-significant for both awareness ($p = 0.511$) and perception ($p = 0.166$).

In contrast, the only factor that established a powerful and highly reliable connection was whether a participant had previously heard of genetic testing. Prior exposure to the term had an extremely significant relationship with both awareness and perception (both $p < 0.001$).

Discussion

The primary objective of this cross-sectional study was to assess the baseline knowledge, awareness, and perception regarding genetic testing among Lebanese university students. Overall, knowledge levels were high, with 83.2% of participants demonstrating adequate knowledge, while only 11.8% and 5.0% were classified as having inadequate and moderate knowledge, respectively. This high level of knowledge is a positive indicator, suggesting that human genetics and biomedical advancements are

increasingly integrated into higher education, curriculum, or public discourse in Lebanon. Participants who had previously heard of genetic testing where more likely to have adequate knowledge compared to those who had not (91.3% vs. 54.7%, $p < 0.001$), indicating the important role of awareness and education in people's perception of genetic testing. These results are consistent with several international studies that also reported an adequate knowledge of genetic testing among university students. For example, a study conducted among Indonesian university students demonstrated a high level of genetic knowledge, with a mean score of 13.85 out of 16 (86.6%) (Hermanto et al., 2024). Furthermore, studies in Malaysia also revealed adequate knowledge and positive awareness of genetic testing, in which both were influenced by the status of heard or unheard of genetic testing ($P < 0.001$) (Chin and Tham, 2020). However, more recent studies showed that more knowledgeable people were more critical towards the application of genetic testing (Henneman et al. 2013; Etchegary 2014; Eum et al. 2018).

Regarding awareness, our results indicate that while a notable portion of participants (47.5%) were neutral about the sufficiency of their personal knowledge, a strong majority recognized genetic testing's clinical and scientific value. Specifically, 77.8% agreed or strongly agreed on its close relationship to science, and 78.2% acknowledge its utility in revealing disease risks, even though 46.3% noted that not all genetic disorders can be cured. Statistically, the only factor significantly associated with the awareness scores was prior exposure to the concept; having heard of genetic testing was highly significant ($p < 0.001$), whereas demographic factors such as gender ($p = 0.243$), age ($p = 0.969$), and level of study ($p = 0.511$) showed no meaningful correlation.These findings suggest that while university students in Lebanon possess a pragmatic awareness of the clinical utility of genetic testing, they remain cautious about its commercialization, preferring that these tools remain within the regulated boundaries of the healthcare system. The strong association between prior exposure and awareness underscores the critical role of the public health communication and education. Our results are closely aligned with recent international findings. For instance, a Malaysian study consistent with our findings reported that prior exposure to the concept of genetic testing was the primary driver of both adequate knowledge and positive awareness (Chin & Tham, 2020). However, a notable divergence emerged concerning demographic factors; while Chin and Tham (2020) found that awareness was also significantly influenced by their participant's educational level and field of study, our Lebanese sample showed homogenous awareness across these demographic lines. The high recognition of genetic testing's clinical utility in our study mirrors recent Indonesian research findings (Hermanto et al., 2024), who observed that a majority of Indonesian students supported the use of DNA testing for the early detection of diseases. Similarly to our case, an assessment of young Jordanians demonstrated strong clinical awareness, stating that over three-quarters (77.1%) of the respondents were familiar with this concept and the vast majority (93.9%) viewed genetic testing as a valuable method for diagnosis and preventing hereditary conditions (Altaany et al.,2019). On the other hand, our respondents' high neutrality regarding the adequacy of their own knowledge aligns closely with findings from the United States college cohort, where a majority of the sample(57.6%) had a neutral idea towards personalized medicine and a significant portion (44.1%) felt insufficiently informed about this subject (Xu & Wu, 2023). These

interpretations highlight the fact that while a broad awareness of medical benefits and regulatory needs of genetic testing is present, translating it into a confident understating remain a shared challenge.

Overall, more than half of Lebanese university students showed a positive perception toward genetic testing, with 153 participants (45.1%) agreeing and 118 (34.8%) strongly agreeing that genetic testing is important. Similarly, many participants indicated that the main purpose of utilizing genetic testing is preventive care. They also agreed that genetic testing should be performed on newborns and all pregnant women, further emphasizing its importance in the early detection and prevention of diseases.

These findings align well with a recent study, which reported the responsiveness of Jordanian women to non-invasive prenatal genetic screening (Abdo et al., 2018). Also, the majority of participants stated that knowledge in general about the disease and having a solid background about it will help people live longer. This was also supported by the finding that people agreed genetic testing does more good than harm and should be used to improve quality of life. Nonetheless, most of the respondents remained neutral when asked whether genetic testing tampers with nature and opposes religion and their beliefs. This also strongly aligns with the results of a study conducted in Malaysia, which showed that when asked whether genetic testing tampers with nature, 184 participants (41.3%) expressed neutrality, and when asked whether it opposes religion and their beliefs, 168 participants (37.7%) also expressed neutrality (Chin et al., 2020). Nevertheless, the majority of people believed that the lack of education and knowledge of genetics and genetic testing is what raises ethical issues related to genetic testing. This led the majority to support education, awareness, and appropriate government policies to implement and support genetic testing and ensure its safe and effective use.

Strengths and Limitations

To our knowledge, this survey provides the first insight into Lebanese students' knowledge, awareness, and perception of genetic testing for hereditary disorders. Thus, this study serves as a foundation for future studies on this topic. However, this study has a cross-sectional design that limits our ability to establish causality and temporal order, rendering it difficult to establish the real relation between participant characteristics and their knowledge, awareness, and perceptions of genetic testing. Also, this study was done through an online questionnaire administered to university students and is highly susceptible to selection bias, which limits the representativeness of the study population. The use of self-reported responses may introduce recall and response bias.

Conclusion

In conclusion, genetic testing is becoming increasingly accepted worldwide, including in Lebanon. Lebanese university students demonstrated a high level of knowledge, positive awareness, and favorable attitudes toward genetic testing. Previous exposure to genetic testing emerged as the strongest factor associated with higher levels of knowledge, awareness, and positive attitudes. These findings underscore the importance of expanding educational and public awareness initiatives to further improve

understanding of genetic testing. In addition, the development and implementation of national policies and guidelines could facilitate the integration of genetic testing services into healthcare systems and promote equitable access across hospitals in Lebanon.

Declarations

Ethical Approval:

ethical approval was obtained from the Research Ethics Committee (REC) and the Human Research Protection Program (HRPP) at the Holy Spirit University of Kaslik (Approval Number: HCR/EC 2025-058).

Informed Consent:

All participants provided electronic informed consent prior to their enrollment in the study, and participation was completely voluntary. For participants younger than 16 years of age, informed consent was obtained from their parents or legal guardians before participation. Participation was voluntary, and all responses were collected anonymously and treated confidentially. No identifiable information was collected, and all responses remain confidential, accessible only to the research team. All data will be stored in password-protected files.

Conflict of Interest:

All the authors declare no competing interests.

Clinical trial number:

not applicable.

Consent for publication:

Not Applicable

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Author Contribution

All authors have contributed equally to this manuscript. The corresponding author is Rawad Affan, and his email is: rawad.r.affan@net.usek.edu.lb

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N/A

Data Availability

The datasets generated and analyzed during the study are available from the corresponding author upon reasonable request.

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