



Original Article

Comprehension of premarital screening and genetic disorders among the population of Riyadh



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المخلص

أهداف البحث: فحص ما قبل الزواج، للأسف، لم يشمل جميع الأمراض الوراثية المحتملة مثل أمراض القلب الخلقية والسكري وارتفاع ضغط الدم، بالإضافة إلى الطفرات الجينية الغير معروفة التي يمكن أن تسبب عيوباً خطيرة في الجيل القادم. ومع ذلك، هناك معرفة محدودة بين السعوديين حول فحص ما قبل الزواج ونوعية الأمراض التي يتم تحليلها. بناءً على ذلك، فإننا نهدف في هذه الدراسة إلى بحث معرفة وموقف سكان الرياض تجاه فحص ما قبل الزواج.

طرق البحث: تم إجراء دراسة مقطعية، قائمة على الملاحظة باستخدام استبانة مصممة للإجابة عليها ذاتياً. وقد شمل الاستطلاع أسئلة تتعلق بالبيانات الاجتماعية والديموغرافية، وعلم الوراثة، والاختبار الجيني، وفحص ما قبل الزواج. تم إدخال جميع البيانات وتحليلها من خلال الإصدار 22 من الحزمة الإحصائية.

النتائج: أجاب مجموعة 385 مشاركاً على الاستبانة، وكان مستوى المعرفة بشكل علم جيد لغالبية المشاركين باختلاف مستوى التعليم، والجنس. علاوة على ذلك كان الموقف والسلوك العام للمشاركين إيجابياً تجاه فحص ما قبل الزواج بشكل ملحوظ إلا أنه كان هناك فئة معينة من المشاركين اختلفت في سلوكها تجاه فحص ما قبل الزواج عن بقية المشاركين بسبب تدني وعدم توفر المعلومات اللازمة عن فحص ما قبل الزواج والأمراض الجينية.

الاستنتاجات: يجب تحسين معرفة وموقف سكان الرياض تجاه فحص ما قبل الزواج من خلال برامج التوعية الوطنية. في ضوء نتائجنا، هناك بالتأكيد حاجة

لمزيد من المعلومات والتعليم حول البرنامج. يجب إجراء مزيد من الدراسات في المناطق الحضرية والتحقيق في مستوى الرضا عن البرامج القائمة.

الكلمات المفتاحية: فحص ما قبل الزواج؛ استشارة وراثية؛ قرابة؛ السعودية

Abstract

Objective: Premarital, unfortunately, does not cover all possible genetic diseases, such as deafness and congenital heart diseases, diabetes mellitus, and hypertension, nor does it cover unknown genetic mutations that may cause severe defects in subsequent generations. However, the Saudi population has limited knowledge regarding premarital screening tests, which do not detect all genetic disorders or diseases. Hence, we aimed to explore the knowledge and attitudes among the population of Riyadh toward premarital screening.

Methods: A cross-sectional observational study was conducted with a self-administered designed questionnaire. The survey included questions regarding socio-demographic data, genetics, genetic testing, and premarital screening. All data were entered and analyzed in the statistical package SPSS version 22.

Results: A total of 385 participants responded to the questionnaire, and good knowledge among most participants was significantly associated with education level ($p < 0.001$), sex ($p < 0.001$), and prior screening ($p = 0.001$). The overall attitude was positive toward premarital screening, and significant associations of sex and social/marital status with a positive response to premarital screening were observed.

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Conclusion: Knowledge and attitudes among the population of Riyadh toward premarital screening must be improved through national awareness programs. In light of our results, a need exists to provide more information and education regarding screening. Further studies must be conducted in urban areas to investigate the level of satisfaction with existing programs.

Keywords: Consanguineous couples; Consanguinity; Genetic counseling; KSA; Premarital screening

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Introduction

Premarital counseling is a service offered to couples before marriage, with an aim to guide, educate, and prepare them for establishing a healthy family.¹ The KSA, where the consanguineous marriage rate is rising, has the highest consanguinity rates among Middle Eastern countries.² The percentage range varies among regions in KSA but typically ranges from 25% to 60%. Consanguineous marriage can be life-threatening, and can cause several medical and psychosocial marital problems among couples intending to marry.³ Under the Royal decree of March 2002, the Ministry of Health in KSA set organizational arrangements for the Saudi Premarital Screening Program (PMS), which started 2 years later under the second Royal decree and made premarital screening mandatory for all couples planning to marry. Marriage contracts are not issued until the results of screening tests are submitted. Thousands of couples have called off marriages after finding that they were genetically incompatible.⁴

In 2004, the PMS program started as a blood test for hereditary hemoglobinopathies. In particular, the PMS aimed to detect sickle cell anemia, and thalassemia. In 2008, it was updated to include chronic infectious diseases, hepatitis B and C viruses, and HIV.⁵ Although statistics have indicated that KSA has among the lowest prevalence rates of hepatitis and HIV, this update was essential to improving health education and clarifying unknown infection risks.⁶ Medical consultations are aimed at indicating the odds of transmitting such diseases to possible partners or offspring, and providing solutions and alternatives to help soon-to-be-married couples plan for healthy families.⁷ One misconception among couples is that premarital testing is sufficient to determine whether they will have children with genetic diseases; many people do not realize that they could be at high risk for the many diseases that are not tested for. In Arab countries and the Gulf region, the leading cause of infant and child death, morbidity, and disability is genetic diseases.⁸ Therefore, several screening programs have been implemented in the Gulf region and the Middle East to address this issue. One solution is premarital genetic screening programs, which have been highly effective in preventing genetic disorders and multifactorial health problems in the Gulf region and the Middle East. Genetic diseases greatly influence quality of life among affected

individuals; moreover, they pose a major burden on national healthcare costs and substantially contribute to the USD\$30 billion annual healthcare expenditures in the Kingdom.⁹ Saudi premarital screening unfortunately does not cover all possible genetic diseases, such as deafness and congenital heart diseases, diabetes mellitus, and hypertension. A study by Al-Kahtani et al. on a population in Riyadh has reported that 75.2% of participants accepted the idea of premarital screening, thus indicating a positive attitude toward healthcare among the Saudi populace, as long as confidentiality is ensured, the study also showed that 82%, results correlated with adult age, marital status, educational level, and comprehension of Islamic health related issues.¹⁰ A program to educate young people would be likely to shift the community's attitudes toward premarital screening. Ibrahim et al. have assessed the knowledge among young unmarried college women and concluded that such programs are successful, and should be appropriately implemented at secondary and higher education levels.¹¹ Therefore the aim of this study was to explore the knowledge and attitudes of the Saudi population toward premarital screening programs. The novel data from this study should help establish awareness campaigns that could be customized and designed according to each person's level, to eliminate consanguineous marriages and potentially encourage the Ministry of Health to modify the existing PMS to include more genetic diseases.

Materials and Methods

Study design and data collection

This was a cross-sectional observational study conducted in Riyadh, the capital of the KSA. The study was performed during April 2019 to August 2020. The inclusion criteria were adults of both sexes 16 years of age or above in the general population, because this age range is considered acceptable for marriage. Participants were recruited from universities, public venues, and primary healthcare centers in Riyadh city. Those who did not meet the inclusion criteria were excluded. The data were collected by a trained data collector via a self-administered, validated, and structured questionnaire designed in the Arabic language. The questionnaire consisted of multiple-choice questions to determine participants' knowledge, attitudes, and perceptions. The questionnaire was developed on the basis of perceived misconceptions regarding such screening programs reported in the literature. The questions included information on sociodemographic data, knowledge of premarital screening programs, country-prevalent hereditary diseases, and information on the Saudi Genome project. Research coordinators distributed the questionnaire to randomly selected individuals from the five regions of Riyadh (North, West, South, East, and Central).

Questionnaire validation

A pilot study was conducted during designing of the questionnaire, which was then validated. The content validity of the questionnaire was assessed and reviewed independently by four expert consultants in the field of medical genetics. The pilot testing was implemented after corrections

Table 1: Sociodemographic characteristics of the participants.

Sociodemographic character	Frequency	Percentage
Age (mean ± SD)	(26.8 ± 8.1)	
Sex		
Male	102	15.6%
Female	550	84.4%
Marital status		
Single	413	63.3%
Married	26	4.0%
Engaged	213	32.7%
Highest educational level		
Primary school	1	0.2%
Intermediate school	2	0.3%
High school	117	17.9%
Diploma	9	1.4%
University	504	77.3%
Postgraduate	19	2.9%
Have you ever heard about premarital screening?		
Yes	648	99.4%
No	4	0.6%
Did you perform premarital screening?		
Yes	189	29.0%
No	463	71.0%

Table 2: Indicators of participants' knowledge of pre-marital genetic screening.

Factor	Knowledge score		p-value
	Poor n	Good n	
Age (mean ± SD)	(26.7 ± 8.09)		
Sex			
Male	63	11	0.038
Female	487	91	
Marital status			
Single	375	38	0.075
Married	22	4	
Engaged	181	32	
Education			
Primary school	0	1	0.001
Intermediate school	2	0	
High school	108	9	
Diploma	8	1	
University	448	56	
Postgraduate	12	7	
Have you ever heard about premarital screening?			
Yes	574	74	0.473
No	4	0	

were made and the experts had approved. The reliability of the present questionnaires was also assessed with the internal consistency method with Cronbach's alpha coefficient. A total of 30 factors were deemed suitable for this study; for the null hypothesis, $C_{A0} = 0.702$ (adjusted Cronbach alpha derived for the pilot sample), and for the alternative hypothesis, $C_{A1} = 0.80$ (at least a 10% increase in the interim correlation was expected in the final outcome).

Sample size calculation

The cross-sectional survey regarding the Saudi PMS and genetic disorders was collected from April 2020 to August 2021. The sample size was calculated in Rao soft® sample size software for prevalence studies by considering the total population of approximately 50,000 non-medical

Table 3: Multivariate logistic regression analysis of factors significantly associated with knowledge of premarital screening.

	B	95% confidence interval		p-value
Sex	0.07	0.543	2.109	0.83
Primary school	-19.296	4.167	4.167	.
Intermediate school	14.709	0.000	0.000	0.992
High school	1.946	2.208	22.192	0.001
Diploma	1.540	0.478	45.546	0.185
University	1.540	1.764	12.343	0.002
Postgraduate	0.00	.	.	.

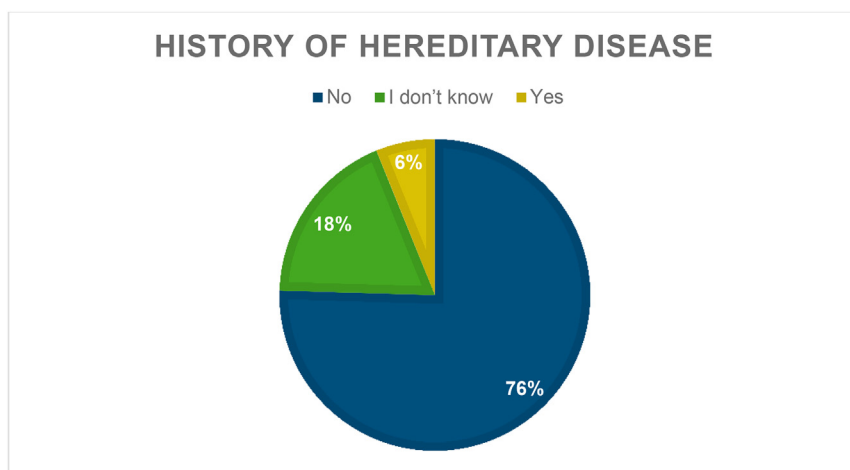


Figure 1: History of hereditary disease in the Riyadh population.

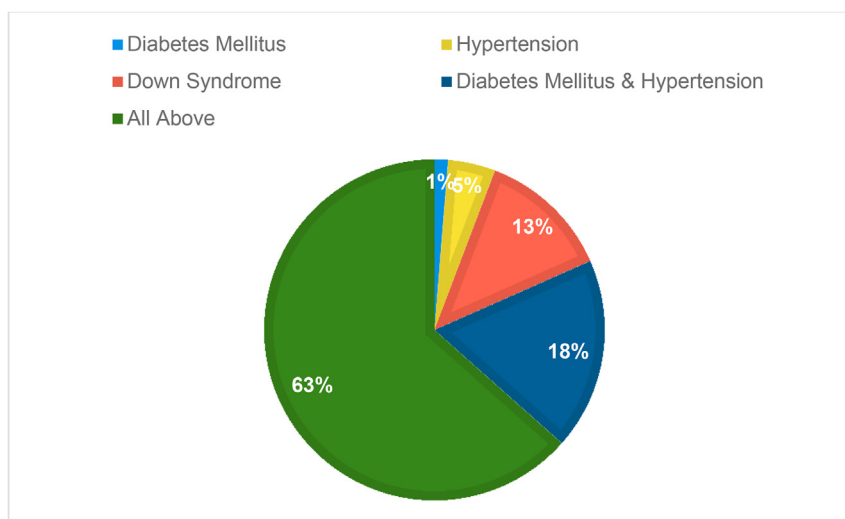


Figure 2: Knowledge of the Riyadh population regarding diseases in premarital screening.

professionals, including IT professionals, researchers, academicians, educators, etc. These non-medical professionals might have different knowledge, attitudes, opinions, and constraints regarding premarital screening and its application compared with medical professionals with medical knowledge and background about PMS, followed by 95% C.I. and 5% margin of error. To overcome intra-cluster variance among groups, the respective sample size was multiplied by a minimum design effect of 1.5. Hence, the total sample size was 652 for assessing premarital screening.

Statistical analysis

All categorical variables (sex, marital status, educational level, etc.) are presented as numbers and percentages. The continuous variable of age is expressed as mean \pm S.D. The chi-square test was applied according to whether the expected frequency was smaller than 5, and was used to evaluate significant associations among categorical variables. A P-value less than 0.05 was considered statistically significant. All data were entered and analyzed in the statistical package SPSS version 22.

Results

Sample characteristics

A total of 652 Saudi men and women from Riyadh responded to this survey; the age range of the participants was 16–60 years, and 84.4% were women. Analysis according to socio-demographic characteristics of the participants was performed (Table 1). A total of 98.8% of the participants were aware of premarital screening; however, because most of our sample comprised singles, only 25.8% had actually performed the screening, and 1.2% had not known or heard about premarital screening. The majority of responders did not have a personal history of hereditary disease, whereas 6.1% had a history of hereditary disease, and 18.4% did not know whether they were carriers of genetic mutations associated with a disease (Figure 1).

Table 4: Responses to knowledge questions.

Questions	Frequency	Percentage
Why is premarital screening performed?		
Routine procedure in KSA	20	3.1
To reduce hereditary and infectious diseases	629	96.5
All of the above	3	0.5
Did you know the importance of premarital screening?		
Yes	620	95.1
No	32	4.9
What is the source of information you have about premarital screening?		
Internet	37	5.7
Family	110	16.9
Friends	58	8.9
Books	447	68.6
Select where premarital screening is done.		
Government hospitals	530	81.3
Private hospitals	42	6.4
I do not know	80	12.3
Do you think premarital screening involves the detection of all genetic diseases?		
Yes	297	45.6
No	355	54.4
If your answer was no, what diseases are not included in premarital screening? (More than one answer can be selected)		
Diabetes mellitus	49	10.5
Hypertension	63	13.5
Down syndrome	59	9.0
All of the above	297	45.6
Do you know the complications of the diseases involved in premarital screening?		
Yes	448	68.7
No	204	31.3
If you answered yes, choose the complication.		
Transmission of infectious diseases	317	31.2
Transmission of genetic diseases	376	37.01
Social effects	153	15.1
Psychological effects	170	16.7
Have you heard of the Saudi Genome project?		

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Table 4 (continued)

Questions	Frequency	Percentage
Yes	115	17.6
No	506	77.6
Maybe	31	4.8
Do you realize the importance of deciphering the genetic code among Saudi people?		
Yes	272	41.7
No	285	43.7
Maybe	95	14.6
If your answer was yes, how important is the decoding of Saudi society?		
Detection of infectious diseases	21	3.2
Detection of genetic disorders and diseases	119	18.3
All of the above	229	35.1

Knowledge of premarital screening and deciphering the genetic code

In this study, 99.4% of participants had known about premarital screening, and 95.1% knew that screening is important and is mandatory by the government. The top three main sources of information on premarital screening for most (68.6%) participants included (books/educational publications, family and friends, and internet/social media). Statistically significant differences in participants’ knowledge were observed according to sex and education level. Female participants had significantly better and knowledge than male participants in the population of Riyadh. Moreover, approximately 12.5% of those with good knowledge had higher education levels (university/postgraduate). **Table 2** shows indicators of participants’ knowledge of pre-marital

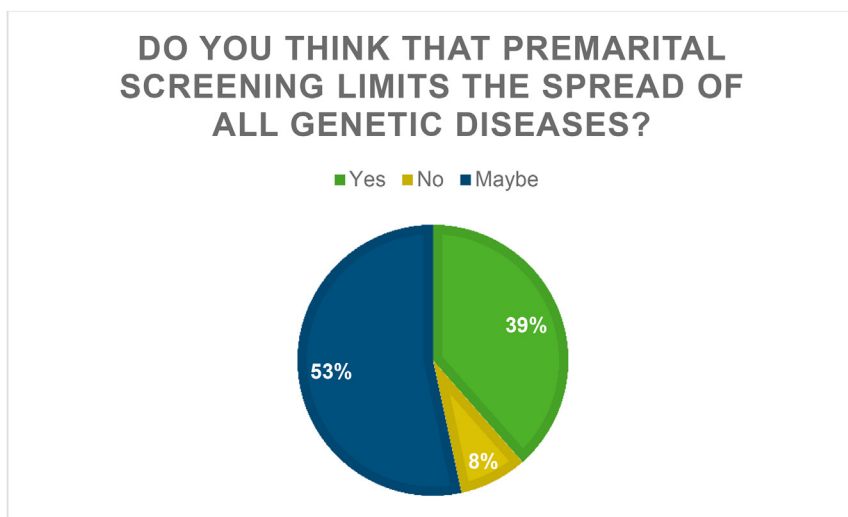


Figure 3: Respondents’ understanding of premarital screening and genetic diseases.

Table 5: Attitudes among participants regarding the importance of premarital screening and genetic diseases.

Data	Participants (n = 652) [n (%)]		
	Agree	Neutral	Disagree
Do you think premarital screening is a preventive measure?	628 (96.32%)	13 (1.99%)	11 (1.69%)
Should a positive screening result prevent couples from marriage, as enforced by legal measures?	403 (61.81%)	170 (26.07%)	78 (11.96%)
If a positive screening indicated that both you and your partner were carriers of a known hereditary disease, would you proceed with the marriage?	38 (5.83%)	164 (25.15%)	448 (68.712%)
If a positive screening indicated that you had carrier status and your partner was affected by the same hereditary disease, would you proceed with marriage?	28 (4.29%)	153 (23.47%)	471 (72.24%)
If premarital screening indicated that you had a hereditary disease and your partner was affected, would you get married?	32 (4.91%)	116 (17.79%)	504 (77.30%)
Do you think that the decision to marry in cases of incompatibility between spouses is wrong?	349 (53.53%)	123 (18.87%)	180 (27.61%)
If premarital screening indicated that you had a hereditary disease and your partner was affected, do you expect alternative solutions for unaffected children?	168 (25.77%)	309 (47.39%)	175 (26.84%)
In your view, should a positive screening prevent couples from marriage?	578 (88.65%)	43 (6.60%)	31 (4.75%)

Table 6: Factors affecting participants' attitudes regarding the importance of premarital screening and genetic diseases.

A: Sex				
<i>Do you think premarital screening is a preventive measure?</i>	Male	Female		<i>p</i> -value
<i>Negative</i>	2	9		0.31
<i>Positive</i>	96	532		
<i>Neutral</i>	4	9		
<i>Should a positive screening result prevent couples from marriage, as enforced by legal measures?</i>				
<i>Negative</i>	18	60		0.15
<i>Positive</i>	58	345		
<i>Neutral</i>	26	145		
<i>If a positive screening indicated that both you and your partner were carriers of a known hereditary disease, would you proceed with the marriage?</i>				
<i>Negative</i>	5	33		0.07
<i>Positive</i>	62	388		
<i>Neutral</i>	35	129		
<i>If a positive screening indicated that you had carrier status and your partner was affected by the same hereditary disease, would you proceed with marriage?</i>				
<i>Negative</i>	6	22		0.004
<i>Positive</i>	60	411		
<i>Neutral</i>	36	117		
<i>If premarital screening indicated that you had a hereditary disease and your partner was affected, would you get married?</i>				
<i>Negative</i>	6	26		0.033
<i>Positive</i>	69	435		
<i>Neutral</i>	27	89		
<i>Do you think that the decision to marry in cases of incompatibility between spouses is wrong?</i>				
<i>Negative</i>	29	143		0.644
<i>Positive</i>	29	142		
<i>Neutral</i>	44	265		
<i>If premarital screening indicated that you had a hereditary disease and your partner was affected, do you expect alternative solutions for unaffected children?</i>				
<i>Negative</i>	3	20		0.302
<i>Positive</i>	95	521		
<i>Neutral</i>	4	9		
<i>In your view, should a positive screening prevent couples from marriage?</i>				
<i>Negative</i>	9	22		0.059
<i>Positive</i>	84	494		
<i>Neutral</i>	9	34		
B: Social status				
<i>Do you think premarital screening is a preventive measure?</i>	Single	Married	Engaged	<i>p</i> -value
<i>Negative</i>	7	0	4	0.880
<i>Positive</i>	398	26	204	
<i>Neutral</i>	8	0	5	
<i>Should a positive screening result prevent couples from marriage, as enforced by legal measures?</i>				
<i>Negative</i>	58	4	16	0.144
<i>Positive</i>	247	14	142	
<i>Neutral</i>	108	8	55	
<i>If a positive screening indicated that both you and your partner were carriers of a known hereditary disease, would you proceed with the marriage?</i>				
<i>Negative</i>	30	5	3	0.005
<i>Positive</i>	271	18	161	
<i>Neutral</i>	112	3	49	
<i>If a positive screening indicated that you had carrier status and your partner was affected by the same hereditary disease, would you proceed with marriage?</i>				
<i>Negative</i>	26	3	3	0.022
<i>Positive</i>	311	21	172	
<i>Neutral</i>	76	2	38	

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Table 6 (continued)

B: Social status				
<i>Do you think premarital screening is a preventive measure?</i>	Single	Married	Engaged	<i>p</i> -value
<i>If premarital screening indicated that you had a hereditary disease and your partner was affected, would you get married?</i>				0.087
Negative	20	3	5	
Positive	290	20	161	
Neutral	103	3	47	
<i>Do you think that the decision to marry in cases of incompatibility between spouses is wrong?</i>				0.448
Negative	212	17	120	
Positive	119	4	57	
Neutral	82	5	36	
<i>If premarital screening indicated that you had a hereditary disease and your partner was affected, do you expect alternative solutions for unaffected children?</i>				0.498
Negative	104	6	62	
Positive	110	10	51	
Neutral	199	10	100	
<i>Do you think premarital screening limits the spread of certain genetic diseases?</i>				0.775
Negative	16	1	6	
Positive	387	25	204	
Neutral	10	0	3	
<i>In your view, should a positive screening prevent couples from marriage?</i>				0.008
Negative	27	0	4	
Positive	352	25	201	
Neutral	34	1	8	

screening and deciphering the genetic code. Moreover, multinomial logistic regression was performed to predict a nominal dependent variable given one or more independent variables, as an extension of binomial logistic regression to allow for a dependent variable with more than two categories (Table 3). Overall, the score for the knowledge section was moderate in the population of Riyadh. To assess their knowledge, we asked the participants whether detection of genetic diseases is included in the premarital screening testing. Almost half (54.4%) the participants reported no. Figure 2 shows the participants' responses regarding what diseases are not included in premarital screening. Only 17.6% of the population of Riyadh were aware of the Saudi Genome project, and 41.7% saw the importance of deciphering the genetic codes of Saudi people. Nearly half (32.2%) understood that decoding of the Saudi society genetic code will help in the detection of genetic disorders and diseases (Table 4).

Attitudes toward premarital screening and expected outcomes

The measurement of the studied sample's attitudes toward premarital screening revealed that almost half (39%) the participants believed that premarital screening limits the spread of genetic diseases, whereas 53% did not know whether premarital screening could help limit genetic diseases (Figure 3).

Table 5 indicates that most participants (96.32%) strongly believed that premarital screening was considered a preventive measure, and 61.81% believed that premarital screening should be legally enforced by the authorities. Unexpectedly, most participants indicated that they would not proceed

with marriage if one or both members of the couple were found to carry or to be affected by a hereditary disease. In addition, 88.6% of the sample strongly agreed that preventing couples from marriage in the event of positive screening is important; however, 47.3% were uncertain regarding the possibility of having unaffected children from parents with hereditary disease.

We observed statistically significant differences according to sex and social/marital status in participants' attitudes regarding proceeding with marriage if the partner were a carrier, and whether a positive screening result should prevent couples from marriage (Table 6). Although no significant differences were observed for the other questions, the differences in participants' attitudes were near the significance level.

Discussion

Detection of hereditary or genetic disease carriers to control disease prevalence is among the most effective prevention strategies, particularly in countries with a high prevalence of consanguineous marriages. KSA's consanguinity rate exceeds 50%, and the prevalence of first-degree relative marriages is high.¹² Premarital screening usually targets unmarried adults, because their attitudes and perception will affect their lives, particularly in their choice of a partner, thereby affecting the quality of their marriage and the health of future generations.^{13,14} The purpose of this quantitative study was to evaluate levels of knowledge and attitudes regarding the existing premarital screening program and the importance of genetic testing in the PMS program among the population of Riyadh.

The PMS program was initiated in 2004 in KSA, aiming to screen individuals intending to marry for common genetic

diseases such as sickle cell disease, thalassemia, HIV, and hepatitis B and C.¹⁵ In our study only 25.8% of respondents had undergone screening, because most of our sample comprised singles. Our participants had some knowledge regarding the basics of genetic testing, and 54.4% of the participants knew that the PMS program does not screen for all genetic diseases; however, almost half the participants believed that PMS covers all genetic diseases, a finding whose importance cannot be underestimated. Furthermore, the respondents' knowledge of what diseases are included in the PMS was poor, thus suggesting that the participants had limited information on genetic diseases. The data were similar to those from studies in Qatar and Oman, where knowledge deficiencies have been observed regardless of understanding of the importance of PMC.^{16,17} Our results are consistent with those from many previous studies conducted in specific populations in KSA. For instance, one study has reported that unmarried female university students had inadequate knowledge: less than one-third of participants knew which disorders are tested for.^{18,19} Similar findings have been reported in Jeddah: participants from governmental outpatient clinics have been found to have low knowledge of premarital screening.²⁰ Similarly, in a study by Al-Shroby et al. among participants randomly selected from all 20 health regions in KSA, only 9.2% had satisfactory knowledge of premarital screening, and related screened genetic and infectious diseases.²¹ These results indicate the need for structured educational programs and awareness campaigns for the community, because the gap in knowledge among participants did not decrease and remained at unsatisfactory level. This lack of knowledge can be resolved through proper genetic counseling campaigns in schools, universities, and public places, particularly if participation is free of charge, according to Ibrahim et al.¹⁸

The present study indicated that respondents had positive attitudes regarding premarital screening tests, and the findings were largely favorable: most respondents indicated that they would not proceed with marriage if they were found to carry or to be affected by a hereditary disease. Moreover, the majority agreed that deciding to marry if the PMS results were incompatible would be wrong. These results are similar to those previously reported in the Saudi population.^{22–26} The findings from this study also indicated that a high number of participants agreed with the idea of a compulsory premarital screening test before marriage and were in favor of laws prohibiting marriages in the event of positive results. However, a small percentage of participants had insufficient attitude toward PMS, yet this small percentage is negligible with respect to that reported in a study by Alhamdan et al. in 2007, in which approximately 90% of high-risk couples still opted to marry despite being aware of the risk of having offspring with a genetic disease.²⁷ Establishing a law preventing marriage among people who have received incompatible results and conducting good educational awareness campaigns could significantly decrease this number. Additionally, we observed a significant association between positive attitudes regarding premarital screening tests and both female sex and social status, given that the percentage of women outnumbered that of men. Most respondents were willing to change their marriage decisions in the event of incompatibility, a finding in line with those

from other studies in the literature.^{19,22} Notably, another program called the National Newborn Screening Program aims to screen newborns across the Kingdom to achieve early detection of hereditary diseases that would cause serious health complications.^{28,29} However, having a compulsory preventive program that screens for genetic and hereditary diseases in individuals who intend to marry is essential to decrease the transmission of these diseases, particularly in cultures with a high rate of consanguineous marriages, which increase the frequency of congenital diseases affecting the population.

Conclusion

Overall knowledge regarding premarital screening tests must be improved. On the basis of the study results, participants had positive attitudes toward premarital screening and understood its importance. The study data may aid in developing educational programs designed to enhance awareness of, and positive inclinations toward, premarital screening tests. These results could be changed by raising awareness through educational programs in the media, which should be a powerful tool to achieve this goal. The limitation of this study is its sex bias, because most of our sample comprised women. Further studies that cover the whole kingdom will be crucial to understanding the knowledge and attitudes of people who are far from urban cities and to potentially target couples with consanguineous marriages.

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Conflict of interest

The authors have no conflict of interest to declare.

Ethical approval

Ethical approval was obtained from the Institutional Review Board at King Fahad Medical City, Riyadh, KSA, before collection of the data (IRB # 19-182, 2019). The questionnaire was distributed and completed electronically; replying was optional, and confidentiality was assured.

Consent

Informed consent was obtained from all participants before participation in this study, and no names or IDs were collected from the participants.

Authors contributions

E.K., R.S., A.A., and A.M. worked on the conceptualization of the study and data curation. Formal analysis was performed by A. AlQhtani and S.A. The original draft was written by R.S. and S.A. Final review and editing were

performed by S.A. All authors have critically reviewed and approved the final draft and are responsible for the content and similarity index of the manuscript.

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