Knowledge and Attitude toward Hemoglobinopathies in Premarital Screening Program among the General Population in the Western Region of Saudi Arabia

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ABSTRACT
The National Premarital Screening Program, which includes sickle cell disease and thalassemia, was made mandatory in 2004 by the Kingdom of Saudi Arabia (KSA), and the earlier studies have shown a poor knowledge and negative attitude toward this program in the different study groups. This study was conducted to assess the knowledge and attitudes toward premartial screening (PMS) in a randomly selected national sample of the Saudi population, 18 years and above. This was a cross-sectional study conducted in the Saudi population in the western region between July and December 2021. Valid and reliable questionnaire and data were collected from 893 participants aged ≥18 years. The χ² test was used to ascertain if there is an association between categorical variables. Multivariate logistic regression was used to determine factors predicting satisfactory knowledge. All 893 study participants had heard about PMS with 625 (70.0%), 244 (27.3%) and 24 (2.7%) having satisfactory, fair and poor knowledge, respectively. Participants aged 26–35 years (p = 0.038), females (p < 0.001), those with higher education (p = 0.003) and employed (p = 0.004), had a better knowledge compared to other groups. Most of the participants had a positive attitude toward PMS. There is a changing trend in the knowledge and attitude toward PMS with a greater number of people wanting to go for PMS. There is also an improvement in the number of participants opting out of marriage in case of incompatibility with their future partner. However, the health education programs need to be improved regarding the hemoglobinopathies.

Introduction
Hereditary disorders are quite common in the general population of the Kingdom of Saudi Arabia (KSA) due to the high prevalence of consanguineous marriages [1–3]. Consanguinity is defined as a marriage between a heterosexual couple with at least one common ancestor [4]. It is very common in the majority of Middle Eastern countries, first cousin marriages being the most common. The prevalence of consanguinity was 51.3% in the Jordanian population, 54.0% in Qatar, 50.5% in the United Arab Emirates (UAE), and 40.0% in Yemen [5–8]. The prevalence of consanguinity is around 56.0% in Saudi Arabia, being higher among the rural than the urban population [9–11].

Premarital screening (PMS) is described as screening of couples who are about to get married, for common inherited hemoglobinopathies and infectious diseases [12]. In 2001, the KSA announced the National Premarital Screening Program (NPSP) for hemoglobinopathies, mainly sickle cell anemia and thalassemia. However, it was made mandatory to get a marriage certificate only in the year 2004 [9,13]. It is being presently performed in 131 centers of Ministry of Health hospitals. It involves screening couples planning to get married for hemoglobinopathies such as sickle cell anemia, thalassemia, and viral infections diseases such as HIV, and hepatitis B and C [2,12]. Once they complete the screening, couples are given a certificate of PMS allowing them to proceed with the marriage. The program clearly defines the targeted subjects, the site for performing screening tests and the process of screening. Couples at-risk after screening are those who are either affected or are carriers of these conditions and are likely to have affected children with these diseases. According to the PMS program, at-risk couples are not prevented from marrying each other. Instead, they are referred to clinics for further evaluation and counseling [1,13]. Premarital screening is superior to prenatal screening as it is a type of primary prevention. It can reduce the burden of hemoglobinopathies by bringing down the number of high-risk marriages [1]. The preliminary data from PMS tests for hemoglobinopathies show considerable regional variances. Evaluated couples (2.1%) were potential high-risk marriages, with the majority continuing the marriage despite the risk [3].

According to WHO, the two most common inherited hemoglobinopathies are sickle cell anemia and thalassemia and they are a major public health problem worldwide.
Sickle cell disease, an autosomal recessive inherited disorder in which individuals with a homozygous Hb S (HBB: c.20A>T) (β²/β²) genotype are severely affected, known as sickle cell anemia, whereas those with one copy of the sickle variant and one copy of the normal β-globin gene (Hb AS) (β¹A/β²), generally do not express the disease and are called carriers or sickle cell trait [16]. Thalassemia is a hemoglobinopathy caused by impaired synthesis of either the α or β hemoglobin (Hb) chain and is of two types, α or β-thalassemia (α or β-thal) [17]. The β-thal disorder is common mainly in the East and Western regions of KSA [18]. It is further classified as a β-thal trait (thalassemia minor) or β-thal major (β-TM) [19]. Patients with β-TM present with severe illness and need repeated blood transfusions, whereas β-thal trait individuals are generally asymptomatic and are detected incidentally through routine blood testing [19,20]. Children of the β-thal trait individuals can inherit β-TM if their partner also has β-thal trait. Patients with β-TM require a lot of financial, social, and psychological support for the maintenance and treatment of their illness [3,21]. The estimated prevalence of β-thal and sickle cell anemia in KSA is 1.0–5.0% and 17.0%, respectively, as per the general statistical organization [1–3].

It is essential to reduce the burden of hemoglobinopathies, especially β-thal and sickle cell anemia in KSA, and an effective PMS will help in achieving this target [2,22]. One of the most important measures of any prevention programs for genetic disorders is to inform and educate the target population. The KSA, UAE and Bahrain have introduced genetics information on hemoglobinopathies, to the general population with the help of health care workers and primary healthcare centers as well as through various media [23]. Health education is one of the cornerstones in improving the community’s perception of newly available health interventions. Despite the available facilities the general population has very low knowledge about the PMS [15,24].

Education is the best way for improving the situation of any community with a higher incidence of certain practices, such as consanguinity, to prevent the occurrence of many inherited diseases including hemoglobinopathies. Moreover, this education should be initiated at all levels including secondary schools. Better education, as well as counseling of the couple both before and after PMS, can go a long way in reducing the burden of hemoglobinopathies in the general population [25,26]. The effectiveness of such education and the degree of awareness in the community can be assessed through community-based surveys, and thus, this study was conducted to assess the changing attitude of the general population toward PMS. Therefore, this study aims to assess the knowledge, attitudes, and practices toward PMS in a randomly selected national sample of the Saudi population 18 years and above. Identifying associated sociodemographic factors that might also help stakeholders to improve the health education regarding a PMS.

**Materials and methods**

A descriptive cross-sectional study was conducted in the general Saudi population in the western region of KSA, aged 18 years and above. A questionnaire was generated through SurveyMonkey software (https://www.surveymonkey.com) and distributed for the study. It included three main domains: sociodemographic data, knowledge and attitude toward PMS. The survey was distributed electronically using text messages and social media such as WhatsApp and Twitter.

**Data collection**

All information of participants was kept confidential. Names and identifying information were not requested. Participation was voluntary and participants were given the freedom to terminate the survey anytime. Completion of the survey was considered to be a consent to participate. The questions were written first in English and then translated into Arabic as it is the native language of the region. The questions for the survey were reviewed and checked by 20 researchers and external experts for content validity. A pilot study was done with 20 participants to check the ease and clarity of questions and some questions were changed and amended after the pilot study. Participants of the pilot study were excluded from the main survey. It took around 7–10 min. to complete the survey. Participants who did not complete the survey were also excluded from the final study (n = 122). In the knowledge domain, participants were given scores depending on the number of questions they answered correctly, once they completed the survey.

The questionnaires consisted of three parts. Part 1: Sociodemographic characteristics consisting of 15 items giving the demographic details such as age, gender, occupation, educational level, marital status, place of residence, parent’s consanguinity, and personal and family history of hemoglobinopathies including sickle cell anemia and thalassemia. Part 2: Knowledge included 15 items to assess the participant’s knowledge regarding the PMS program such as the importance of the PMS program, source of information regarding PMS, their knowledge of hemoglobinopathies and various tests done under PMS. The participants were given scores in this section with the correct answer being allotted one mark and zero for incorrect answers or ‘don’t know’ responses (15 items). The total score and percentage were calculated for each participant. Those who answered ≥12 items (80.0%) correctly, were considered as having ‘satisfactory’ knowledge, while a score between 53.0–73.0% answering 8–11 items was considered ‘moderate’ in knowledge, and those who answered <8 items (53.0%) were allotted the category of having ‘poor’ knowledge. Part 3: Attitude assessed the Saudi citizen’s attitude toward PMS and consisted of 13 items. A five-point Likert scale ranging from 1 = strongly disagree to 5 = strongly agree was used to assess this domain. The item score and percentage were computed. The attitude score ranged from 12 to 60, and based on the score, the participants were classified into three categories; a low score of 20.0–60.0% (12–36 points) was graded as a negative attitude, 61.0–80.0% (37–48 points) as neutral attitude and 81.0–100.0% (49–60 points) as a positive attitude.
**Ethics**

Ethics approval was obtained from the Biomedical Ethics Committee of Umm Al-Qura University [HAPO-02-K-012–2020-10–477]. This committee is located at the College of Medicine, Umm Al-Qura University, Makkah, KSA.

**Statistical analyses**

Data analysis was performed using Microsoft Excel and Statistical Package for the Social Sciences (SPSS) version 23 (IBM Inc., Armonk, NY, USA; https://www.ibm.com). Frequency and percentages were used to display categorical variables. The χ² test was used to test for the presence of an association between categorical variables. Multivariate logistic regression was used to determine factors predicting satisfactory knowledge. The logistic regression model included the following variables: age, gender, marital status, occupation, education, family history of consanguinity, family history of genetic disease, and personal history of hereditary disease. A p values of ≤0.05 was considered to be significant.

**Results**

**Part 1: sociodemographic profile of the participants**

A total of 1015 participants attempted the questionnaire with 893 (87.98%) completing the survey. Females actively participated in the survey and their number was 698 (78.2%), while only 195 were males (21.8%). The age and city-wise distribution of participants are depicted in Table 1; 1452 (50.6%) of them were married and about 30.9% were students. Based on their educational level, most of the participants held a bachelor’s degree 612 (68.5%), of which 222 were from the medical field, as shown in Table 1. About 312 (34.9%) participants had parents with consanguineous marriages, 207 were married to their first cousins (first degree relative) and 105 were second cousins (second degree relative). Family history of the genetic disease was reported by 294 (32.9%) participants and personal history of the hereditary disease was reported by 60 (6.7%) participants (Supplementary Table 1).

**Part 2: knowledge**

All study participants had heard about PMS (n = 893). The source of information in most cases was either from their relatives or friends and the medical community, accounting for 27.33, 17.15 and 24.98%, respectively (Figure 1). When asked about their knowledge of PMS, according to the scores 625 (70.0%), 244 (27.3%) and 24 (2.7%) had satisfactory, fair and poor knowledge, respectively. Above 85.0% of participants answered five questions correctly and between 625 (70.0%), 244 (27.3%) and 24 (2.7%) had satisfactory, fair and poor knowledge, respectively. Above 85.0% of participants answered five questions correctly and between 84.0–60.0% of participants answered six questions correctly (Supplementary Table 2).

Table 2 illustrates the factors associated with knowledge level. A significant association was found between age and knowledge level (p = 0.038), whereas the highest rate of satisfactory knowledge was found in participants between 26–35 and 36–44 years. Gender and marital status were also significantly associated with knowledge level, where females had a higher rate of satisfactory knowledge compared to males (73.5 vs. 57.4%), and the highest rate of satisfactory knowledge was seen in widowed participants and the lowest was found in married participants (p = 0.04). The occupation was also significantly associated with knowledge level (p = 0.004), where the lowest rate of satisfactory knowledge was found in retired participants, while the highest rate of satisfactory knowledge was found in participants with other occupations. Education was also significantly associated with knowledge level (p = 0.003), where, overall, the higher the education level, the higher the rate of satisfactory knowledge. Those with medical education had a significantly (p < 0.001) higher rate of satisfactory knowledge compared to non medical professionals. Personal history of the hereditary disease was also significantly associated with knowledge level (p = 0.014), whereas those with personal history had a significantly higher rate of satisfactory knowledge compared to those who did not (71.7 vs. 69.9%). The multivariate logistic regression was used to determine factors predicting
satisfactory knowledge. The higher rate of having satisfactory knowledge: being single \( p < 0.001, \) odds ratio (OR) = 2.96. The factors that predicted lower rate of having satisfactory knowledge: being a male \( p < 0.001, \) OR = 0.41, and being a housewife \( p = 0.039, \) OR = 0.42 (Supplementary Table 3).

### Part 3: attitude

More than half of the participants opted to cancel or discontinue engagement in case they fell in the category of ‘at-risk couples’ (473 out of 893). While 225 (25.20%) of participants said they would decide based on the probability of getting the disease and only 83 (9.29%) of the participants were reported to continue engagements and their marriage with either a firm belief in God (64; 7.17%) or emotional reasons (16; 1.79%) and/or family pressure (three; 0.33%) (Figure 2).

In general, most participants 76.93\% (\( n = 687 \)) had a positive attitude toward PMS, while 22.62\% (\( n = 202 \)) had neutral and only 0.45\% (\( n = 4 \)) had a negative attitude. Most of the participants 97.2\% (\( n = 868 \)) believed that PMS is very important for their future children. Furthermore, most of the participants \( \sim 98.0\% \) will go for a PMS and gave it significant importance. Of these, 39.6\% agreed that PMS helps to prevent transmission of the diseases to the next generation, while about 27.0\% thought that PMS ensures the health of the partner and prevents disease transmission to them. Only 5.6\% of the participants reported that they will go for a PMS to comply with the law. Of these, 6.6\% opted to disagree or had no opinion on believing the PMS laboratory results, and surprisingly, about 1.3\% (\( n = 12 \)) were medical graduates (Figure 3).

In total, 97.64\% of the participants supported the idea of giving health education about PMS in schools. Interestingly, 80.5\% of the participants thought that counseling sessions

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**Table 2.** Relationship between knowledge level about the premarital screening program and sociodemographic factors and personal history in Saudi citizens in the western region of Saudi Arabia (\( n = 893 \)).

| Knowledge Levels | Fair/Poor | Satisfactory | \( p \) Value |
|------------------|----------|--------------|--------------|
| **Age (years)** |          |              |              |
| 18–25            | 108 (33.9) | 211 (66.1)   | 0.038\*      |
| 26–35            | 35 (23.3)  | 115 (76.7)   |              |
| 36–44            | 30 (23.6)  | 97 (76.4)    |              |
| >45              | 95 (32.0)  | 202 (68.0)   |              |
| **Gender**       |          |              |              |
| Males            | 83 (42.6)  | 112 (57.4)   | <0.001\*     |
| Females          | 185 (26.5) | 513 (73.5)   |              |
| **Marital status** |        |              |              |
| Single           | 133 (35.1) | 246 (64.9)   | 0.04\*       |
| Married          | 120 (26.5) | 332 (73.5)   |              |
| Divorced         | 11 (25.0)  | 33 (75.0)    |              |
| Widowed          | 4 (22.2)   | 14 (77.8)    |              |
| **Occupation**   |          |              |              |
| Not working      | 16 (21.3)  | 59 (78.7)    | 0.004\*      |
| Student          | 98 (35.5)  | 178 (64.5)   |              |
| Public sector    | 58 (22.1)  | 204 (77.9)   |              |
| Self-employed    | 10 (35.7)  | 18 (64.3)    |              |
| Housewife        | 25 (32.1)  | 53 (67.9)    |              |
| Retired          | 58 (36.7)  | 100 (63.3)   |              |
| Other            | 3 (18.8)   | 13 (81.3)    |              |
| **Education**    |          |              |              |
| Intermediate     | 4 (50.0)   | 4 (50.0)     | 0.003\*      |
| High school      | 38 (38.4)  | 61 (61.6)    |              |
| Diploma in any field | 18 (42.9) | 24 (57.1)    |              |
| Bachelor's degree | 183 (29.9) | 429 (70.1)   |              |
| Postgraduate     | 25 (18.9)  | 107 (81.1)   |              |
| Medical          | 52 (17.9)  | 239 (82.1)   | <0.001\*     |
| Non medical      | 155 (34.4) | 295 (65.6)   |              |
| **Parental consanguinity?** | | | |
| Yes              | 103 (33.0) | 209 (67.0)   | 0.152        |
| No               | 165 (28.4) | 416 (71.6)   |              |
| **Family history of genetic disease** | | | |
| Yes              | 90 (30.6)  | 204 (69.4)   | 0.784        |
| No               | 178 (29.7) | 421 (70.3)   |              |
| **Personal history of hereditary disease** | | | |
| Yes              | 17 (28.3)  | 43 (71.7)    | 0.014\*      |
| No               | 251 (30.1) | 582 (69.9)   |              |

\*A \( p \) values of \( \leq 0.05 \) was considered to be significant.
should be given before and after PMS. Thirty-eight (4.25%) participants with medical backgrounds (graduate or above) disagreed \( (n=7) \) or had no opinion \( (n=24) \). Eight hundred and sixty-nine \( (97.31\%) \) believed that PMS can reduce the risk of genetic inherited disorders and sexually transmitted diseases (STDs). About 74.58\% \( (n=666) \) of the participants would cancel the marriage if the results were incompatible, and the majority will interrupt the marriage on discovering that their partner has STDs or was carrying the inherited disease, which was about 80.51\% \( (n=719) \) and 71.33\% \( (n=637) \), respectively. Unfortunately, 22 and 13 of the participants with a medical background would carry on with the marriage, even if the PMS test showed a high risk of either STDs or inherited disease, respectively (Supplementary Table 4).

Finally, we analyzed the factors associated with attitude toward PMS or hereditary blood diseases. Parental consanguinity was also significantly associated with a positive attitude toward PMS for hemoglobinopathies \( (p=0.03) \), whereas those with no history of parental consanguinity were observed to have a higher rate of positive attitude compared to those who did not \( (79.2 \text{ vs. } 72.8\%) \) (Table 3).

**Discussion**

There is a high prevalence of inherited blood disorders in KSA, and one of the important risk factors is a high prevalence of consanguineous marriages [18,27]. To reduce the burden of the disease on future generations, KSA initiated the PMS program in the year 2004. However, the initial studies have shown a poor knowledge of the PMS program among the general population as well as specific groups for example unmarried population and university students [2,16,21,27]. The consanguinity rate in KSA is around 56\%.

The present study revealed parental consanguinity in 34.9\% of the participants, 66.4\% of these were first degree relatives. The percentage is much lower in our study as compared to Alahdal *et al.* [4], who reported that 51.8\% of the female university students were in consanguineous marriage families. Earlier studies have reported even higher percentages ranging from 57.7 to 80.6\% [4]. The changing trend could be attributed to the awareness regarding inherited genetic disorders through health education programs and PMS program.
The present study assessed the knowledge, attitudes and practices toward PMS in a randomly selected national sample, aged more than 18 years in the Western region of the KSA and tried to identify associated sociodemographic factors that might improve the program education. Around 80.0% of the participants were females, most probably because female participants are more concerned about their future generations, are more active and cooperative. Secondly, it is also partly due to an all female research team leading to researcher bias.

Knowledge

Eight hundred and ninety-three participants who completely answered the survey were considered for the final survey. All the participants (100.0%) had heard about the PMS program and based on their scoring, 625 (70.0%), 244 (27.3%) and 24 (2.7%) had satisfactory, fair, and poor knowledge, respectively. In a study by Alhowiti and Shaqran [25], 48.3% of the students had sufficient knowledge regarding PMS. Another study conducted in the general population of KSA reported a very low number (9.2%) of participants with satisfactory knowledge [9]. Ibrahim et al. [15] reported that 80.9% of students obtained poor scores, while only 12.5% and 6.6% obtained fair and satisfactory scores, respectively, in a pretest, and the scores improved post test after providing the students with a health education program regarding PMS. This variation in the knowledge score in different study groups can be attributed to the different types of study groups in each of them and also to the variation of exposure to the various sources of information in these groups. It also highlights the importance of creating more awareness in the general population regarding PMS.

When asked if the participants had ever heard about sickle cell anemia or thalassemia, 667 (74.7%) gave a positive response and only 125 (14.0%) answered negatively. The major sources of information in our study were either relatives or friends and the medical community, which were about 27.33 or 17.15, and 24.98%, respectively. This knowledge was obtained from personal experience (12.73%), as 57.6% (n = 514) of the participants were either married or previously married (divorced or widowed). Binshihon et al. [27] and al Kindi et al. [28] reported a similar finding in their studies, emphasizing the need to increase the awareness regarding PMS via social media, the internet, and health education programs for the community in general and in particular, couples about to be married.

The various sociodemographic factors that affected the knowledge score regarding PMS include the age of the individual, gender, level of education and occupation. Participants in the age group of 26–35 years, had significantly more knowledge scores than the other age groups (p = 0.038). Al Shroby et al. [9] mentioned that 70.1% of Saudis aged >18 years had fair and satisfactory knowledge scores compared to 42.9% of those aged ≤18 years (p < 0.001). Higher education and employed individuals had a better knowledge score compared to the other categories. This finding was in line with the other studies [9,27,29]. Surprisingly, having a family history of genetic disease or consanguinity did not considerably improve the participants’ knowledge score. Al-Aama et al. [29] reported a similar finding.

### Table 3. Relationship to attitude level about the premarital screening program with sociodemographic factors in Saudi citizens in the western region of Saudi Arabia (n = 893).

| Factor                        | Knowledge Levels | p Value |
|-------------------------------|-----------------|---------|
|                               | Neg./Neutral    | Positive|       |
| Age (years)                   |                 |         |       |
| 18–25                         | 80 (25.1)       | 239 (74.9) | 0.133 |
| 26–35                         | 24 (16.0)       | 126 (84.0) |       |
| 36–44                         | 28 (22.0)       | 99 (78.0)  |       |
| >45                           | 74 (24.9)       | 223 (75.1) |       |
| Gender                        |                 |         |       |
| Males                         | 54 (27.7)       | 141 (72.3) | 0.083 |
| Females                       | 152 (21.8)      | 546 (78.2) |       |
| Marital status                |                 |         |       |
| Single                        | 96 (25.3)       | 283 (74.7) | 0.538 |
| Married                       | 97 (21.5)       | 355 (78.5) |       |
| Divorced                      | 10 (22.7)       | 34 (77.3)  |       |
| Widowed                       | 3 (16.7)        | 15 (83.3)  |       |
| Occupation                    |                 |         |       |
| Student                       | 65 (23.6)       | 211 (76.4) | 0.080 |
| Public sector                 | 55 (21.0)       | 207 (79.0) |       |
| Self-employed                 | 9 (32.1)        | 19 (67.9)  |       |
| Housewife                     | 27 (34.6)       | 51 (65.4)  |       |
| Retired                       | 29 (18.4)       | 129 (81.6) |       |
| Other                         | 4 (24.0)        | 12 (75.0)  |       |
| Education                     |                 |         | 0.056 |
| Intermediate                  | 2 (25.0)        | 5 (75.0)   |       |
| High school                   | 33 (33.3)       | 66 (66.7)  |       |
| Diploma in any field          | 13 (31.0)       | 29 (69.0)  |       |
| Bachelor’s degree             | 127 (20.8)      | 485 (79.2) |       |
| Postgraduate                  | 31 (23.5)       | 101 (76.5) |       |
| Parental consanguinity?       |                 |         | 0.03* |
| Yes                           | 85 (27.2)       | 227 (72.8) |       |
| No                            | 121 (20.8)      | 460 (79.2) |       |
| Family history of genetic disease |            |         | 0.111 |
| Yes                           | 71 (24.1)       | 223 (75.9) |       |
| No                            | 79 (19.2)       | 333 (80.8) |       |
| Personal history of hereditary disease |    |         | 0.358 |
| Yes                           | 16 (26.7)       | 44 (73.3)  |       |
| No                            | 165 (21.6)      | 600 (78.4) |       |

Neg.: negative.  
*A p values of ≤0.05 was considered to be significant.*
Attitude

Most of the participants, 76.93% \((n = 687)\) had a positive attitude toward PMS, while 22.62% \((n = 202)\) had a neutral attitude, and only 0.45% \((n = 4)\) had negative attitudes. Another study reported around two-thirds \(66.6\%\) of the participants with a positive attitude [25]. Al-Qattan et al. [30] in their study on 350 Saudi adults, found that 144 \((41.0\%)\) had a good attitude, while the remaining 207 participants \(59.0\%)\) had a poor attitude. Binshihon et al. [27] reported that 60.4% of the participants had a positive attitude toward PMS, while 32.8% had a neutral one and 6.7% had negative attitudes. Thus, the present study shows an improved positive attitude in the general population.

When the participants were asked about their response to the possibility of having an affected child, 473 \((53\%)\) said they would cancel the engagement and not proceed with the marriage, and 225 \((25.2\%)\) said it would depend on the probability of the offspring inheriting the disease. About two-thirds of the students \(67.1\%)\) in an earlier study [15] agreed that when test results were incompatible, the decision to marry should be changed. There was a positive change in attitude in the present study, as only three participants \(0.3\%)\) would continue with the marriage due to family pressure, despite being incompatible, while an earlier study reported a higher percentage \(52.4\%)\) getting married due to family pressure [27].

A surprising finding in the current study was that individuals with a positive family or personal history of genetic disease or parental consanguinity, showed a lower positive attitude compared to those who did not have these associations (Table 3). A similar finding was reported by Al-Aama et al. [29].

When asked if the diagnosis of sickle cell anemia or thalassemia is possible through PMS, 59.6 and 48.5% gave an affirmative answer. A recent study showed a similar finding, the percentage was 61.3% for sickle cell anemia and 42.4% for thalassemia in the Al-Madinah community [31].

Regarding PMS, 97.64% of the participants agreed that to have a proper foundation, education should be provided to all the students in schools. Recent health education programs to improve knowledge about genetic diseases and PMS in secondary school and college students have reported good results [9]. Another study also supports this view, as the knowledge score drastically improved in unmarried female students in a Saudi university following an intervention health education program [15].

This study highlights the changing trends in the knowledge and attitude toward PMS with a greater number of people wanting to go for PMS, being aware of the various tests done, the diseases detected and the importance of PMS. There is also an improvement in the number of participants opting out of marriage in case of incompatibility with their future partner.

Conclusions and recommendations

Almost half of the current study population does not know that sickle cell anemia and thalassemia can be diagnosed by PMS. It is highly recommended that further awareness programs regarding hemoglobinopathies should be conducted in the general population. Health education at all levels including secondary schools, high schools, universities as well as higher institutes of learning, should be the main focus. Awareness of the general population through social media platforms by reinforcing programs can help in achieving this goal. Professionals in genetics, health education and governmental agencies, can come together to increase the awareness of genetic diseases in the adult population in the KSA.

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