

## ORIGINAL RESEARCH ARTICLE

# Empowering deaf and hard hearing females toward premarital counseling and genetic screening: An educational intervention based on empowerment model

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## Abstract

Hearing loss affects many people worldwide, and it hinders speech, language, and social development. Consanguineous marriage is the most prevalent social custom that leads to an increased prevalence of congenital anomalies. Premarital Counseling and Genetic Screening (PMSGC) educational program is urgently needed to empower deaf and hard hearing girls. This study aimed to investigate the effect of educational intervention based on the empowerment model on deaf and hard hearing females' self-efficacy, knowledge, and attitude toward PMSGC. A Quasi-experimental research design was conducted on 64 deaf and hard hearing female students. The data collection instrument comprised four parts: basic data and personal/family history, PMSGC quiz, Likert attitude scale, and general self-efficacy scale. Data were collected from September to December 2020. The empowerment educational intervention was conducted in four sequential phases; needs assessment, planning, implementation, and evaluation. The intervention addressed the students' knowledge, attitudes and self-efficacy. The results showed that 76.6% of the study participants had consanguineous marriage between their parents, 64.1% had a history of hereditary deafness in first-degree relatives. There were statistically significant differences between the total knowledge, attitude, and self-efficacy before and after intervention ( $p < 0.001$ ). In detail, 76.6% of the participants had good knowledge after the intervention compared to only 12.5% before it. Besides, 81.3% of the study participants had a positive attitude toward PMSGC before the intervention compared to 95.3% after it. Self-efficacy was low (25.0%) or moderate (75%) before the intervention compared to moderate (45.3%) or high (42.2%) after the intervention. Educational intervention based on the empowerment model significantly increased the deaf and hard hearing population's self-efficacy, knowledge, and attitude toward PMSGC. The use of the empowerment model in health education should be encouraged and taught to the medical and paramedical students. (*Afr J Reprod Health 2021; 25[1s]: 36-49*).

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**Keywords:** Attitude, knowledge, self-efficacy, empowerment model, deaf and hard hearing females, premarital counseling, genetic screening

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## Résumé

La perte auditive affecte de nombreuses personnes dans le monde et entrave la parole, le langage et le développement social. Le mariage consanguin est la coutume sociale la plus répandue qui conduit à une prévalence accrue d'anomalies congénitales. Un programme éducatif de conseil et de dépistage génétique prénuptial (PMSGC) est nécessaire de toute urgence pour autonomiser les filles sourdes et malentendantes. Cette étude visait à étudier l'effet d'une intervention éducative basée sur le modèle d'autonomisation sur l'auto-efficacité, les connaissances et l'attitude des femmes sourdes et malentendantes à l'égard de PMSGC. Un plan de recherche quasi expérimental a été mené sur 64 étudiantes sourdes et malentendantes. L'instrument de collecte de données comprenait quatre parties: les données de base et les antécédents personnels / familiaux, le questionnaire PMSGC, l'échelle d'attitude de Likert et l'échelle d'auto-efficacité générale. Les données ont été collectées de septembre à décembre 2020. L'intervention éducative d'autonomisation s'est déroulée en quatre phases séquentielles; évaluation des besoins, planification, mise en œuvre et évaluation. L'intervention a porté sur les connaissances, les attitudes et l'auto-efficacité des élèves. Les résultats ont montré que 76,6% des participants à l'étude avaient un mariage consanguin entre leurs parents, 64,1% avaient des antécédents de surdité héréditaire chez des parents au premier degré. Il y avait des différences statistiquement significatives entre les connaissances

totales, l'attitude et l'auto-efficacité avant et après l'intervention ( $p < 0,001$ ). Dans le détail, 76,6% des participants avaient de bonnes connaissances après l'intervention contre seulement 12,5% avant celle-ci. En outre, 81,3% des participants à l'étude avaient une attitude positive envers PMSGC avant l'intervention, contre 95,3% après. L'auto-efficacité était faible (25,0%) ou modérée (75%) avant l'intervention par rapport à modérée (45,3%) ou élevée (42,2%) après l'intervention. L'intervention éducative basée sur le modèle d'autonomisation a considérablement augmenté l'auto-efficacité, les connaissances et l'attitude de la population sourde et malentendante à l'égard de l'EMSP. L'utilisation du modèle d'autonomisation dans l'éducation sanitaire devrait être encouragée et enseignée aux étudiants en médecine et paramédical. (*Afr J Reprod Health 2021; 25[1s]: 36-49*).

**Mots-clés:** Attitude, connaissances, auto-efficacité, modèle d'autonomisation, femmes sourdes et malentendantes, counseling prénuptial, dépistage génétique

## Introduction

Hearing loss affects many people worldwide and is the fourth leading cause of disability. It hinders development, involving speech, language, and social development<sup>1,2</sup>. The most affected regions of the world by impaired hearing loss are South Asia, Asia Pacific, and sub-Saharan Africa. It has a significant challenge and an intense impact on affected people's everyday lives that needs to be appropriately addressed<sup>3</sup>. The prevalence of hearing difficulties with different degrees in the Kingdom of Saudi Arabia (KSA) is 1.4%<sup>4</sup>. Consanguineous marriage is the most prevalent social custom that leads to increased prevalence of congenital anomalies in KSA as it becomes of great concern. It reported that consanguineous marriage is more common among parents of deaf children. Raising community awareness about the drawbacks of consanguineous marriage is highly recommended<sup>5,6</sup>. The most effective methods of preventing disability is premarital counseling and genetic screening as it is important for health promotion and disease prevention, particularly for couples that are planning for conception<sup>7</sup>.

Premarital screening and genetic counseling (PMSGC) involves health promotion and enhancing well-being of a woman, husband and future family before marriage and pregnancy. It is considered a primary preventive approach for couples planning for marriage and an important step towards society wellbeing and allowing people to enjoy life. PMSGC includes premarital health counseling, general medical examination, laboratory investigations and genetic screening for high risk couples<sup>7</sup>. PMSGC is a comprehensive program that aims to decrease the infectious diseases spread as hepatitis B&C and human immunodeficiency virus/acquired immune deficiency syndrome. Besides genetic diseases such as sickle cell anemia and thalassemia<sup>8</sup>; It is used to determine the mutations or genetic variants that raise the hazard of many diseases'

progress<sup>9</sup>. PMSGC is offered in the majority of the health centers and main hospitals in KSA and made compulsory for prospective couples. It covers screening for most common hemoglobinopathies among intended couples due to the increased consanguineous marriage rate. Health education is provided to couples about hereditary disorders; they do the blood tests if they are carriers of any of the hereditary blood disorders. Counseling about the consequences of having affected offspring is also discussed. They are also educated about the technological advances that may help in the prevention and early detection of hereditary deafness<sup>10</sup>.

Genetic counselors and primary care physicians must be provided with sufficient training about dealing with deaf people as they reported limited training and knowledge regarding the deaf community. The health care providers lack of training and knowledge about sign language may limit their ability to provide health education for population needs<sup>11,12</sup>. The more knowledge about deaf individuals, the more increased skill to deal with their problems. Professionals who are skillful and highly qualified in dealing with deaf people will reduce misperceptions about PMSGC and consequently improve their knowledge and attitudes toward it<sup>13</sup>.

Increasing the deaf and hard hearing populations' knowledge about genetic counseling is a key requirement for decreasing hereditary diseases' vulnerability<sup>14</sup>. Changing the deaf and hard hearing girls' beliefs and self-perception can empower them to seek PMSGC. Saudi customs and tradition imply consanguineous marriage for girls. The male guardian can choose the suitable husband for the girls from the family relatives even if the future husband is deaf, and also the girls' agreement is unnecessary. Therefore, the girls may perceive themselves as helpless and less empowered. Increasing the deaf and hard hearing population's self-confidence, self-efficacy, and knowledge are essential requirements for PMSGC program

efficiency. Educational programs for women's empowerment can change females' beliefs and improve their self-efficacy to contribute to their communities and support one another<sup>15</sup>. During the empowerment process, females will realize their needs and demands. They find the bravery to achieve their goals and accomplish their demands. The fundamentals of empowerment include self-efficacy, knowledge, and attitude toward PMSGC<sup>16,17</sup>.

Some Saudi studies showed a low level of knowledge regarding PMSGC. *Ibrahim et al.* conducted an educational intervention to increase King Abdul-Aziz University students' awareness about PMSGC. They reported that the students' knowledge regarding PMSGC was poor before the intervention<sup>7</sup>. Besides, *Moussa et al.* conducted a study in Hail, KSA, among female university students. They concluded that their knowledge was not enough and recommended enhancing their perception, knowledge, and attitude regarding PMSGC benefits<sup>18</sup>. Therefore, it is recommended that efforts should be made by government and health personnel to improve population knowledge and attitude toward PMSGC. In addition, women empowerment is an essential element of any educational program aimed to increase the utilization of PMSGC. Especially for distinguished and isolated subgroup of the communities such as deaf and hard of hearing population. Therefore, the current study tried to explore the effect of an educational intervention based on the empowerment model on deaf and hard of hearing females' knowledge, attitude, and self-efficacy toward PMSGC<sup>19</sup>.

## Methods

### *Study design, subjects, and setting*

A quasi-experimental research design was followed in this study. A convenience sample of 64 deaf and hard hearing female students from Tabuk University, Al Amal center for deaf females, and secondary schools (which contain integrated hard hearing students) at Tabuk city, Saudi Arabia participated in the study. Deaf and hard hearing residents represent a relatively small segment of Tabuk population; therefore, using the sample size

formula in the present study was difficult to apply. All available deaf and hard hearing females who fit the inclusion criteria and agreed to participate in the study were included. Inclusion criteria were unmarried Saudi women between the ages of 15 and 45 (childbearing period), use and understanding of sign language, free from mental or psychological problems, and any other hereditary or health problems.

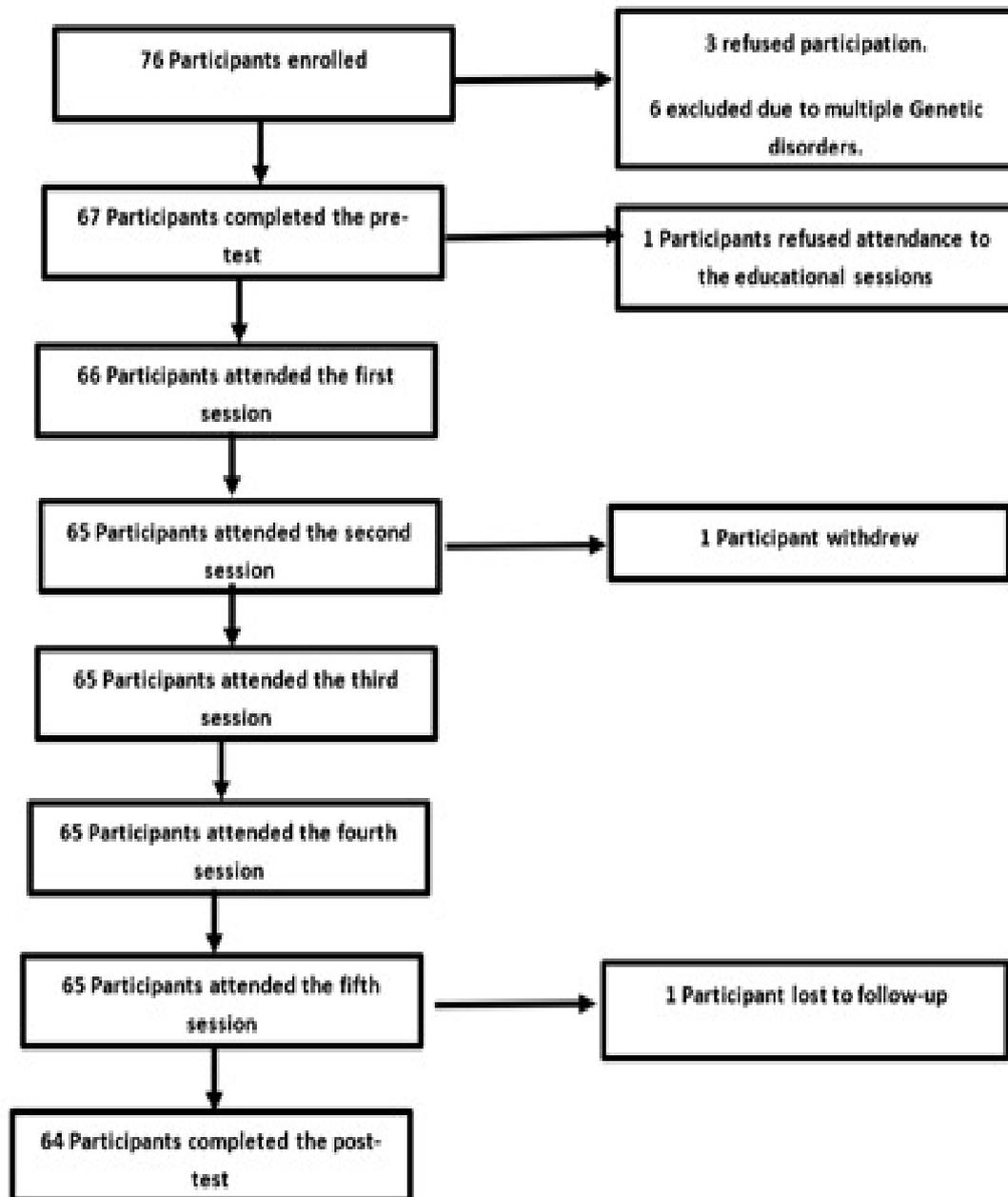
### *Data collection instrument*

Data was collected by an electronic questionnaire, which was elaborated to the participants using sign language by the principal investigator (sign language specialist) at the time of data collection. The researchers developed it after reviewing the related literature. According to *Taghdisi et al.*, an empowerment model consists of three constructs: participants' awareness, attitude, and self-efficacy<sup>20</sup>. Therefore, the electronic questionnaire was involved four main parts.

*The first part* included basic data and personal/family history of the study participants, as age, residence, education, mother's education, consanguinity, types of handicap, family history of deaf/hard hearing and genetic diseases, family history of PMSGC, and previous attendance of PMSGC educational programs.

*The second part* was the PMSGC quiz to assess deaf and hard hearing students' knowledge. This part comprised seven questions; two of them were dichotomous, where the correct answer obtains "one," and the incorrect one gets "zero". For the other five multiple answers questions, the correct answer obtains "two"; incomplete "one" and incorrect or don't know scored "zero". The overall scores were obtained by summing the number of correct and incomplete answers, with a range of possible overall scores from 0 to 12, with higher scores corresponding to higher PMSGC knowledge level. The participants obtained poor level if her overall score <6, fair if her overall score ranged from ≥6- <9, and good if her overall score ≥9. The quiz evaluated PMSGC definitions, hereditary and infectious blood diseases covered by it, benefits, the appropriate timing for the PMSGC, and validity of a healthy marriage certificate.

*The third part*, Likert scale to assesses deaf and hard hearing students' attitudes regarding PMSGC.



**Figure 1:** Participants' flowchart

It was designed on a five-point Likert scale ranging from strongly disagree (1) to strongly agree (5). The overall attitude scores were obtained by summing the participants' responses, with a range of possible overall scores from 10 to 50, with higher scores corresponding to the more positive PMSGC attitude. The participant was considered to have a

negative (10-23), neutral (24-38) and, positive (39-50) attitude according to her overall score.

*The fourth part*; the general self-efficacy scale; It was developed by *Schwarzer and Jerusalem* to assess self-efficacy. The scale was composed of ten items rated on a 4-point Likert scale. The total score ranged from 10 to 40. The participant had to choose

between four alternatives scored as exactly true =4, moderately true =3, hardly true=2, not all true=1. The participant was considered to have low self-efficacy if her overall score ranged between 10-20, moderate if her score ranged between 21-30, and high if her score ranged between 31-40<sup>21</sup>.

The instrument was tested for face, content, and construct validity by a jury of 5 experts in the nursing field. Instrument reliability was conducted using Cronbach's Alpha coefficient test ( $r=0.78, 0.82, 0.85$  for the second, third, and fourth parts, respectively), which showed an instrument's adequate internal consistency.

The ethical approval for conducting the study was obtained from Scientific Research Deanship at the University of Tabuk. Official approvals were obtained for data collection via official lines of authority by the principal investigator. Informed consent was taken from each participant before data collection. All collected data was confidential and was only used for research purposes. The participant was informed that she has the right to withdraw from the study without any consequences. The pilot study was conducted on 10% of the participants. The pilot study aimed to ensure the clarity and applicability of the instrument. No modifications were made to the instrument based on the pilot study results.

### ***Data collection plan and educational intervention implementation***

Data were collected from September to December 2020 by the principal investigator. Due to the COVID-19 pandemic, data collection was done through online classes using the blackboard system. Sign language educational sessions were conducted through virtual blackboard classes. The educational intervention based on the empowerment model was designed and implemented through four consecutive phases:

***Needs assessment phase:*** Assessment of participants' knowledge and attitude toward PMSGC using the developed instrument as an online pre-test. The pre-test results were analyzed to reveal participants' training needs for PMSGC.

***Planning phase:*** Based on the results of the needs assessment phase, and in light of the relevant literature, the researchers designed an educational intervention based on the empowerment model in

the form of (PowerPoint presentation), which was independently evaluated by external reviewers. The educational intervention addressed the areas of significant deficiency in students' self-efficacy, knowledge, and attitude towards PMSGC. The empowerment model comprises three main constructs, which emphasize self-efficacy, knowledge, and attitude. These three constructs were addressed in the educational intervention by tailoring suitable content for each construct.

***Implementation phase:*** After designing an educational intervention based on the empowerment model and taking formal approval, a schedule of online interviews was arranged through virtual classes on the blackboard system in cooperation with students. The educational intervention included five sessions and conducted based on the participants' readiness. Various teaching strategies were used, such as lectures, group discussions, and problem-solving.

***Evaluation phase:*** Follow-up testing was done after one month, using the same pre-test instrument through an online questionnaire.

### ***Data analysis***

Data were analyzed through the Statistical Package for Social Science (SPSS, IBM, USA), version 23. The participants' basic data and personal/family history were described using descriptive statistics. The knowledge and attitude toward PMSGC were represented in terms of numbers, percentages, means, and standard deviations. A paired t-test and Fisher Exact Test were conducted to compare the participants' knowledge and attitude before and after the educational intervention. The P-value was considered significant at  $p \leq 0.05$ .

## **Results**

Table 1 illustrates that 89.1% of the study participants were aged more than 20 years with a mean age of  $23.765 \pm 4.085$ . Also, 93.8% of the participants were urban area residents, and 65.6% were university-educated. An equal (25.0%) proportion of the participants' mothers were secondary or university educated. Around two-thirds (59.4%) of the study participants had a monthly income of 5,000 to 10,000 SAR per month. Furthermore, 76.6% of them had

**Table 1:** Demographic characteristics and history of the study participants. (N= 64)

Basic data	N (64)	%
<b>Age</b>		
– <20	7	10.9
– ≤20	57	89.1
Mean±SD	23.765±4.085	
<b>Residence</b>		
– Rural	4	6.3
– Urban	60	93.8
<b>Education</b>		
– Secondary School	22	34.4
– University	42	65.6
<b>Mother education</b>		
– Illiterate	17	26.6
– Read and write	15	23.4
– Secondary education	16	25.0
– University education	16	25.0
<b>Monthly income</b>		
– Less than 5000 SAR per month	14	21.9
– From 5,000 to 10,000 SAR per month	38	59.4
– More than 10,000 SAR per month	12	18.8
<b>Consanguinity</b>		
– Yes	49	76.6
– No	15	23.4
<b>Type of handicaps</b>		
– Deafness	39	60.9
– hard hearing	25	39.1
<b>Family history of deafness or hard hearing</b>		
– 1 <sup>st</sup> degree relatives	41	64.1
– 2 <sup>nd</sup> degree relatives	11	17.2
– No history	12	18.8
<b>Attendance of previous PMSGC program</b>		
– Yes	3	4.7
– No	61	95.3
<b>Family history of premarital counseling</b>		
– Yes	17	26.6
– No	6	9.4
– Don't know	41	64.1
<b>Family history of other genetic diseases</b>		
– 1 <sup>st</sup> degree relatives	13	20.3
– 2 <sup>nd</sup> degree relatives	10	15.6
– No history	41	64.1

consanguineous marriage between their parents, and 64.1% had a history of hereditary deafness or other genetic diseases (20.3%) in first-degree relatives. Three fifths (60.9%) of the study participants were deaf, and the other two-fifths were hard hearing. In

addition, 64.1% of them did not know if their families conducted PMSGC or not, and the majority (95.3%) of them had never attended any educational programs about PMSGC.

Table 2 illustrates a significant improvement in the participants' knowledge toward PMSGC after the educational intervention ( $p<0.001$ ). In more detail, 84.4% and 76.6% of the study participants had correct answers related to premarital screening and genetic counseling definitions after the educational intervention compared to 9.4% and 12.5% before it, respectively. Besides, only 14.4% and 17.2% of the study participants had correct answers regarding hereditary and infectious blood diseases covered by PMSGC before intervention compared to 78.1% and 65.6% after it, respectively. Furthermore, 28.1% and 17.2% of the participant answered correctly regarding the appropriate timing of PMSGC and healthy marriage certificate compared to 70.3% and 79.7% after it. Finally, 75% of the study participants answered correctly regarding PMSGC after the educational intervention compared to only 15.6% before it.

Table 3 portrays that there are statistically significant differences ( $p<0.001$ ) between the participants' attitudes toward PMSGC before and after the educational intervention in all items except for the sentence "PMSGC prevents social and psychological problems of the family" ( $p>0.686$ ). Table 4 shows the study participants' self-efficacy regarding PMSGC before and after the educational intervention. All the self-efficacy scale items were significantly higher after the intervention compared to before the intervention ( $p<0.05$ ) except for the statement "I am sure that I could deal efficiently with unexpected events that may prevent me from performing PMSGC" ( $p>0.05$ ).

Table 5 shows statistically significant differences between the total knowledge, attitude, and self-efficacy before and after intervention ( $p<0.001$ ). Where, 76.6% of the participants had good knowledge after the intervention compared to only 12.5% before it. In addition, 81.3% of the study participants had a positive attitude toward PMSGC before the intervention compared to 95.3% after the intervention. Furthermore, all of the study participants were divided between low

**Table 2:** Study participants' knowledge regarding PMSGC before and after the educational intervention. (N= 64)

Participants' Knowledge	Pre-intervention			Post-intervention			FET	P
	Correct Answer N (%)	Incomplete N (%)	Incorrect Answer N (%)	Correct Answer N (%)	Incomplete N (%)	Incorrect Answer N (%)		
Definition of premarital screening	6(9.4)	12(18.8)	46(71.9)	54(84.4)	6(9.4)	4(6.3)	83.63	0.000**
Definition of genetic counseling	8(12.5)	10(15.6)	46(71.9)	49(76.6)	10(15.6)	5(7.8)	75.99	0.000**
Hereditary blood diseases covered by PMSGC.	9(14.1)	7(10.9)	48(75.0)	50(78.1)	12(18.8)	2(3.1)	62.76	0.000**
Infectious blood diseases covered by PMSGC.	11(17.2)	2(3.1)	51(79.7)	42(65.6)	12(18.8)	10(15.6)	57.43	0.000**
The appropriate time for the PMSGC.	18(28.1)	0(0.0)	46(71.9)	45(70.3)	0(0.0)	19(29.7)	54.19	0.000**
Validity of healthy marriage certificate	11(17.2)	0(0.0)	53(82.8)	51(79.7)	0(0.0)	13(20.3)	52.19	0.000**
The benefits of PMSGC	10(15.6)	18(28.1)	36(56.3)	48(75.0)	6(9.4)	10(15.6)	48.96	0.000**

\*\*highly significant at  $p < 0.001$

**Table 3:** Study participants' attitudes regarding PMSGC before and after the educational intervention. (N= 64)

Attitude	Pre-intervention		Post-intervention		Paired t-test	p-value
	Mean	SD	Mean	SD		
- PMSGC are very important	4.54	0.75	4.93	0.24	4.179	0.000**
- PMSGC can protect offspring from hereditary diseases and protect myself from infectious diseases	4.28	1.10	4.76	0.55	4.186	0.000**
- It scares me the thought that I might have children with genetic diseases	4.17	0.95	4.75	0.56	4.755	0.000**
- PMSGC are compatible with the principles of Islamic law	4.35	1.05	4.78	0.54	3.470	0.001**
- PMSGC prevent social and psychological problems of the family	4.70	0.52	4.73	0.57	0.406	0.686
- PMSGC leads healthy and successful marriage	4.48	0.71	4.71	0.57	3.211	0.002*
- Consanguineous marriage leads to hereditary diseases such as deafness and hard hearing.	4.04	1.06	4.84	0.44	5.868	0.000**
- I support the mandatory PMSGC	4.54	0.75	4.93	0.24	4.438	0.000**
- PMSGC is very necessary if one of the spouses have hereditary deafness or hard hearing	4.48	0.79	4.90	0.29	4.256	0.000**
- PMSGC allow the couple to decide the fate of their marriage	4.51	0.79	4.93	0.24	4.489	0.000**

\*statistically significant at  $p < 0.05$

\*\*highly significant at  $p < 0.001$

and moderate self-efficacy, 25.0% and 75%, respectively. While after the intervention, the majority of them were divided between moderate and high self-efficacy, 45.3% and 42.2%, respectively.

## Discussion

A major health promotion concern is decreasing genetic diseases' vulnerability by improving public knowledge about the importance of genetic testing and premarital counseling<sup>14</sup>. Premarital counseling is considered an efficient way to prevent genetic diseases and congenital anomalies like hearing

impairment and other blood-borne diseases. that can be prevented<sup>7,10</sup>. One of the important health promotion strategies is empowering people and increasing their possession and control over their health to make the best judgments regarding their health, considering the significance of health determinants, which are of great importance in the physical and social environment<sup>21</sup>. Efforts to control the hereditary diseases by conducting regular community awareness programs about PMSGC is recommended, especially for this neglected group of deaf community<sup>22</sup>. Yet, there is a lack of data on the effect of empowering deaf and

**Table 4:** Study participants' self-efficacy regarding PMSGC before and after the educational intervention. (N= 64)

Participants' self-efficacy	Pre-intervention		Post-intervention		Paired t-test	p-value
	Mean	SD	Mean	SD		
1. If I try hard enough, I can still manage to solve difficult PMTGS-related issues.	2.29	0.66	2.79	0.81	3.795	0.000**
2. I can find the means and ways to get what I want concerning PMSGC if someone opposes me.	2.50	0.50	2.76	0.42	3.160	0.002
3. I can adhere to my aims and accomplish my goals regarding PMSGC.	2.62	0.48	2.87	0.33	3.384	0.001
4. I am sure that I could deal efficiently with unexpected events that may prevent me from performing PMSGC.	3.00	0.50	2.98	0.67	0.151	0.880
5. Thanks to my resourcefulness, I know how to tackle unforeseen issues concerning PMSGC.	2.75	0.83	3.09	0.75	2.497	0.015
6. I can solve most of PMSGC -related problems if I invest the necessary effort.	2.27	0.43	2.75	0.94	3.795	0.002*
7. I can remain calm when facing PMSGC-related difficulties because I can rely on my coping capabilities.	1.87	0.60	3.09	0.88	8.823	0.000**
8. When I am faced with a PMSGC -related problem, I can usually find several solutions.	2.35	0.43	2.84	0.74	5.669	0.000**
9. Usually, if I am in PMSGC -related trouble, I can think in a solution.	2.32	0.97	3.10	0.56	6.111	0.000**
10. When conducting PMSGC, I can usually handle whatever comes my way.	2.25	0.43	2.94	0.66	7.329	0.000**

\*statistically significant at p&lt;0.05

\*\*highly significant at p&lt;0.001

**Table 5:** Study participants' overall knowledge, attitude, and self-efficacy regarding PMSGC before and after the educational intervention. (N= 64)

Variables	Before intervention		After intervention		FET	P value
	N	%	N	%		
<b>Knowledge</b>						
- Poor	51	79.7	7	10.9	87.69	0.000**
- Fair	5	7.8	8	12.5		
- Good	8	12.5	49	76.6		
<b>Attitude</b>						
- Negative	0	0.0	0	0.0	17.87	0.001**
- Neutral	12	18.8	3	4.7		
- Positive	52	81.3	61	95.3		
<b>Self-efficacy</b>						
- Low	16	25.0	8	12.5	35.930	0.000**
- Moderate	48	75.0	29	45.3		
- High	0	0.0	27	42.2		

\*\*highly significant at p&lt;0.001

hard hearing females through educational programs on their self-efficacy, knowledge, and attitudes toward PMSGC; therefore, this study was conducted.

The current study findings showed a positive family history of hereditary deafness or hard hearing in the first-degree relatives between nearly two-thirds of the study participants, and consanguineous parents were found between three-quarters of them. This result goes in the same line

with a study conducted in primary healthcare centers in the Muscat governorate, Oman by Al Zeedi and Al Abri. They found that consanguineous marriage was present in 38.4% of married study participants. They further recommended improving public awareness to enhance the success of the national PMSGC program<sup>23</sup>. In addition, *Yilmazer et al.* found that consanguineous marriage is a risk factor for deafness in children as they found that it is significantly high (50%) in parents of children

with hearing impairment<sup>5</sup>. *Bener* and *Mohammad* investigated the relationship between consanguineous marriage and certain genetic disorders in endogenous populations; they found that hereditary diseases in consanguineous marriages were high. The prevalence of hereditary deafness is found between more than one-quarter of consanguineous generation and their study participants' offspring<sup>24</sup>. Consanguineous marriage is a common tradition in numerous Arab and Islamic communities. Especially in some regions of Saudi Arabia, numerous factors interact to encourage consanguineous marriage, such as the desire to keep property within the family. Other economic and social factors may encourage consanguinity, such as stable marriage between cousins and other economic benefits within the family. Cultures and tradition believe that if the male and female grow in the same cultures and environment, they adjust faster after marriage and easily accept each other. Besides, consanguineous marriage keeps the family strength and enhance the social relations<sup>25</sup>.

The current study findings revealed that most of the study participants did not attend any previous PMSGC programs, which increases the magnitude of the problem for this ignored group. Lack of educational programs for this target group may be attributed to a lack of health care professionals' knowledge about sign language and special needs for deaf and hard hearing populations. This finding clarifies the need for more efforts to increase health care professional knowledge about sign language and deaf and hard hearing populations' needs. A huge effort should be directed to increase the awareness and self-confidence of these segregated populations to increase the utilization of different health services. *Al-Kindi et al.* recommended increased awareness to enhance the PMSGC program's utilization and limit genetic disorders' transmission to the next generations<sup>26</sup>. In addition, *Al-Qahtani et al.* who investigated King Khalid students' awareness regarding PMSGC, stressed the importance of health education programs with medical advice to improve knowledge and attitude towards PMSGC.<sup>27</sup> Educational interventions should be built on educational models that increase the programs' effectiveness. The empowerment model comprises three main components; self-efficacy, knowledge,

and attitude. Each of these components played an important role in empowering the target group to effectively utilize the services.

The present study results revealed insufficient knowledge of deaf and hard hearing females about all items of PMSGC before educational intervention as most of them did not attend any previous PMSGC educational programs. At least three other studies support these results. *First, Khalil et al.* studied 120 female students at King Saud University to explore their knowledge and behaviors regarding PMSGC. They reported that most of their study participants had fair knowledge and behaviors toward PMSGC. They further recommended health education sessions to increase King Saud University's female students' knowledge, behavior, and beliefs about premarital screening<sup>28</sup>. *Second, Ali et al.* illustrated that most university students in their study had inadequate knowledge about diseases covered by PMSGC and the importance of the program<sup>29</sup>. *Third, Alhowiti & Shaqran* found insufficient knowledge regarding premarital screening among half of Tabuk university students<sup>30</sup>.

On the other hand, three other studies contradict the current study results. *First, Foluke*, who studied the utilization of PMSGC services among Ilorin university students, Nigeria. He mentioned that his study participants were fully aware of genetic counseling, and they highly recommended the uptake of PMSGC services. They further stressed the importance of the PMSGC educational problem<sup>31</sup>. *Second, Al-Kindi et al.* explored the knowledge and attitude of 590 Omani students toward PMSGC. He found that most of their participants (79%) had high knowledge about the availability and importance of PMSGC. Although only one-half of them recommended the obligatory application of PMSGC, and one-third of them recommended obligatory prevention of marriage in the case of positive results. Therefore, they recommended the implementation of educational interventions to improve students' attitude toward PMSGC<sup>26</sup>. *Third, Melaibari et al.* evaluated Taif university students' knowledge, attitude, and practice regarding PMSGC. They illustrated that 97.4% of their participants were knowledgeable about the PMSGC program and 82.9% had the intention to conduct it in the future.

They also mentioned that 91.8% of the participants recommended the compulsory application of PMSGC before marriage<sup>32</sup>. The differences between the previous studies group and the current study may be attributed to the participant nature. The previous study groups were conducted on healthy normal participants who can easily access knowledge about PMSGC from different sources. In comparison, the current study was conducted on deaf and hard hearing females who are isolated and neglected from different community and health services. Besides, they can hardly communicate with health care professionals and other sources of information regarding various health services. This fact necessitates the importance of the application of the current study.

Additionally, our study illustrated significant improvement in the participants' knowledge, attitude, and self-efficacy toward PMSGC after the educational intervention ( $p < 0.001$ ). This finding, in turn, reflects the effect of health education based on the empowerment model on enhancing the knowledge towards PMSGC as it was an interesting topic for deaf females. They had a passion for learning about this new and interesting topic that reflects their health and the future of their offspring. Researches about educational intervention regarding PMSGC for deaf and hard hearing females are rarely found in the international database. Therefore, the current study results were discussed in the light of other studies conducted on normal participants. However, deaf and hard hearing females have special needs to be addressed during the educational intervention. In this regard, *Mohamed et al.* evaluated the effect of an educational intervention in improving El Menia university students regarding PMSGC. They found that health education sessions significantly enhanced the knowledge and attitudes towards PMSGC of El Minia University students<sup>33</sup>. Furthermore, *Abd Elfattah et al.* provided Ain Shams University female students with educational counseling sessions about PMSGC. They found improvement in students' knowledge after the counseling sessions<sup>34</sup>. Besides, *Mohamady et al.* documented a statistically significant difference in females' knowledge regarding premarital counseling in the intervention group compared to the control group post-intervention<sup>35</sup>.

Furthermore, *Baldwin et al.* investigated the effect of culturally and linguistically tailored educational intervention on deaf and hard hearing adults' knowledge and beliefs regarding PMSGC. They reported that the availability of culturally sensitive, video-relay, and video phone technology could help care providers to provide effective PMSGC education for the deaf and hard hearing population. They further added that improving the deaf and hard hearing population regarding PMSGC strongly enhanced their attitude, health behaviors, and beliefs<sup>36</sup>. In most circumstances, the deaf and hard hearing population are socially isolated and rarely accessed preventive health services and health education programs. They contacted the health care services in the case of emergencies only. This may be due to difficult communication, embarrassment, and lack of self-efficacy. Therefore, effective health education programs for the deaf and hard hearing population are considered a challenge for the health care providers. For this program to be effective, it needs collaboration between health care providers and hearing impairment specialists. In addition, educational intervention should be specially tailored to enhance deaf and hard hearing females' self-confidence, decision-making, knowledge, and attitude toward PMSGC.

Numerous studies had emphasized on the importance of PMSGC educational programs to improve the attitude toward it. *Bener et al.* reported low levels of knowledge and attitude among their study respondents and recommended motivational and educational programs for school and university students about PMSGC to build healthy families<sup>37</sup>. Furthermore, *Otovwe et al.* demonstrated that more than half of the study participants had a negative attitude toward premarital genotype screening and recommended educational intervention to enhance participants' knowledge and attitude<sup>38</sup>.

*Shelby et al.* studied the effect of health belief model-based educational intervention on young girls' beliefs and preferences regarding PMSGC. They showed that the education and counseling improve the participants' knowledge, attitudes toward PMSGC. They further noted that PMSGC programs should focus on reducing barriers and increasing benefits for individuals. The programs should also consider the participants' preferences and adjust programs accordingly to

increase participation<sup>39</sup>. *Kotb et al.* assessed Jazan university students' knowledge, attitude, and practices regarding PMSGC for sickle cell anemia. They stated that, although the overall knowledge score was high among their participants, 60% supported consanguineous marriage. They further elaborated that 50% of the participants had their knowledge from their friends. They concluded that educational program about PMSGC is so important and should be integrated with school curriculums<sup>40</sup>.

*Kotb et al.* results supported the current study concept that increasing participants' knowledge can only rarely change attitude. Although most of their participants had good knowledge regarding PMSGC, they supported consanguineous marriage with all of its consequences. For deaf and hard hearing females, consanguineous marriage is considered protection from the external community as their cousin grew in the same environment and may also have hearing impairment. She will not be embarrassed of him; therefore, she may prefer to marry the relative to feel safer and more respected. This highlights the significant role of increasing self-efficacy in any educational intervention. Self-efficacy mean self-confidence with the ability to control life events and decisions. For deaf and hard hearing female, self-confidence development is a must to enhance PMSGC utilization.

In the present study, deaf and hard hearing females had significantly higher self-efficacy scores regarding PMSGC after intervention compared to pre-intervention ( $p < 0.05$ ). This reflects the role of the present study intervention based on the empowerment model on improving participants' self-efficacy. Hence self-efficacy energizes action for doing premarital counseling because it includes self-motivation. This is consistent with the study conducted by *Taghdisi et al.*; they documented higher scores of self-efficacy construct after educational intervention as compared to before it. Hence, there is a need for a well-organized continuing deaf community educational intervention using the empowerment model. Increasing self-efficacy using the empowerment model helps to increase the utilization of PMSGC programs<sup>20</sup>. Educational intervention based on the empowerment model should be implemented to

enhance the deaf and hard of hearing community utilization of the PMSGC.

## Conclusion

Based on the study results, it can be concluded that more than three-quarters of the study participants had consanguinity marriage between their parents, 64.1% had a history of hereditary deafness in first-degree relatives. There were statistically significant differences between the total knowledge, attitude, and self-efficacy before and after intervention ( $p < 0.001$ ). In detail, more than three-quarters of the participants had good knowledge after the intervention compared to only 12.5% before it. Besides, 81.3% of the study participants had a positive attitude toward PMSGC before the intervention compared to 95.3% after the intervention. Furthermore, self-efficacy was low (25.0%) or moderate (75%) before the intervention compared to moderate (45.3%) or high (42.2%) after it.

## Implication of the Study

This research addressed a significant issue for deaf and hard hearing females. It targeted a small segregated population who have been addressed by KSA 2030 vision. Using the empowerment model to enhance deaf and hard hearing females' utilization of PMSGC, empower them and increase their self-confidence to control their future. In turn, they can protect the next generation from further genetic problems. Data provided from this study may direct the ministry of health attention to the importance of accessing segregated minority populations and addressing their needs. The use of the empowerment model in health education should be encouraged and taught to the medical and paramedical students. In addition, the implementation of such a program for deaf and hard of hearing females is nearly unavailable on the international database although of its importance for sustainable development. Therefore, this study contributes to both body of knowledge and practice by providing essential data regarding deaf and hard of hearing females.

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## Consent for Publications

The authors have read and approved the publication of the manuscript in its current form. This manuscript has not been submitted for publication elsewhere and has not been previously published.

## Competing Interests

The authors declare they have no conflict of interest.

## Contribution of Authors

*Zaien* conceived the initial idea and participated in data collection. *El Sayed* participated in data collection and contributed to the scientific background. *Ibrahim* reviewed literature, contributed intellectually, and discussed findings. *Elgzar* conceived the initial idea, wrote the initial stage of the manuscript, and contributed intellectually. *Aboraiah* make statistical analysis, contributed intellectually, and wrote the initial draft. *Abdel-Mordy* reviewed literature, contributed intellectually, and wrote the initial stage of the manuscript. All authors agree on the current version of the manuscript.

## References

- Theunissen SC, Rieffe C, Netten AP, Briaire JJ, Soede W, Kouwenberg M and Frijns JH. Self-esteem in hearing-impaired children: the influence of communication, education, and audiological characteristics. *PLoS One*. 2014 Apr 10;9(4): e94521. doi: 10.1371/journal.pone.0094521. PMID: 24722329; PMCID: PMC3983202.
- Tomblin JB, Oleson JJ, Ambrose SE, Walker E and Moeller MP. The influence of hearing aids on the speech and language development of children with hearing loss. *JAMA Otolaryngology—Head & Neck Surgery*, 2014;140(5): 403–9. <http://doi.org/10.1001/jamaoto.2014.267>
- World health organization. Global costs of unaddressed hearing loss and cost-effectiveness of interventions: a WHO report. 2017. doi: Licence: CC BY-NC-SA 3.0 IGO. (accessed on 17 June 2020).
- General Authority for Statistics. Disability Survey. Available online: [https://www.stats.gov.sa/sites/default/files/disability\\_survey\\_2017\\_en.pdf](https://www.stats.gov.sa/sites/default/files/disability_survey_2017_en.pdf) (accessed on 14 June 2020).
- Yılmaz R, Yazıcı MZ, Erdim İ, Kaya HK, Özcan Dalbudak Ş and Kayhan TF. Follow-Up Results of Newborns after Hearing Screening at a Training and Research Hospital in Turkey. *J Int Adv Otol*. 2016;12(1): 55-60. doi: 10.5152/iao.2015.1736.
- Warsy AS, Al-Jaser MH, Albdass A, Al-Daihan S and Alanazi M. Is consanguinity prevalence decreasing in Saudis?: A study in two generations. *Afr Health Sci*. 2014 Jun;14(2): 314-21. doi: 10.4314/ahs.v14i2.5. PMID: 25320579; PMCID: PMC4196414.
- Ibrahim NK, Bashawri J, Al Bar H, Al Ahmadi J, Al Bar A, Qadi M, Milaat W and Feda H. Premarital Screening and Genetic Counseling program: knowledge, attitude, and satisfaction of attendees of governmental outpatient clinics in Jeddah. *J Infect Public Health*. 2013 Feb;6(1): 41-54. doi: 10.1016/j.jiph.2012.05.001. Epub 2012 Nov 21. PMID: 23290092.
- Ministry of Health Portal (MOH). Premarital Screening [Internet]. 2017 [Accessed 2017 July 21]. Available from: <https://www.moh.gov.sa/en/healthawareness/before-marriage/Pages/default.aspx>.
- Lalani SR. Current Genetic Testing Tools in Neonatal Medicine. *Pediatr Neonatol*. 2017 Apr;58(2): 111-121. doi: 10.1016/j.pedneo.2016.07.002. Epub 2016 Sep 28. PMID: 28277305.
- Alswaidi FM, Memish ZA, O'Brien SJ, Al-Hamdan NA, Al-Enzy FM, Alhayani OA and Al-Wadey AM. At-risk marriages after compulsory premarital testing and counseling for  $\beta$ -thalassemia and sickle cell disease in Saudi Arabia, 2005-2006. *J Genet Couns*. 2012 Apr;21(2): 243-55. doi: 10.1007/s10897-011-9395-4. Epub 2011 Aug 9. PMID: 21826578.
- Nagakura H, Schneider G, Morris J, Lafferty KA and Palmer CG. Assessing deaf awareness training: knowledge and attitudes of recent genetic counseling graduates. *J Genet Couns*. 2015 Feb;24(1): 104-16. doi: 10.1007/s10897-014-9742-3. Epub 2014 Jul 18. PMID: 25030269.
- Haga SB, Kim E, Myers RA and Ginsburg GS. Primary Care Physicians' Knowledge, Attitudes, and Experience with Personal Genetic Testing. *J Pers Med*. 2019 May 24;9(2): 29. doi: 10.3390/jpm9020029. PMID: 31137623; PMCID: PMC6617198.
- Weiss PM. Examining the relationship between mental health professionals knowledge and beliefs as predictors of attitudes toward the deaf, Dissertation submitted to the graduate school of Wayne state university, for the degree of doctor of philosophy, 2016.
- Haga SB, Barry WT, Mills R, Ginsburg GS, Svetkey L, Sullivan J and Willard HF. Public knowledge of and attitudes toward genetics and genetic testing. *Genet Test Mol Biomarkers*. 2013 Apr;17(4): 327-35. doi: 10.1089/gtmb.2012.0350. Epub 2013 Feb 13. PMID: 23406207; PMCID: PMC3609633.

15. Quattrochi J, Biaba R, Nordås R, Østby G, Allmén S, Cikara A, Namegabe E and Amisi C. Effects of an empowerment program for survivors of sexual violence on attitudes and beliefs: evidence from the Democratic Republic of Congo. *Int J Equity Health*. 2019 Sep 18;18(1): 149. doi: 10.1186/s12939-019-1049-4. PMID: 31533738; PMCID: PMC6751604.
16. Soleiman EY, Shojaeizadeh D, Rahimi FA, Ghofranipour F and Ahmadi B. The Effect of an Intervention Based on the PRECEDE- PROCEED Model on Preventive Behaviors of Domestic Violence Among Iranian High School Girls. *Iran Red Crescent Med J*. 2013 Jan;15(1): 21-8. doi: 10.5812/ircmj.3517. Epub 2013 Jan 5. PMID: 23486646; PMCID: PMC3589774.
17. Linos N, Slopen N, Berkman L, Subramanian SV and Kawachi I. Predictors of help-seeking behaviour among women exposed to violence in Nigeria: a multilevel analysis to evaluate the impact of contextual and individual factors. *J Epidemiol Community Health*. 2014 Mar;68(3): 211-7. doi: 10.1136/jech-2012-202187. Epub 2013 Nov 11. PMID: 24218072.
18. Moussa S, Al-Zaylai F, Al-Shammari B, Al-Malqa KA, Al-Shammari SR and Al-Shammari TS. Knowledge and attitude towards premarital screening and genetic counseling program among female university students, Hail region, Saudi Arabia. *International Journal of Medical and Health Research*, 2018; 4(1): 1-6. Available at <http://www.medicalsciencejournal.com/archives/2018/vol4/issue1/3-11-46>
19. Bridget IO. Knowledge attitude and practice towards premarital/prenatal genetic testing among young people (15-45) years of age in Sapele local government area, delta state. Nigeria, *South American Journal of Academic Research*, 2015;2(1): 1–38.
20. Schuler SR and Rottach E. Women's Empowerment across Generations in Bangladesh. *J Dev Stud*. 2010 Mar;46(3): 379-396. doi: 10.1080/00220380903318095. PMID: 20847904; PMCID: PMC2938081.
20. Taghdisi MH, Estebarsari F, Dastoorpour M, Jamshidi E, Jamalzadeh F and Latifi M. The impact of educational intervention based on empowerment model in preventing violence against women. *Iran Red Crescent Med J*. 2014 Jul;16(7): e14432. doi: 10.5812/ircmj.14432. Epub 2014 Jul 5. PMID: 25237563; PMCID: PMC4166082.
21. Schwarzer R, and Jerusalem M Generalized Self-Efficacy scale. In J. Weinman, S. Wright, and M. Johnston, Measures in health psychology: A user's portfolio. Causal and control beliefs 1995;(pp. 35-37). Windsor, UK: NFER-NELSON.
22. Belhouli KM, Abdulrahman M and Alraei RF. Hemoglobinopathy carrier prevalence in the United Arab Emirates: first analysis of the Dubai Health Authority premarital screening program results. *Hemoglobin*. 2013;37(4): 359-68. doi: 10.3109/03630269.2013.791627. Epub 2013 May 7. PMID: 23647352.
23. Al Zeedi MASA and Al Abri ZG. Attitudes and impact among people with abnormal premarital screening test results in Muscat governorate's primary healthcare centers in 2018. *J Community Genet*. 2020 Nov 21. doi: 10.1007/s12687-020-00493-1. Epub ahead of print. PMID: 33222096.
24. Bener A and Mohammad RR. Global distribution of consanguinity and their impact on complex diseases: Genetic disorders from an endogamous population, The Egyptian journal of medical human genetics. October 2017;18(4): 315-320. <https://doi.org/10.1016/j.ejmhg.2017.01.002>
25. El-Hazmi MA, al-Swailem AR, Warsy AS, al-Swailem AM, Sulaimani R and al-Meshari AA. Consanguinity among the Saudi Arabian population. *J Med Genet*. 1995 Aug;32(8): 623-6. doi: 10.1136/jmg.32.8.623. PMID: 7473654; PMCID: PMC1051637.
26. Al-Kindi RM, Kannekanti S, Natarajan J, Shakman L, Al-Azri Z and Al-Kalbani NI. Awareness and Attitude Towards the Premarital Screening Programme Among High School Students in Muscat, Oman. *Sultan Qaboos Univ Med J*. 2019 Aug;19(3): e217-e224. doi: 10.18295/squmj.2019.19.03.007. Epub 2019 Nov 5. PMID: 31728219; PMCID: PMC6839672.
27. Al-Qahtani FS, Alfahad MI, Alshahrani AM, Almalih HS, Al-Malki ASQ, Alshehri TK, Alqhtani AAN, Al-Qahtani AM, Alfaiifi SH, Alasmari RFA, Bharti RK and Chaudhary S. Perception of premarital counseling among King Khalid University students. *J Family Med Prim Care*. 2019 Aug 28;8(8): 2607-2611. doi: 10.4103/jfmpc.jfmpc\_364\_19. PMID: 31548941; PMCID: PMC6753798.
28. Khalil EMF, Abdelkader SM, Alsaed MD and Alshahrany MN. Knowledge, Beliefs and behavior intention about premarital screening among King Saud University Female Students in Riyadh Sch. *J. App. Med. Sci*. 2014; 2(5E): 1797-1805. <https://fac.ksu.edu.sa/sababdelkader/publication/111013>
29. Ali M, Elshabory N, Hassan HE, Zahra N and Alrefai H. Perception about Premarital Screening and Genetic Counseling Among Males And Females Nursing Students IOSR-JNHS. 2018;7(1): 51-57. DOI: 10.9790/1959-0701065157
30. Alhowiti A and Shaqran T. Premarital Screening Program Knowledge and Attitude among Saudi University Students in TABUK City 2019, *International Journal of Medical Research & Health Sciences*, 2019;8(11): 75-84. <https://www.ijmrhs.com/abstract/premarital-screening-program-knowledge-and-attitude-among-saudi-university-students-in-tabuk-city-2019-19228.html>
31. Foluke BS. Uptake of premarital genetic counseling : awareness and demand –research, *Africa Journal of Nursing and Midwifery*, 2020; 22 (1) <https://doi.org/10.25159/2520-5293/5839>.
32. Melaibari M, Shilbayeh S and Kabli A. University

- Students' knowledge, attitudes, and practices towards the National Premarital Screening Program of Saudi Arabia. *J Egypt Public Health Assoc.* 2017 Mar 1;92(1): 36-43. doi: 10.21608/epx.2017.7008. PMID: 29924926.
33. Mohamed HA, Lamadah SM and Hafez AM. Improving knowledge and attitude of medical and non-medical students at El Minia University regarding premarital screening and counseling. *American Journal of Nursing Science.* 2015; 4(5): 270-9 doi: 10.11648/j.ajns.20150405.14
  34. Abd Elfattah H, Soliman SM and Amin FM. Premarital Genetic Counseling among Female Adolescents Students. *J Am Sci* 2015;11(6):218-225. <http://www.jofamericanscience.org>
  35. Mohamady SH, Said SAE and EL Sayed HA. Effect of Application of Health Belief Model on females' Knowledge and Practice regarding the premarital counseling. *IOSR-JNHS.* 2017; 6 (1): 05-15. DOI: 10.9790/1959-0601080515
  36. Baldwin EE, Boudreault P, Fox M, Sinsheimer JS and Palmer CG. Effect of pre-test genetic counseling for deaf adults on knowledge of genetic testing. *J Genet Couns.* 2012 Apr;21(2): 256-72. doi: 10.1007/s10897-011-9398-1. Epub 2011 Aug 5. PMID: 21818696; PMCID: PMC3313024.
  37. Bener A, Al-Mulla M and Clarke A. Premarital Screening and Genetic Counseling Program: Studies from an Endogamous Population. *Int J Appl Basic Med Res.* 2019 Jan-Mar;9(1): 20-26. doi: 10.4103/ijabmr.IJABMR\_42\_18. PMID: 30820415; PMCID: PMC6385533.
  38. Otovwe A, Sunday UI, Oghenenioborue Rume OB and Awulo DM. Knowledge and Attitude of Premarital Genotype Screening Among Women of Child-Bearing Age in Kumo-Akko Local Government Area of Gombe State Nigeria. *Open J Public Health.* 2019; 1(2): 1006. <http://www.remedypublications.com/open-journal-of-public-health-abstract.php?aid=5591>
  39. Shelby C. Borowski and Rachel B. Tambling. Applying the Health Belief Model to Young Individuals' Beliefs and Preferences About Premarital Counseling, *The family journal*, 2015;23(4): 417-426 <https://doi.org/10.1177/1066480715602221>
  40. Kotb MM, Almalki MJ, Hassan Y, Al Sharif A, Khan M and Sheikh K. Effect of Health Education Programme on the Knowledge of and Attitude about Sickle Cell Anaemia among Male Secondary School Students in the Jazan Region of Saudi Arabia: Health Policy Implications. *Biomed Res Int.* 2019 Jul 25;2019: 9653092. doi: 10.1155/2019/9653092. PMID: 31428653; PMCID: PMC6683794.