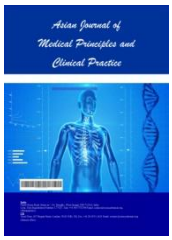

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Knowledge and Attitude towards Genetic Diseases and Genetic Testing among Undergraduate Medical Students

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Genetic testing of newly diagnosed patients with rare hereditary disorders is said to improve early family detection, allow patients to receive disease-specific treatment when available. A deficiency in knowledge of genetic testing has been reported among populations as well as health practitioners in developed and developing nations. We conducted this cross-sectional study to determine the awareness, knowledge and attitude about genetic diseases and genetic testing among clinical year medical students of private medical college in Malaysia. The data was collected by distributing questionnaires in electronic version and a total of 119 students were recruited. The data was analysed by using Epi Info version 7.2.5 and SPSS version 12. Independent t-test, one way ANOVA and linear regression were calculated. Among the students, 43.7% of the student had good knowledge towards genetic diseases and genetic testing while 56.3% had poor knowledge among the students. 31.1% of the participants had good attitude and 68.9% had poor attitude towards genetic diseases and genetic testing. Presence of family members suffering from genetic disease, and awareness of genetic testing and counselling have shown to have significant association with knowledge towards genetic diseases and genetic testing. However, there were no significant association between demographic variables and attitude towards genetic diseases and genetic

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testing. There was a significant positive association between knowledge and attitude towards genetic diseases and genetic testing (b=0.042, P=0.004). The knowledge and attitude towards genetic diseases and genetic testing among undergraduate medical students were not up to optimal level. Thus, medical schools and their curriculum play a role in improving the knowledge and attitude about genetic diseases and genetic testing, and greater emphasis is needed on courses related to this topic.

Keywords: Knowledge; attitude; genetic diseases; genetic testing; medical students.

1. INTRODUCTION

"Genetic disorder is a health condition inherited by a person, in which there are usually mutations in the deoxyribonucleic acid (DNA) or changes in the number or overall structure of chromosomes" [1]. "There are several types of commonly known diseases which have been determined to be associated with hereditary gene mutations. These include major well- known non-communicable health concerns such as hypertension, diabetes, and hypercholesterolemia which are common in developed or developing countries including Malaysia. On the other hand, approximately 5% to 10% of cancers are known to be due to hereditary components such as breast cancer and colorectal cancer" [2]. Furthermore, blood-related disorders including sickle cell disease, thalassemia, and haemophilia, are also categorized as hereditary diseases.

Genetic testing of newly diagnosed patients with rare hereditary disorders is said to improve early family detection, allows patients to receive disease-specific treatment when available, and also allows more patients to be detected at a younger age [3]. Prenatal genetic testing, for instance, has the greatest benefits in terms of not only preventing birth of children with chronic hereditary disorders but also provides pregnant parents with some relief from reproductive risk [4]. Genetic testing has many benefits as it can be used to provide medical services such as primary, secondary, tertiary prevention and delivery of health services including pharmaceuticals. Primary prophylaxis may include the use of genomic risk profiles to boost adoption of physical activity. Secondary prophylaxis involves the use of genetic testing for early detection of various diseases such as colorectal cancer. Tertiary prophylaxis is best described by using pharmacological genomics trials to target drug treatment and to adjust dosages in the treatment of various diseases [5]. Genetic screening for common complex disorders ideally provides prophylactic strategy options related to interventions such as lifestyle, dosing, or regular monitoring. For example, serum biochemical markers such as cholesterol levels, organ function monitoring, and early detection of precancerous lesions are well known procedures of genetic screening [6].

"A deficiency in knowledge of genetic testing has been reported among the public, including populations in developed and developing nations" [7-11]. Previous studies regarding prenatal or neonatal genetic testing showed the need for further improvement in health education, facilities, and infrastructures to enhance the adaptation of non-invasive genetic testing among the public [12,13]. Among medical students, it was reported to have a high level of awareness regarding genetic testing [14]. Although knowledge was deficient regarding genetic diseases among practitioners, gynaecologists, and paediatricians, it has been proposed that physicians' confidence and awareness in genetic testing can be enhanced by providing additional health education [15]. According to a study done about the attitude and knowledge on prenatal screening for genetic diseases, most of the general public agreed on using genetic testing could improve diagnosing diseases and to further comprehend their causes. However, a more critical attitude towards some aspects of genetic testing and its uses was reported [16]. A survey done on public knowledge and attitude about genetic testing revealed that most people had positive attitudes regarding genetic testing for certain aspects such as early detection of diseases. However, there were some negative attitudes when it came to the consequences of genetic testing, such as the ability to find a job, the ability to get health insurance, and how the genetic testing might alter their future [17]. In another study that compared people's attitudes on genetic testing between the year 2002 and 2010, results showed more people had positive opinions in 2010 compared to early time. There was an increase in knowledge about genetic testing, however, it was reported that people with more knowledge about

genetic testing had a more critical attitude towards it [18].

In Malaysia, it has been reported that there is an urgent need to strengthen the field of genetic testing [19]. “Researchers or stakeholders have taken continuous efforts by introducing medical genetic services nearly a decade ago. With the availability of genetic counselling, testing and diagnosis, genetic services have been improved. Clinical genetics has been recognized as a subspecialty and increased funding for genetics services has also contributed to the growth of genetic testing. The level of knowledge, perception, or awareness regarding genetic risk of inheritable disorders has been assessed among patients and young Malaysians” [20-22], and also among physicians [23]. Though it has been reported as high public acceptance of genetic tests for cancer risk in Malaysia [24,25], the public view towards genetic testing for the same is still limited. Previous study done among multi-racial Malaysians revealed there was awareness of thalassemia, however, more effective and culturally acceptable educational intervention was essential to reach out diverse socio-demographic and ethnic communities to cultivate better knowledge and attitudes [26]. “In Malaysia, the study done among the local residents in one metropolitan area showed adequate knowledge and positive awareness of hereditary disorders and genetic testing, which were influenced by education level, field of study, and heard of genetic testing previously” [27].

Many previous studies have been conducted to assess the awareness, knowledge and attitude towards genetic diseases and genetic testing among general public, medical practitioners such as doctors, nurses and university students in Netherland, Canada, Iran, Oman, Croatia, and Italy [15,16,28,29,30,31]. Though the similar study has been done among general public in Malaysia, there is limited information on the knowledge, awareness, and attitudes of undergraduate medical students towards hereditary diseases and genetic testing. Therefore, this survey was done to determine the awareness, knowledge and attitude about genetic diseases and genetic testing among clinical year medical students of private medical university. We also aimed to find the association between demographic factors including family history of inherited diseases, whether the students have ever attended talk or elective courses, and knowledge and attitude of genetic diseases and genetic testing.

2. METHODOLOGY

A cross-sectional study was conducted from March 2022 to April 2022, among undergraduate medical students of the private medical college in Malaysia. The college has two campuses which are located in Melaka state and Johor state. There are three courses offered by this college such as Bachelor of Medicine and Bachelor of Surgery (MBBS), Bachelor of Dental Surgery (BDS), and Foundation in Science (FIS). In this study, we included students from the clinical years of the MBBS programme who are currently in Semester 6 to Semester 10, and the estimated number of clinical year students was 500.

The sample size was calculated using Epi info software version 7.2.5.0, and an estimated proportion of 74.2% of clinical year medical students considered that genetic counselling and consultation was indispensable or necessary [32], 95% confidence interval, 7% acceptable margin of error. The minimum sample size required was 115. By considering 10% of the non-response rate, the final sample size was 128.

We used non-probability, purposive sampling to recruit the participants. The inclusion criteria were undergraduate clinical year medical students at two campuses of our university, and the students who provided written informed consent for this study. The exclusion criteria were preclinical year medical students, students from Foundation in Science (FiS) program, and students from the BDS programme. Moreover, we excluded the students who were unable to complete the required parts of the questionnaire.

We prepared the questionnaire using google form and it was distributed to clinical year medical students of our university via social media platforms such as WhatsApp, email, etc. Measuring the awareness, knowledge and attitudes towards genetic diseases and genetic testing, we modified the questionnaire from the previous studies [32,33]. The survey questionnaire comprised three sections which include socio-demographic characteristics, knowledge and attitude towards genetic diseases and genetic testing. The first section addressed socio-demographic questions such as gender, ethnicity, academic year, family history, whether respondents have attended any elective courses, talks, conferences on genetic diseases and awareness of genetic testing and counselling. The second section consisted of nine questions that are related to knowledge regarding genetic

diseases and genetic testing. The responses for knowledge were categorized as 'true', 'false' or 'don't know' and assigned a score of '1' was given for 'correct answer', and score of '0' was given for 'wrong answer' and 'don't know'. Meanwhile, the third section included 12 questions concerning attitudes on genetic testing. The responses for attitude were categorized as 'agree', 'disagree', and 'don't know'. For positive statements, we assigned a score of '1' for 'agree', and '0' for 'don't know' and 'disagree'. For negative statements, we assigned a score of '1' for 'disagree', and '0' for 'don't know' and 'agree'.

The content validity of the questionnaire was checked with the experts. The internal consistency of knowledge and attitude were calculated using Cronbach's alpha coefficient. The Cronbach's alpha coefficient value of knowledge was 0.453 and attitude was 0.730. As English is the language of instruction in our college, we did not translate the original English questionnaire to the local language.

Consent form was also included in the first part of the questionnaire. The consent form included detailed information regarding the purpose and significance of the study and informed students that participation in the study was voluntary and all data was anonymous and confidential. Respondents' anonymity was respected.

The data were analysed by using Epi Info software version 7.2.5.0 and SPSS version 12. The outcome variables in this study were knowledge and attitude toward genetic diseases and genetic testing. The independent variables of this study were gender, ethnicity, academic year, family history of inherited diseases, prior participation in any elective courses/talk/conferences on genetic diseases and genetic testing and lastly any prior awareness of genetic diseases and genetic testing.

We calculated total score of knowledge and attitudes. Knowledge score was further converted to a percentage score. We categorized knowledge and attitude into two groups such as good (above median score) and poor (≤ median score).

Descriptive statistics such as frequency and percentage were calculated for the categorical variables such as gender, ethnicity, academic year, family history of inherited diseases, prior participation in any elective courses/talks/conferences, and any prior awareness of genetic diseases and genetic testing. Mean and standard deviation were also calculated for quantitative variables including knowledge and attitudes scores. We calculated independent t-test, one-way ANOVA, and linear regression. 95% confidence level was also calculated for mean difference and regression coefficient. P value less than 0.05 was considered statistically significant.

3. RESULTS

Table 1 shows the demographic characteristics among clinical year medical students. A total number of 119 responses were received out of 128 undergraduate medical students from the online questionnaire (response rate of 92.96%). Among the participants, 38.7% were males and the remainder of 61.3% were females. With regards to ethnicity, 11.8% of the respondents were Malays, 42.9% were Chinese, 42.0% were Indians and the remaining 3.4% respondents were other ethnicities. Based on the academic year, 57.1% of respondents were from semester 6, 16.0% from semester 7, 11.8% from semester 8, and 7.6% from semester 9 and 10. 28.6% of respondents had a family member suffering from genetic disease. A total of 31.9 % of respondents had experience attending elective courses or talks or conferences regarding genetic diseases. Most of the respondents (73.1%) were aware of genetic testing and counselling.

Table 2 showed the number and percentage of students who answered correctly for individual knowledge questions.

Table 3 showed the number and percentage of students who answered agree, disagree and don't know regarding attitude towards genetic diseases and genetic testing among clinical year medical students.

Table 4 describes the knowledge and attitude towards genetic diseases and genetic testing among clinical year medical students. From the data collected, 56.3% of the respondents had poor knowledge towards genetic diseases and genetic testing while 43.7% of the respondents had good knowledge. The mean knowledge score is 78.0 while the standard deviation is 15.7. Majority of the students (68.9%) had poor attitude towards genetic testing as 31.1% of the respondents reported having a good attitude. The mean attitude score is 7.5 while the standard deviation is 2.5.

Table 5 describes the association between demographic variables and knowledge towards genetic diseases and genetic testing. There were no statistically significant association between gender, ethnicity, academic year, whether the students had attended any elective course/talks/conference regarding genetic diseases, and knowledge towards genetic diseases and genetic testing. However, there were statistically significant association between having family member suffering from genetic disease (mean difference -7.6, 95% CI -13.8 to -1.5; P=0.016), awareness of genetic testing and counselling and knowledge towards genetic diseases and genetic testing (mean difference 11.1, 95% CI 5.0 to 17.2; P = 0.001).

Table 6 describes the association between demographic variables and attitude towards genetic diseases and genetic testing. There were no statistically significant association between gender, ethnicity, academic year, family history of inherited diseases, prior participation in any elective courses/talk/conferences on genetic diseases and genetic testing, awareness of genetic diseases and genetic testing, and attitude towards genetic testing.

Table 7 shows the association between knowledge and attitude towards genetic diseases and genetic testing. Simple linear regression was used and R^2 for this model was 6.8%. There was statistically significant positive association between knowledge and attitude towards genetic diseases and genetic testing (b=0.042, 95% CI 0.013 to 0.070; P = 0.004).

4. DISCUSSION

We conducted a cross-sectional study to investigate the knowledge and attitude toward genetic diseases and genetic testing among clinical year medical students of the private medical college in Malaysia. Besides that, we set out to determine the association between demographic factors including a family history of inherited diseases, whether the students have ever attended a talk or elective courses, and knowledge and attitude toward genetic diseases and genetic testing.

With regards to the knowledge of genetic diseases and genetic testing among these clinical year medical students, we found that 43.7 % had good knowledge while 56.3% had poor knowledge. However, the majority of our students were aware of the investigation done to diagnose genetic diseases. According to research done among Indonesian medical students, it was found that the students had relatively good familiarity and literacy in genetics [34]. Similar to our finding, a cross-sectional study done in Cameroon suggested poor knowledge of genetic tests among physicians and medical students [32]. Moreover, a deficiency of knowledge regarding genetic diseases was also revealed among practitioners, gynaecologists, and paediatricians in the Netherlands. It has been proposed that physicians' confidence and awareness of genetic testing can be enhanced by providing additional health education regarding this topic [15]. Among medical students in Italy, it was reported to have a high level of awareness of genetic testing [14]. Furthermore, "a deficiency in knowledge of genetic diseases and genetic testing has been reported among the public, including populations in developed and developing nations" [7,11]. Previous studies regarding prenatal or neonatal genetic testing showed the need for further improvement in health education, facilities, and infrastructures to enhance the adaptation of non-invasive genetic testing among the public [12,13].

The participants in our study demonstrated poor attitude towards genetic testing as only 31.1% of the respondents reported having good attitude while 68.9% of the respondents having poor attitude towards genetic testing. This may be due to the majority of the respondents was belonged to junior batches among the clinical year medical students in our study. Similar studies done in Malaysia regarding genetic testing of cancer risk factors reported as moderate to low attitude amongst university undergraduate students. This study also reported that science-based educational background was more aware compared to those from art-based training [24]. These findings support to our study as our study participants consist of clinical year medical students. It can also be attributed to the fact that despite the respondents having an educational background in science, many have poor attitudes towards genetic testing. On contrary, there is high agreement among the respondents that approve of having a genetic test to assess the risk of having genetic disease. Moreover, a study in Italy showed that the majority of the medical students were interested in undergoing genetic tests [14]. However, a study done among medical students and newly qualified doctors revealed that most of them accept the fundamentals of genetic counselling and testing, prenatal diagnosis and they would discuss the diseases

with the family or at-risk individuals. However, the acceptance of termination of affected pregnancies varied on the genetic diseases [35].

In our study, family members suffering from genetic disease and awareness of genetic testing and counselling had shown to have significant association with medical students' knowledge towards genetic diseases and genetic testing. We found that the students who had family members suffering from genetic disease had lower knowledge than those who did not have. This may be due to the fact that most of the students who participated in our study were the most junior batches of the clinical year and they had only joined clinical years a few months ago. Other than that, the subjects that they had learnt about genetic diseases are in medicine and paediatrics postings. Therefore, they might not have the knowledge as the senior year students. Meanwhile, gender, ethnicity, academic year and students that have attended any elective courses/talks/conferences regarding genetic diseases have shown to have no significant association with medical students' knowledge towards genetic diseases and genetic testing. Previous study done in sub-Saharan Africa suggested an acceptable level of knowledge of clinical genetics amongst physicians and medical students although they had poor awareness of DNA diagnosis [32]. Moreover, "in Saudi Arabia, it was shown that having a family history of inherited diseases did not significantly alter the students' knowledge of genetic diseases and genetic testing. Along with that, gender, academic year, and prior awareness of genetic testing were significantly associated with knowledge among college students in Saudi Arabia" [33].

Regarding the association between demographic variables and attitude towards genetic diseases and genetic testing, we found that there was no factor which was shown to have significant association. According to a previous study, a majority of senior college students showed positive attitudes towards genetic testing, and the significant factors which were associated with that included gender, academic year, grade point average and prior awareness of genetic testing [33]. On the other hand, our study showed a significant positive association between knowledge and attitude towards genetic diseases and genetic testing. It was revealed that the students with higher knowledge had more positive attitudes towards genetic testing. On contrary, a study reported that a well-informed public may have a more critical attitude towards morally contentious or socially sensitive issues such as genetic engineering [36]. Although relatively high levels of genetics knowledge and overall positive attitudes towards genetics were observed, participants held more critical attitudes towards it [16].

Our study showed that knowledge and attitude among undergraduate medical students are not optimal but it can be improved on. Medical schools and their curriculum play a role in improving the knowledge and attitude about genetic diseases and genetic testing among undergraduate medical students. Greater emphasis is needed on courses related to genetic diseases and genetic testing. Medical schools should also include more talks and programs related to these topics. Lastly, we recommended that undergraduate medical students take the initiative to educate themselves on these topics by reading journals and articles. As government and non-government bodies play a bigger role in educating the public about genetic diseases and genetic testing, it has been recommended to conduct seminars and campaigns to bring awareness to the public about these topics. Genetic educational programs should be done to improve the public's knowledge and create a public perception that further supports genetic testing. Furthermore, it is essential of the government to ensure the safety and efficiency of genetic testing by implementing laws. Next, the media should also play a role by sharing knowledge about genetic diseases and advocating for the use of genetic testing. We recommended that future study shall explore about the acceptance, opinions and knowledge of genetic therapies in treating genetic diseases among medical students as well as among healthcare professionals.

We have encountered a few limitations in this study. Due to time limitations, we were not able to recruit many of senior year medical students. The response rate was low, especially from senior batch students as only 7.6% of the final year students (semester 10) and 19.4% of year-4 students (semester 8 & 9) participated. Besides, this study was a cross sectional study which only allowed us to collect responses at one point in time, hence we could not observe changes among our participants over a period of time. As our study was only conducted in one medical school, the findings cannot be generalized to other medical schools of different settings.

Table 1. Demographic characteristics among clinical year medical students (n = 119)

Variable	N (%)
Gender	
Male	46 (38.7%)
Female	73 (61.3%)
Ethnicity	
Malay	14 (11.8%)
Chinese	51 (42.9%)
Indian	50 (42.0%)
Others	4 (3.4%)
Academic year	
Semester 6	68 (57.1%)
Semester 7	19 (16.0%)
Semester 8	14 (11.8%)
Semester 9	9 (7.6%)
Semester 10	9 (7.6%)
Family member suffering from genetic disease	
Yes	34 (28.6%)
No, Don't know	85 (71.4%)
Attended any elective courses /talks / conferences regarding genetic diseases	
Yes	38 (31.9%)
No, Don't know	81 (68.1%)
Are you aware of genetic testing and counselling?	
Yes	87 (73.1%)
No, Don't know	32 (26.9%)

Table 2. Knowledge towards genetic diseases and genetic testing (n = 119)

No.	Questions	Correct response N (%)
1.	Consanguineous marriages increase the risk of having child with genetic disease	115 (96.6%)
2.	Genetic diseases can skip a generation	86 (72.3%)
3.	Healthy parents can have a child with a hereditary/genetic disease	106 (89.1%)
4.	If the ultrasound does not reveal any abnormality during pregnancy, the child is assumed healthy	55 (46.2%)
5.	In case of a family having a genetic disease, this will certainly imply that every member of the family would have the disease	60 (50.4%)
6.	Some of the hereditable disorders may not show their symptoms until later in adult life	96 (80.7%)
7.	The lifestyle of a person plays a role in developing some genetic diseases such as colon cancer	104 (87.4%)
8.	Which of the following are genetic diseases?	
	Sickle cell anemia	96 (80.7%)
	G6PD	88 (73.9%)
	Down syndrome	99 (83.2%)
	Hemophilia	102 (85.7%)
	Turner syndrome	93 (78.2%)
	Albinism	85 (71.4%)
	Thalassemia	106 (89.1%)
9.	Which of the following investigations can diagnose genetic diseases?	
	Ultrasound	72 (60.5%)
	Karyotyping	110 (92.4%)
	DNA analysis	101 (84.9%)

Table 3. Attitude towards genetic diseases and genetic testing among clinical year medical students (n = 119)

No.	Questions	N (%)		
		Agree	Disagree	Don't know
1.	Genetic testing will do more harm than good for society	44 (37.0%)	57(47.9%)	18 (15.1%)
2.	Genetic testing may lead to stigmatization of the person if diagnosed positive	59 (49.6%)	33(27.7%)	27 (22.7%)
3.	Genetic testing may lead to denial of marriage for a couple	75 (63.0%)	21(17.7%)	23 (19.3%)
4.	Genetic testing is not favorable because the results may lead to conflicts with insurance for people who have a genetic-related disease	62 (52.1%)	35(29.4%)	22 (18.5%)
5.	Parents have the right to get their children checked up for the risk of developing genetic diseases even if it is not necessary for the child's immediate health	89 (74.8%)	9 (7.6%)	21 (17.7%)
6.	A pregnant woman has the right to have her fetus screened for the risk of having a genetic disease that is common in the family	101(84.9%)	5 (4.2%)	13 (10.9%)
7.	The doctor has the right to share patient information for genetic tests with patient's relatives if it has important health consequences for the relatives	69 (58.0%)	25(21.0%)	25 (21.0%)
8.	Would you approve of having a genetic test to assess the risk of having a genetic disease	105(88.2%)	3 (2.5%)	11 (9.2%)
9.	If the fetus was diagnosed with a genetic disorder, would you like to consult your patient with the available treatment options	105(88.2%)	5 (4.2%)	9 (7.6%)
10.	If a test shows the baby has a serious genetic defects, would you like to discuss with your patient various options including abortion	91(76.5%)	5 (4.2%)	23 (19.3%)
11.	Upon approval, the medical staff has the right to use patients' results of genetic testing for research purposes	85(71.4%)	12(10.1%)	22 (18.5%)
12.	Would you accept termination of pregnancy if the pregnancy is affected by a serious malformation	100(84.0%)	4 (3.4%)	15 (12.6%)

Table 4. Level of knowledge and attitude towards genetic diseases and genetic testing among clinical year medical students (n = 119)

Variable	N (%)
Knowledge (0-100)	
Good	52 (43.7%)
Poor	67 (56.3%)
Mean (SD)	78.0 (15.7)
Minimum - Maximum	11.8 - 100.0
Attitude (0-12)	
Good	37 (31.1%)
Poor	82 (68.9%)
Mean (SD)	7.5 (2.5)
Minimum - Maximum	0.0 - 12.0

Table 5. Association between demographic variables and knowledge towards genetic diseases and genetic testing

Variable	Knowledge percentage score mean (SD)	Mean difference (95% CI)	P value
Gender			
Female	78.3 (14.0)	1.0 (-4.9,6.8)	0.747[a]
Male	77.4 (18.1)		
Ethnicity			
Malay	77.3 (14.6)	-	0.348[b]
Chinese	80.4 (13.3)		
Indian	75.2 (18.2)		
Others	83.8 (8.8)		
Academic year			
Semester 6	76.8 (16.2)	-	0.481[b]
Semester 7	75.5 (14.6)		
Semester 8	79.8 (13.4)		
Semester 9	85.6 (13.2)		
Semester 10	81.0 (19.0)		
Family member suffering from genetic disease			
Yes	72.5 (14.7)	-7.6 (-13.8, -1.5)	0.016[a]
No, Don't know	80.1 (15.6)		
Attended any elective courses /talks / conferences regarding genetic diseases			
Yes	78.0 (14.2)	0.1 (-6.0,6.2)	0.975[a]
No, Don't know	77.9 (16.4)		
Are you aware of genetic testing and counselling?			
Yes	80.9 (13.4)	11.1 (5.0, 17.2)	0.001[a]
No, Don't know	69.9 (18.5)		

95% CI = 95% confidence interval; [a] Independent T-test; [b] ANOVA

Table 6. Association between demographic variables and attitude towards genetic diseases and genetic testing

Variable	Attitude total score Mean (SD)	Mean difference (95% CI)	P value
Gender			
Female	7.7 (2.3)	0.6 (-0.3,1.6)	0.195[a]
Male	7.1 (2.9)		
Ethnicity			
Malay	8.1 (2.0)	-	0.172[b]
Chinese	7.8 (2.4)		
Indian	6.9 (2.8)		
Others	8.8 (1.0)		
Academic year			
Semester 6	7.4 (2.6)	-	0.844[b]
Semester 7	7.3 (2.4)		
Semester 8	7.4 (2.0)		
Semester 9	7.4 (3.3)		
Semester 10	8.4 (2.0)		
Family member suffering from genetic disease			
Yes	7.0 (1.7)	-0.7 (-1.7,0.3)	0.159[a]
No, Don't know	7.7 (2.8)		
Attended any elective courses /talks / conferences regarding genetic diseases			
Yes	7.2 (2.1)	-0.4 (-1.4,0.6)	0.415[a]
No, Don't know	7.6 (2.7)		
Are you aware of genetic testing and counselling?			
Yes	7.7 (2.2)	0.8 (-0.3, 1.8)	0.150[a]
No, Don't know	6.9 (3.2)		

95% CI = 95% confidence interval; [a] Independent T-test; [b] One-way ANOVA

Table 7. Simple linear regression analysis of association between knowledge and attitude towards genetic diseases and genetic testing

Variable	Attitude b (95% CI)	SE	R^2	P value
Knowledge	0.042 (0.013, 0.070)	0.014	0.068	0.004

b=regression coefficient; 95% CI = 95% confidence interval; SE= standard error; R^2=coefficient of determination

5. CONCLUSION

In conclusion, the majority of the respondents have limited knowledge and more critical attitude towards genetic diseases and genetic testing. Gender, ethnicity, academic year were not shown to have any significant association with knowledge and attitude towards genetic diseases and genetic testing. However, there was a significant positive association between knowledge and attitude towards genetic diseases and genetic testing. Medical schools and their curriculum play an important role in improving the knowledge and attitude about genetic diseases and genetic testing, and greater emphasis is needed on courses related to this topic.

CONSENT

An information sheet and written informed consent which included all the important and relevant details of this study were provided to the participants. We ensured that the participation was entirely voluntary. No incentives were given to the participants nor no one was forced to participate in this study. All the information provided by the participants in this study was kept confidential and only used for the study purpose. Participant anonymity and privacy were ensured.

ETHICAL APPROVAL

This study has been approved by the Research Ethics Committee, Faculty of Medicine, Manipal University College Malaysia (MUCM), Malaysia (MUCM/FOM/Research Ethics Committee – 26/ 2022).

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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