Case Study

Knowledge and Attitude Levels Regarding Sickle Cell Disease and Premarital Screening among the Saudi Population

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Abstract

Sickle cell disease (SCD) is recognized as a hereditary hemoglobinopathy that is more prevalent due to consanguinity. Assessing knowledge and attitudes toward SCD and premarital screening is crucial to reducing its incidence in Saudi Arabia. The primary objective of this study is to assess the level of awareness and attitudes among the Saudi population regarding sickle cell disease (SCD) and premarital screening. This cross-sectional study among Saudi population, aged between 18 and 60 years old. The questionnaire included demographic features, knowledge statements, and attitude statements. Scores were categorized as high, medium, or low for knowledge and positive, neutral, or negative for attitude. The data was entered using the "Microsoft Office Excel Software" program and then transmitted to the SPSS application, version 20. The study included 789 participants, the majority of participants fall within the 20-30 age range, accounting for 28% of the total. 54.4% of the participants are female, while 45.6% are male. Only 10% of participants had good knowledge scores regarding sickle cell disease and premarital screening, 74.9% had moderate knowledge scores, and 15.1% had poor knowledge scores. As for attitude, only 34.7% of participants had positive attitude scores regarding sickle cell disease and premarital screening. In conclusion, participants show inadequate knowledge and negative attitudes towards sickle cell disease compared to previous figures in Saudi Arabia and worldwide. Addressing the knowledge and attitude levels regarding sickle cell disease and premarital screening in Saudi Arabia is crucial for improving the health and well-being of the population.

Keywords: Sickle cell disease, Premarital screening, Knowledge, Attitude, Saudi population

Introduction

Millions worldwide suffer from several genetic blood abnormalities known as sickle cell disease (SCD) [1]. It is one of the most notable single-gene illnesses in humans. It is an autosomal recessive disorder defined by the development of defective hemoglobin S (HbS). The disease is characterized by unpredictable, recurrent, and episodic episodes of acute pain that can influence the patient's quality of life [2]. Valine, an amino acid, replaces Glutamate at amino acid 6 of the beta-globin chain, resulting in a mutation in the DNA codon that results in the formation of HbS [3]. By 2050, there was a 30% increase in children born with SCD worldwide [4]. The prevalence of inherited hemoglobinopathies in Saudi Arabia is a matter of interest due to their classification as endemic diseases. This can be attributed to a combination of cultural and biological factors [5].

In 2010, it was estimated that 5,788,000 neonates, comprising 5,476,000 heterozygous individuals and 312,000 homozygous individuals, were affected by HbS [6]. The majority of those originated from India, Saudi Arabia, the Mediterranean, and sub-Saharan Africa [7]. 1.4% of Saudi Arabia's population had SCD, and 2%-27% were sickle cell trait carriers. The most elevated rates of the carrier, 17%–21%, and SCD, 1.2%–2.6%, are seen in Eastern Providence [8].

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The results of 120 questionnaires distributed to male secondary school students in Jazan, Saudi Arabia, in 2019 showed that the mean knowledge score at the beginning was 6.04 (SD 3.02). Following the health education program, the score rose to 10.73 (SD 3.47). It was statistically significant that the mean difference (4.70) had occurred (95% CI: 4.086, 5.307). The difference between students' responses to the attitude statements at baseline and after the intervention (support consanguinity, support pre-marriage screening, proceed with risky marriage, and support banning risky marriage by law) was not statistically significant ($p > 0.05$), according to the attitude statement responses from students [9].

A research paper was conducted in 2021 among Saudi adults in the Eastern Region of Saudi Arabia, examining their knowledge and attitudes concerning premarital screening for Thalassemia and Sickle Cell Disease (SCD). The results have shown that Premarital screening was deemed imperative by most participants 645 (95.6%), while 651 (96.4%) people consented to go through premarital screening. Nearly 50% of the participants consented to take PMS to protect their spouse, and an additional 22.2% agreed to take PMS to stop the spread of genetic disorders. Approximately 50% of the individuals involved in an engagement would consider ending it if there was a possibility that they could have offspring with potential health concerns. On the other hand, 21% would decide based on the likelihood of having an affected child, and 14.2% would proceed with marriage [10]. In 2022, research done in Makka, Saudi Arabia, showed that About 51.1% of people reported having an acceptable understanding of PMS, whereas 48.9% had insufficient knowledge. 57.4% of participants in the 36-44 age group had high levels of knowledge, compared to 35.4% of individuals in the 18-25 age group, with a statistically significant difference ($p = 0.018$). Additionally, compared to individuals with only secondary education, 53.9% of participants with a university degree reported strong knowledge and awareness of PMS ($p = 0.049$). As opposed to 40.4% of the single group, over 55.2% of married individuals had an excellent understanding of PMS ($p = 0.049$) [11].

In the Kingdom of Saudi Arabia (KSA), a significant portion of the hereditary defects that cause a major burden are hemoglobinopathies. The prevalence of consanguineous marriage is notably high in the KSA [12]. Therefore, the awareness of the population of KSA towards the PMC and SCD needs to be assessed to identify ways to reduce the prevalence of SCD in the KSA. This research will contribute to the current, yet limited, studies on PMC and SCD in the KSA. To assess knowledge and attitude levels regarding sickle cell disease and premarital counseling among the population of Saudi Arabia.

Materials and Methods

Study Design

A cross-sectional study was conducted from August to December 2023 among the Saudi Arabian population.

Study Setting: Participants, Recruitment, and Sampling Procedure

The study's participants are Saudi citizens whose ages range from 18 to 60 from both genders.

Inclusion and Exclusion Criteria

Saudi males and females who are older than 18 and younger than 60 from all social classes were included; Saudi males and females who are younger than 18 and older than 60 were excluded. We also decided to exclude individuals who are actively engaged in the medical profession or currently pursuing medical studies from this group or context.

Sample Size

To achieve precise results, a sample size of at least 384 individuals was determined using a sample size calculator (Raosoft, Inc., Seattle, WA, USA) software. This estimation was based on a 95% confidence interval and a maximum permissible marginal error of 0.05.

Method for Data Collection and Instrument (Data Collection Technique and Tools)

For this study, a structured questionnaire was utilized as the study tool. This tool was developed based on relevant studies conducted in Saudi Arabia. The participants were required to answer the questions through a self-administered online survey. Data collectors were recruited, and the individuals will undergo standardized training to gather the necessary data for the research. The questionnaire included 25 questions and was divided into three sections. The first section included demographic features such as age, gender, nationality, marital status, and level of education. In the second section, the participants were asked about their knowledge of sickle cell disease. In the third section, they were asked about their attitude regarding premarital tests for sickle cell disease.

Scoring System

This study was performed to assess individuals' knowledge and attitudes regarding premarital counseling and sickle cell disease. The knowledge score was determined based on thirteen statements, with one point awarded for correct answers and zero points for incorrect responses. The scoring system was categorized as follows: a score of ≥ 9 indicated a high level of knowledge, a score of 5-8 indicated a medium level, and a score of ≤ 4 indicated a low knowledge level. The attitude score was determined based on four statements and assessed using a dichotomous Likert scale with options of yes, no, and I don't know. A positive attitude was defined as a score of ≥ 3, a neutral attitude was defined as a score of 1-2, and a negative attitude was defined as a score of < 1.

Analyzes and Entry Method

The computer's "Microsoft Office Excel Software" (2016) program was used to enter the data. Then, the data was

transmitted to the SPSS application, version 20 (IBM SPSS Statistics for Windows, Version 20.0; Armonk, NY: IBM Corp.), where it was statistically analyzed.

Results and Discussion

As shown in **Table 1**, in terms of age, the majority of participants fall within the 20-30 age range, accounting for 28% of the total. This is followed by the 41-50 age group at 26.1% and the 31-40 age group at 17.4%. Moving on to gender distribution, the data shows that 54.4% of the participants are female, while 45.6% are male. In regards to nationality, the overwhelming majority of participants (97.7%) are Saudi, with only 2.3% being non-Saudi. When it comes to location, the Eastern Province has the highest representation at 57.4%, followed by Tabuk at 14.1% and Makkah at 10.6%. In terms of education level, the data shows that the majority of participants hold a Bachelor's degree, accounting for 53.1% of the total. This is followed by individuals with secondary education at 22.6% and those with a diploma at 15.2%. It is also worth noting that there are participants with higher education qualifications such as Master's degrees (4.8%) and Ph.Ds. (1.0%). Finally, the data reveals that the majority of participants are married (66.2%), followed by single individuals at 29.4%. Divorced and widowed individuals make up smaller percentages at 2.2% and 2.3% respectively.

Table 1. Sociodemographic characteristics of participants (n=789)

Parameter		No.	Percent
Age	less than 20	71	9.0
	20_30	221	28.0
	31_40	137	17.4
	41_50	206	26.1
	51_60	140	17.7
	more than 60	14	1.8
Gender	Male	360	45.6
	Female	429	54.4
Nationality	Saudi	771	97.7
	Non-Saudi	18	2.3
Location	Hasa	65	8.2
	Al-Baha	1	.1
	Northern borders	1	.1
	Riyadh	45	5.7
	Al-Qassim	8	1.0
	AL Madinah AL Munawwarah	15	1.9
	Eastern Province	453	57.4
	Tabuk	111	14.1
	Jazan	3	.4
	Hail	1	.1
	difficult	2	.3
	Makkah	84	10.6
Education Level	primary	5	.6
	middle	21	2.7
	secondary	178	22.6
	diploma	120	15.2
	Bachelor's	419	53.1
	Master's	38	4.8
	Ph.D	8	1.0
Marital Status	Married	522	66.2
	Single	232	29.4
	Divorced	17	2.2
	Widowed	18	2.3

As illustrated in **Table 2**, only 89.9% of the respondents think that genetics is related to sickle cell anemia, while 7.4% are unsure. 22.1% of the respondents think that a pregnant woman with sickle cell anemia has symptoms, while 11.3% are unsure. Additionally, 38.4% of the respondents believe that children of couples with one healthy partner and one pregnant woman are at risk of contracting the disease, with 13.7% being unsure. 76.0% of the respondents think that a carrier of the disease should abstain from marriage to prevent the birth of infected children, while 11.4% are unsure. Similarly, 64.1% of the respondents believe that blood transfusion treats the disease completely, with 29.3% being unsure.

Table 2. Knowledge of participants of sickle cell disease and premarital screening (n=789)

Parameter	Yes	No	Don't know
Think genetics is related to sickle cell anemia	709 89.9%	22 2.8%	58 7.4%
Think that a pregnant woman with sickle cell anemia has symptoms	526 66.7%	174 22.1%	89 11.3%
Think that children of spouses infected with the disease are at risk of infection	703 89.1%	23 2.9%	63 8.0%
Think that children of carriers of the disease are more likely to be infected	610 77.3%	86 10.9%	93 11.8%
Think that children of couples with one healthy partner and one pregnant woman are at risk of contracting the disease	378 47.9%	303 38.4%	108 13.7%
Think that a carrier of the disease should abstain from marriage to prevent the birth of infected children	99 12.5%	600 76.0%	90 11.4%

Think that someone infected with the disease should abstain from marriage to prevent the birth of infected children	114 14.4%	575 72.9%	100 12.7%
Think that blood transfusion treats the disease completely	52 6.6%	506 64.1%	231 29.3%
Think that there is currently a comprehensive treatment for the disease	140 17.7%	399 50.6%	250 31.7%
Think that a carrier of the disease may become infected?	228 28.9%	372 47.1%	189 24.0%

According to **Table 3**, 77.6% of respondents identified heredity as the cause of sickle cell anemia, while only a small percentage attributed it to factors such as malnutrition, bacterial or viral infections, or mineral deficiencies. The symptoms of sickle cell anemia can vary, but the majority of respondents reported experiencing fatigue and exhaustion (75.2%) and chronic pain attacks (75.8%). Other common symptoms included pale skin (61.2%), headache (37.0%), frequent infections (25.2%), vomiting (10.0%), diarrhea (6.2%), and vision problems (16.5%). When it comes to diagnosing sickle cell anemia, the most common test mentioned by respondents was a blood test, with 86.6% indicating it as a diagnostic tool. The survey also revealed that the majority of respondents (95.9%) believe in the necessity of undergoing a pre-marriage examination. If both parties conduct a genetic test and the result indicates a high risk of their children being infected with sickle cell anemia, the majority of respondents (56.7%) indicated that they would consult a doctor. Interestingly, the survey also showed that a significant portion of respondents (72.6%) do not support consanguineous marriage, which involves marrying a close relative. Finally, when asked if they would propose in the event of a positive premarital test result indicating a possibility of their children contracting the disease, the majority of respondents (79.7%) indicated that they would not propose.

Table 3. Attitude of participants towards sickle cell disease and premarital screening (n=789)

Parameter		No.	Percent
Cause of sickle cell anemia	Hereditary	612	77.6
	Malnutrition	45	5.7
	Bacterial infection	3	.4
	Viral infection	9	1.1
	Mineral deficiency	37	4.7
	I don't know	83	10.5
Symptoms of sickle cell anemia	Pale skin	483	61.2
	Fatigue and exhaustion	593	75.2
	Headache	292	37.0
	Chronic pain attacks	598	75.8
	Frequent infections	199	25.2
	vomiting (vomiting)	79	10.0
	Diarrhea	49	6.2
	Vision problems	130	16.5
Tests to diagnose sickle cell anemia	Ultrasound	8	1.0
	Urine and stool examination	13	1.6
	blood test	683	86.6
	I don't know	85	10.8
It is necessary to undergo a pre-marriage examination	Yes	757	95.9
	no	16	2.0
	I don't know	16	2.0
If both parties conduct a genetic test and the result is that the children may be infected with the disease, what should they do?	Consult a doctor	447	56.7
	Completing their marriage	16	2.0
	Separation	291	36.9
	I don't know	35	4.4
Support consanguineous marriage	Yes	216	27.4
	no	573	72.6
If your premarital test result is positive, will you propose?	Yes	160	20.3

	no	629	79.7

According to **Figure 1**, only 10% of participants had good knowledge scores regarding sickle cell disease and premarital screening, 74.9% had moderate knowledge scores, and 15.1% had poor knowledge scores.

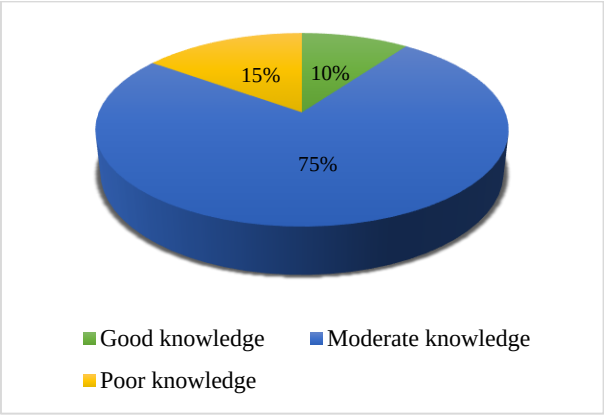

Figure 1. Participants' knowledge scores regarding sickle cell disease and premarital screening

According to **Figure 2**, only 34.7% of participants had positive attitude scores regarding sickle cell disease and premarital screening, 64.9% had neutral attitude scores, and 0.4% had negative attitude scores.

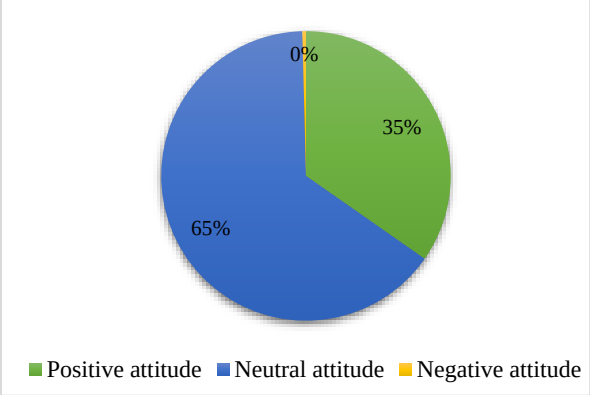

Figure 2. Participants' attitude scores towards sickle cell disease and premarital screening

The data presented in **Table 4** shows that, participants aged 20-30 and 41-50 exhibit the highest percentage of individuals with moderate knowledge, at 19.0% and 21.0% respectively. On the other hand, individuals aged less than 20 and more than 60 have the lowest percentage of individuals with good knowledge, at 1.4% and 0.0% respectively. The observed P value of 0.022 suggests a significant association between age and knowledge scores. Secondly, the distribution of knowledge scores by marital status also yields interesting findings. Married individuals have the highest percentage of individuals with moderate knowledge (51.8%), while single individuals have the highest percentage of individuals with poor knowledge (5.6%). Although the P value of 0.116 indicates a weaker association compared to age, the disparities in knowledge scores among different marital statuses are still noteworthy. Furthermore, the analysis of knowledge scores by gender reveals a striking disparity. Male participants have a significantly higher percentage of individuals with good knowledge (5.1%) compared to female participants (4.9%), as well as a lower percentage of individuals with moderate and poor knowledge. The P value of 0.001 indicates a strong association between gender and knowledge scores. Additionally, the distribution of knowledge scores by nationality demonstrates a clear difference between Saudi and non-Saudi participants. Saudi individuals have a much higher percentage of individuals with good knowledge (9.8%) compared to non-Saudi individuals (0.3%), with a P value of 0.014 signifying a significant association. Finally, the analysis of knowledge scores by education level showcases varying percentages of individuals with good, moderate, and poor knowledge across different educational backgrounds. Participants with a bachelor's degree have the highest percentage of individuals with good knowledge (6.2%), while those with a doctoral degree have the lowest percentage (0.1%). The P value of 0.525 for education level suggests a weaker association compared to other demographic factors.

Table 4. Participants' knowledge scores in association with their sociodemographic characters (n=789)

		Knowledge scores			Total (N=789)	P value
		Good knowledge	Moderate knowledge	Poor knowledge		
Age	less than 20	11	45	15	71	0.022
		1.4%	5.7%	1.9%	9.0%	
	20_30	30	150	41	221	
		3.8%	19.0%	5.2%	28.0%	
	31_40	12	103	22	137	
		1.5%	13.1%	2.8%	17.4%	
	41_50	15	166	25	206	

		1.9%	21.0%	3.2%	26.1%	
	51_60	11	114	15	140	
		1.4%	14.4%	1.9%	17.7%	
	more than 60	0	13	1	14	
		0.0%	1.6%	0.1%	1.8%	
	Single	29	159	44	232	
		3.7%	20.2%	5.6%	29.4%	
	Married	46	409	67	522	
		5.8%	51.8%	8.5%	66.2%	
marital status	Divorced	2	11	4	17	0.116
		0.3%	1.4%	0.5%	2.2%	
	widow	2	12	4	18	
		0.3%	1.5%	0.5%	2.3%	
	Male	40	284	36	360	0.001
		5.1%	36.0%	4.6%	45.6%	
Gender	Female	39	307	83	429	
		4.9%	38.9%	10.5%	54.4%	
	Saudi	77	582	112	771	0.014
		9.8%	73.8%	14.2%	97.7%	
Nationality	Non-Saudi	2	9	7	18	
		0.3%	1.1%	0.9%	2.3%	
	Primary	0	3	2	5	0.525
		0.0%	0.4%	0.3%	0.6%	
	Preparatory	1	14	6	21	
		0.1%	1.8%	0.8%	2.7%	
	Secondary	14	137	27	178	
		1.8%	17.4%	3.4%	22.6%	
Education Level	Diploma	12	94	14	120	
		1.5%	11.9%	1.8%	15.2%	
	Bachelor	49	308	62	419	
		6.2%	39.0%	7.9%	53.1%	
	Masters	2	30	6	38	
		0.3%	3.8%	0.8%	4.8%	
	Doctoral	1	5	2	8	
		0.1%	0.6%	0.3%	1.0%	

The data in **Table 5** demonstrates that individuals aged between 20-50 years old have a higher proportion of positive attitude scores, ranging from 8.2% to 18.8%. In contrast, individuals below the age of 20 and above 60 years old have a lower proportion of positive attitude scores, ranging from 0.8% to 6.5%. Moreover, the P-value of 0.701 suggests that there is no significant difference in attitude scores among individuals in different age groups. Moving on to marital status, the results indicate that married individuals have a higher proportion of positive attitude scores (24.7%) compared to single (8.7%), divorced (0.9%), and widowed (0.4%) individuals. The P-value of 0.003 suggests that there is a significant difference in attitude scores among individuals with different marital statuses. Regarding gender, the data demonstrates that male individuals have a lower proportion of positive attitude scores (18.0%) compared to female individuals (16.7%). The P-value of 0.013 suggests that there is a significant difference in attitude scores among male and female individuals. In terms of education level, the results indicate that individuals with a bachelor's degree have the highest proportion of positive attitude scores (19.6%), followed by secondary (6.8%), diploma (5.1%), masters (1.6%), and doctoral (0.3%) degree holders. The P-value of 0.160 suggests that there is no significant difference in attitude scores among individuals with different education levels. Lastly, the data showcases that Saudi individuals have a higher proportion of positive attitude scores (33.3%) compared to non-Saudi individuals (1.4%). However, the P-value of 0.058 suggests that there is no significant difference in attitude scores among Saudi and non-Saudi individuals.

Table 5. Participants' attitude scores in association with their sociodemographic characters (n=789)

		Attitude scores			Total (N=789)	P value
		Positive attitude	Neutral attitude	Negative attitude		
Age	less than 20	25	46	0	71	0.701
		3.2%	5.8%	0.0%	9.0%	
	20_30	71	148	2	221	
		9.0%	18.8%	0.3%	28.0%	
	31_40	56	81	0	137	
		7.1%	10.3%	0.0%	17.4%	
	41_50	65	140	1	206	
		8.2%	17.7%	0.1%	26.1%	
	51_60	51	89	0	140	
		6.5%	11.3%	0.0%	17.7%	
	more than 60	6	8	0	14	
		0.8%	1.0%	0.0%	1.8%	
marital status	Single	69	162	1	232	0.003
		8.7%	20.5%	0.1%	29.4%	
	Married	195	326	1	522	
		24.7%	41.3%	0.1%	66.2%	
	Divorced	7	10	0	17	
		0.9%	1.3%	0.0%	2.2%	
	widow	3	14	1	18	
		0.4%	1.8%	0.1%	2.3%	
Gender	Male	142	218	0	360	0.013
		18.0%	27.6%	0.0%	45.6%	
	Female	132	294	3	429	
		16.7%	37.3%	0.4%	54.4%	
Nationality	Saudi	263	505	3	771	
		33.3%	64.0%	0.4%	97.7%	0.058
	Non-Saudi	11	7	0	18	
		1.4%	0.9%	0.0%	2.3%	
Education Level	Primary	3	2	0	5	
		0.4%	0.3%	0.0%	0.6%	
	Preparatory	7	13	1	21	
		0.9%	1.6%	0.1%	2.7%	
	Secondary	54	124	0	178	
		6.8%	15.7%	0.0%	22.6%	
	Diploma	40	79	1	120	0.160
		5.1%	10.0%	0.1%	15.2%	
	Bachelor	155	263	1	419	
		19.6%	33.3%	0.1%	53.1%	
	Masters	13	25	0	38	
		1.6%	3.2%	0.0%	4.8%	
	Doctoral	2	6	0	8	
		0.3%	0.8%	0.0%	1.0%	

It is imperative to address the knowledge and attitude levels regarding sickle cell disease and premarital screening in Saudi Arabia. Sickle cell disease is a genetic disorder that affects the red blood cells, leading to various health complications. In Saudi Arabia, the prevalence of sickle cell disease is relatively high, with a significant impact on the population's health and well-being.

According to our study results, only 10% of participants had good knowledge scores regarding sickle cell disease and

premarital screening, 74.9% had moderate knowledge scores, and 15.1% had poor knowledge scores. This was lower than reported in a previous Saudi study as 28.8% of participants had good knowledge [13]. Studies conducted in Bahrain (93%) [14], Oman (96%) [15], and Saudi Arabia (94.3%) [16] revealed greater rates of good knowledge; nonetheless, these findings were comparable to those in Nigeria (17.8%) [17] and Sudan (26.9%) [18]. The participants in a study by Binshihon *et al*. [19] had varying degrees of familiarity with the PMS program. Less than half of the participants had adequate expertise. This outcome may be explained by the general public's lack of access to health campaigns and health education. However, the other participants had a good degree of knowledge, which is consistent with the findings of a study carried out by Al Sulaiman *et al*. [20]. In accordance with the current study, a previous study reported that more than half of the participants (51.0%) showed a good knowledge of the PMS program. While 48.8% exhibited poor knowledge about the PMS program [11].

Regarding attitude, only 34.7% of participants had positive attitude scores regarding sickle cell disease and premarital screening, 64.9% had neutral attitude scores, and 0.4% had negative attitude scores. With just 42% of participants in Riyadh and 29% in Abha supporting the execution of the mandatory PMGC law [15], this was lower than stated in another study attitude results in 41% of participants having a good attitude [13]. These results were comparable to those of the previous studies conducted in Saudi Arabia. Just 48% of participants in Sudan exhibited a suitable attitude [18]. Additionally, a study by Binshihon *et al*. [19] revealed that participants' attitudes on PMS were positive. Approximately 75% of the participants strongly agreed that PMS can serve as a prophylactic against some viral diseases and inherited ailments. Nonetheless, additional research revealed that, respectively, 86.9% and 70% of participants supported mandatory PMGC [15]. A study conducted in Saudi Arabia revealed that a significant proportion of participants (83.8%) held a good view of the significance of PMSGC, the impact of screened genetic and viral disorders on the family, and the incorrectness of marrying when the PMSG results indicated incompatibility [21]. The majority of participants in the study by Al-Sulaiman *et al*. felt that the PMS program should be available to all couples in all regions of the Kingdom, and they also discovered that the Saudi community was generally supportive of PMSGC [20]. The majority of female Saudi students in the research expressed favorable opinions of premarital screening. The majority recognized the advantages of premarital screening as well as the seriousness of the diseases it can avoid [22]. When advising potential couples who may have a positive screening test, this upbeat approach may help medical professionals. Prospective research ought to go deeper into the correlation between attitudes and screening tests by utilizing theories pertaining to behavior modification and decision-making.

Surprisingly, 20.3% of our sample would proceed in marriage despite having a positive trait for a hematological disorder. Nonetheless, prior research has shown that up to 90% of married couples continued their marriage despite having a positive trait for a hematological illness. This was mostly because of social stigma (21%) and noncancellable wedding preparations (43%–52%) [23-26]. Age, gender, and nationality were all significantly associated with knowledge scores, but not educational level. Conversely, research indicates that education is the primary predictor of a high PMSGC knowledge score [21]. This finding is in line with another study that revealed people with a bachelor's degree or above had a higher knowledge score [27]. Recent research on the general population in western Saudi Arabia found that higher family wealth was also a strong predictor [19, 21]. A study also found a correlation between marital status and PMSGC knowledge [21], with participants who had previously been married scoring higher on the knowledge test than those who had never been married. This is probably because these people had previously gone to premarital counseling for married couples.

Male participants have a significantly higher percentage of individuals with good knowledge (5.1%) compared to female participants (4.9%). This contradicts a study that reported that females had a statistically significant greater knowledge about PMSGC than males [21]. Although the reasons for this gender difference are not entirely evident, the outcome is in line with the findings of Alhowiti *et al*. [28], who discovered that female students knew more about premarital screening than male students. However, a recent study conducted in Qatar [29] found no gender difference. This could be a result of women's increased concern over chronic illnesses that lower the quality of life for moms and their offspring.

Promising outcomes have been reported from recent health education programs aimed at increasing secondary school and college students' understanding of hemoglobinopathies and premarital screening [9, 30]. Future health education programs should focus on men and single adults, according to our results, but health education and awareness efforts about the nature and importance of PMSGC from reliable sources are still important. Furthermore, it is imperative for health education messaging to be appropriate for particular age groups, educational levels, and socioeconomic backgrounds.

Marital status and gender significantly affected participants' attitudes. In a different study, marital status, age, family income, and education level were related to opinions about PMSGC [21]. Similar findings were observed by Bener *et al*. in their recent investigation of Qataris' premarital screening program knowledge, attitudes, and practices [29].

One of the key factors in addressing sickle cell disease is raising awareness and promoting education about the condition. Individuals need to have a good understanding of

the disease, its symptoms, and its potential impact on their lives. Moreover, having accurate knowledge about sickle cell disease can help individuals make informed decisions regarding their health, including seeking appropriate medical care and participating in preventive measures [4].

In addition to knowledge, attitudes towards sickle cell disease and premarital screening play a crucial role in addressing the issue. In Saudi Arabia, there may be cultural and social factors that influence attitudes toward genetic screening and the importance of knowing one's carrier status. It is essential to promote positive attitudes towards premarital screening as a means of preventing the transmission of genetic disorders, including sickle cell disease, to future generations [9, 12].

Furthermore, addressing the knowledge and attitude levels regarding sickle cell disease and premarital screening requires a multi-faceted approach. This includes implementing educational programs in schools, universities, and communities to raise awareness about the disease and the importance of genetic screening. Additionally, healthcare professionals play a vital role in providing accurate information and counseling to individuals and families affected by sickle cell disease [5, 7].

Moreover, it is essential to collaborate with religious and community leaders to promote positive attitudes toward premarital screening and to dispel any misconceptions or stigmas associated with genetic testing. By engaging with various stakeholders, including government agencies, healthcare providers, and community organizations, it is possible to create a supportive environment that encourages individuals to take proactive steps toward understanding and addressing sickle cell disease [1, 13].

While the study provides valuable insights into the awareness and perceptions of sickle cell disease and premarital screening in Saudi Arabia, it is important to acknowledge its limitations. One limitation is the potential for selection bias, as the study may not have included a representative sample of the entire Saudi population. Additionally, the study may have been limited by the self-reported nature of the data, which could introduce recall bias and social desirability bias. Furthermore, the study's findings may not be generalizable to other populations outside of Saudi Arabia. Despite these limitations, the study still offers valuable information that can contribute to the understanding and improvement of sickle cell disease awareness and premarital screening in Saudi Arabia.

Conclusion

In conclusion, participants show inadequate knowledge and negative attitudes towards sickle cell disease compared to previous figures in Saudi Arabia and worldwide. Addressing the knowledge and attitude levels regarding sickle cell disease and premarital screening in Saudi Arabia is crucial for improving the health and well-being of the population. By promoting accurate knowledge, positive attitudes, and collaborative efforts, it is possible to make significant strides in preventing and managing sickle cell disease. All stakeholders need to work together towards this common goal, ultimately leading to a healthier and more informed society.

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