Premarital Screening and Genetic Counseling program: Studies from an Endogamous Population

Abdulbari Bener 1,2, Mariam Al-Mulla 3, Angus Clarke 5

1 Dept. of Biostatistics & Medical Informatics, Cerrahpaşa Faculty of Medicine, Istanbul University, Istanbul, Turkey
2 Dept. of Evidence for Population Health Unit, School of Epidemiology and Health Sciences, University of Manchester, Manchester, UK
3 Istanbul Medipol University, International School of Medicine, İstanbul, Turkey
4 Dept. of Pediatrics Genetics, Hamad Medical Corporation, Qatar
5 Division of Cancer & Genetics, Institute of Medical Genetics Building, School of Medicine, Cardiff University, Heath Park Cardiff CF14 4XN Cardiff, UK

Key words: Knowledge and attitude; Premarital Screening Program; Premarital testing; Consanguinity; Qatar.

Running headline: Premarital Screening and Genetic Counseling in consanguineous Arab population

Correspondence to:
Prof. Abdulbari Bener
Advisor to WHO
Professor of Public Health
Dept. of Biostatistics & Medical Informatics
Cerrahpaşa Faculty of Medicine
Istanbul University
34098 Cerrahpasa-Istanbul,
TURKEY
Mobile:+90-535 663 9090
Tel: +90-212-414 3041
Fax:+90-212-632 0033
email: abdulbari.bener@istanbul.edu.tr
email:abener99@yahoo.com
Summary

**Background:** Studies in Arab countries have shown a significant lack of knowledge of Premarital Screening and Genetic Counseling [PMSGC] Program. PMSGC can identify and modify, through prevention and management, some behavioral, medical, and other health risk factors known to impact pregnancy outcomes.

**Objective:** The aim of this study was to explore the knowledge, attitudes and practice of Qatari's towards the premarital screening program and shedding more light on a complex matter.

**Subjects and Methods:** A cross-sectional study based on Hospitals and Primary Health Care Centers [PHC]. A total sample of 1,246 subjects was surveyed and 873 subjects (70.0%) expressed their consent to participate in the study during January 2013 - May 2014. The questionnaire based on socio-demographic data and for responses, on the PMSGC program knowledge, attitude and practice statements. Additionally, questions was asked regarding the services, activities and how to attract and motivate the PMSGC program.

**Results:** The mean age and SD of the males age was 30.4 ± 6.50, the mean and SD of females age was 31.08 ± 5.98. There were statistically significant differences between males and females with regards to age, educational status, occupation status, household income, consanguinity, BMI, cigarette smoking and sheesha smoking. There was no any statistically significant differences between males and females regarding Sickle Cell, Anaemia Thalassemia), Glucose 6 phosphate dehydrogenase deficiency (G6PD) Cystic Fibrosis, Homocystinuria, HIV, and Hepatitis. The response to the ‘Why proceeding high risk of marriage by gender, males and females responded statistically significant differences (p = 0.019). The stepwise multivariate regression analyses as predictors for knowledge of PMSGC program Program revealed that age, educational level, the lack knowledge of Genetics Counseling, Parental interventions for cousin marriage decision, positive test results affect & change marriage decision, religious impact, household income, consanguinity, hereditary diseases knowledge, occupational status and love factors were considered as the main factors associated with the pre-marriage screening and genetics counseling after adjusting for age, gender and other variables.

**Conclusion:** The current study revealed that knowledge and attitude regarding PMSGC program was low in population. Motivation, enforcement and implementation of program at the school and university educational campaigns is vital. Improved counseling and adding new topics for counseling on genetic, chronic, and mental illness; building healthy families; reproduction and fertility are top priority in community.
INTRODUCTION

Genetic carrier screening programmes are systematic programmes that are generally recommended by government health bodies, making screening available to the entire population of asymptomatic individuals or relevant sections of the population whose risk of particular genetic diseases is known to be increased or for whom carrier status information may be especially relevant [1-3]. As such, they are designed to determine whether individuals are at increased risk for particular genetic diseases or if they carry a genetic predisposition that may produce a disease in their offspring [2-3].

The Premarital Screening and Genetic Counseling (PMSGC) programme in Qatar was established by law in 2006 and implemented from December 2009 [1]. The PMSGC programme involves the promotion of health and well-being for a woman and her partner before pregnancy and is considered a primary preventive approach for couples planning conception and an important step towards promoting well-being throughout society [4-9]. This programme includes premarital health counselling and a general medical examination [4]. Premarital examinations can particularly be important in the prevention of the spread of diseases [5]. PMC can identify and modify, through prevention and management, some behavioral, medical, and other health risk factors known to impact pregnancy outcomes [4-9]. The process should educate couples and provide them with accurate and unbiased information. Premarital education and counseling seem to be effective in strengthening marriages and have clearly been shown to be beneficial [9] and premarital prevention programs are generally effective in producing immediate and short-term gains in interpersonal skills and the overall quality of relationships [10].

However, several countries, mostly Mediterranean and Islamic countries [4-14], such as Cyprus, Saudi Arabia, Iran, Bahrain, United Arab Emirates, Palestine, Jordon, and Qatar, have laws in place that make premarital screening programmes mandatory for the entire population before couples receive their marriage certificates [5]. Most of these countries have implemented mandatory premarital screening programmes due to the high prevalence of consanguineous marriage (20–60%) [11]. The State of Qatar has recently enacted a law making the premarital screening programme mandatory (19 December 2009) [1] and this programme screens for four inherited diseases, of which three follow autosomal recessive inheritance and one is sex-linked. The selection of the genetic diseases was based on genetic disease allele frequency among the Qatari population. Haemoglobinopathies, cystic fibrosis, spinal muscular atrophy, and homocystinuria are genetic diseases that are highly prevalent in Qatar. In addition, in an attempt to prevent the spread of infectious diseases, the premarital screening programme test includes certain types of immune diseases, such as HIV and hepatitis, as well as checking rubella
immunity in women as recommended by the Supreme Council of Health in Qatar [1]. Premarital screening can potentially reduce the burden of inherited hemoglobin diseases by reducing the number of high-risk marriages [4-5,8-9]. In addition, the implementation of premarital infectious disease screening is an ambitious and massive project with regard to cost and impact [5,8]. Premarital programs are most successful when they address social, religious, ethnic, and cultural factors [8]. Couples wishing to get married are advised to visit one of the accredited Primary Health Care [PHC] Centres in Qatar to undergo the appropriate medical examination. The objective of the genetic screening programme, cited by many health systems, is the reduction of the prevalence of a genetic disease by identifying carrier couples at-risk of having affected children, thus enabling them and the health care system to reduce the burden of the genetic disorders on individuals and their families. This is facilitated by offering carrier couples information regarding the potential health of their future offspring [2-3]. The purpose of this study was to assess the knowledge, attitudes and practice of Qatari men and women regarding the PMSGC to identify the predictors of high knowledge scores and to explore the best way of presenting information about the PMSGC programme.

MATERIALS AND METHOD

This study comprises an administered, cross-sectional questionnaire survey conducted at the Primary Health Care (PHC) Centres and Hospitals in the State of Qatar. The survey was conducted among Qatari national and Arab women aged 18-40 years old. Semi-structured but questionnaire-based interviews, conducted in English and Arabic, were held during the period from January 2013 to May 2014. The responses were stratified by age, gender and the presence of consanguinity. In addition, questions assessing the knowledge, attitudes and practice of participants towards the PMSGC programme were asked, using the following format:

1. The first part of the questionnaire elicited information regarding the respondents’ personal and socio-demographic characteristics, their degree of consanguinity and family history of hereditary genetics diseases. The questionnaire also asked the subjects about their sources of knowledge for the PMSGC program.

2. General Knowledge regarding investigations in the PMSGC (8 items): The subjects were asked, such as Cystic Fibrosis, Hemoglobinopathy (Sickle Cell Anaemia and Thalassemia), glucose 6 phosphate dehydrogenase deficiency (G6PD). Also, their knowledge was also assessed regarding the infectious diseases screened in the program such as hepatitis and AIDS. Knowledge was assessed by the accuracy of each person’s selection of one answer for each statement out of four options for each.
3. Evaluating subjects’ attitudes toward premarital screening (19 items): These questions aimed to measure the respondents’ general level of awareness and their attitude towards the topic. Participants were asked about their attitude towards the PMSGC and about the misconception that the PMSGC violates Islamic rules. The subjects’ opinions regarding whether consanguinity may increase the risk of hereditary diseases and whether the PMSGC program is expected to decrease the prevalence of some genetic and sexually transmitted diseases (STDs) were also addressed. Questions were asked regarding the importance of counselling in reducing and preventing the spread of genetic diseases or STDs and whether religious leaders should adopt the ideas of the PMSGC to be discussed on different occasions. Patients were asked to answer the questions by grading them from 1 to 5; 1 for “strongly agree”, 2 for “agree”, 3 for “Moderately agree“; 4 for “Moderately disagree”; 5 for “disagree”, and 6 for “strongly disagree”.

4. General questions regarding the PMSGC program practice. Several questions were asked regarding the services, how they have been implemented and how to attract and motivate people towards the PMSGC programme. What type of PMSGC initiatives would be the most effective? The participant was also asked if there was a description of the counselling and the benefits and accuracy of screening for these diseases or not?

The data were collected through a validated self-administered questionnaire based on face-to-face interviews by physicians and qualified nurses using the local language. The nurses were aware of the Arabic culture and were able to persuade many study participants to take part in this survey even when they were not initially enthusiastic. Data collection took place from January 2013 to May 2014. Of the 22 primary health care centers available, we selected 12 health centers on a random sampling basis; of these, 10 were located in urban and 2 in semi-urban areas of Qatar. PHC centers are frequented by all levels of the general population as a gateway to specialist care. Finally, subjects were simply recruiting alternate patients 1-in-2 using a systematically sampling procedure. Each participant was provided with brief information about the study and was assured of strict confidentiality. A multi-stage sampling design was used and a total sample of 1,246 males and females aged 18-40 years were approached; 873 subjects agreed to participate (70.0%) and responded to the study. The survey instrument was initially tested for validation on 50 patients through face to face interview who visited the health centres. Internal consistency in the present study was explored for each scale, and Cronbach’s alpha coefficients was adequate (0.82), confirming a high level of consistency among the different Likert items in this scale.

Data was analyzed using SPSS Windows version # 22. Student-t test was used to ascertain the significance of differences between the mean values of two continuous variables.
The Chi-square and Fisher’s exact tests (two-tailed) were performed to test for differences in proportions of categorical variables between two or more groups. Reliability (internal consistency) of the questionnaire was tested by Cronbach’s alpha coefficient and the acceptable value to be met was >0.70. Multivariate regression analysis using the forward inclusion and backward deletion method was used to assess the relationship between dependent and independent variables and to adjust for potential confounders and orders the importance of factors (determinants) for knowledge score about pre-marriage screening and genetics counseling. All statistical tests were two-sided and P < 0.05 was considered statistically significant.

RESULTS

873 males and females agreed to participate and were included in the study. The mean age and SD of the males age was 30.4 ± 6.50, the mean and SD of females age was 31.08 ± 5.98.

Table 1 shows the socio-demographic characteristics of the subjects by gender. There were statistically significant differences between males and females with regards to age, educational status, occupation status, household income, consanguinity, BMI, cigarette smoking and sheesha smoking.

Table 2 shows the knowledge of premarital screening and genetics counseling programme by gender. There were no statistically significant differences between males and females regarding knowledge score of Haemoglobinopathies (Sickle Cell Anaemia and Thalassemia), Glucose 6 phosphate dehydrogenase deficiency (G6PD), Cystic Fibrosis, Homocystinuria, HIV, and Hepatitis.

Table 3 reveals the attitude of subjects towards the Premarital Screening and Genetic Counselling Programme. There were statistically significant differences between males and females regarding their attitudes towards the PMSGC programme both in principle and as they had experienced it in practice. The women were more aware of inherited diseases and the risks of genetics, PMC and STDs. Why proceeding high risk of marriage by gender. The study population majority indicated social (males28.4% vs females 22.9%), religious (male 16.5% vs females 23.9%), family or parental interventions (males 20.0% vs female 18.9%), and love (males 19% v female 15%), there was statistically significant differences between males and females response (p = 0.019).

Table 5 gives the results of stepwise multivariate regression analyses as predictors for knowledge of the Premarital Screening and Genetic Counselling Programme and some associated covariates. As can be seen from this table, the participant’s age, educational level, knowledge of Genetic Counseling, their parents’ intervention to support a decision for marriage to a cousin, the effect of a positive test result and the possibility of changing a decision about
marriage, the impact of religion, household income, consanguinity, knowledge concerning hereditary disease, occupational status and strength of love and attachment were considered as the main factors associated with the pre-marriage screening and genetic counseling, after adjusting for age, gender and other variables.

**DISCUSSION**

The nature of a screening programme depends greatly on the stage of life at which it is made available. Worldwide, genetic screening programmes are conducted either before or after birth, or in adolescents and adults before conception but while they are considering marriage and reproduction [1-15-16]. Those conducted before birth, such as screening of foetal DNA in maternal blood, maternal serum screening, and ultrasound screening, are designed to detect genetic disorders or malformations during early pregnancy, thus allowing couples to consider whether to terminate or continue the pregnancy. If a couple decides to continue the pregnancy, the early diagnosis enables the couples and the healthcare provider to plan for the child’s delivery, treatment and follow-up care [1-2-4,8]. The Supreme Council of Health of Qatar stated that they do not prevent high-risk marriages and they only try to educate the couples about their possibility of having an child affected by disease, possible preventive measures, available treatments and other information about the condition. Therefore, the decision about marriage is left to the couple after they have attended a genetic counselling session; this is consistent with other reported studies [5-10,12-15].

According to a recent study in the State of Qatar, the rate of first and second cousin marriage appears highest there, having increased nearly 30 per cent from the previous generation so that it is now over 50 per cent and confirmative with the previous studies [1-2,11].

On its own, marriage between cousins, or consanguinity, is not necessarily problematic. But many debilitating genetic disorders - including sickle cell anemia, cystic fibrosis, spinal muscular atrophy, and many forms of mental retardation and epilepsy - can be up to 20 times more frequent among populations in which cousin marriages are common [19]. The issue in the current study is not cousin marriage *per se*; the issue here is to avoid the inherited diseases that can result from this practice. Marriage between second cousins or more distant relations has much less impact on the incidence of genetic disorders, yet the children of first cousins, who share 12.5 per cent of their genes, are nearly twice as likely as the general population to contract such a disorder. Within populations that intermarry regularly over generations, the incidence of disorders can increase exponentially [17-19].

In the Gulf, most cousin marriages are between first cousins [1-2]. Recently several studies [17-19] found that a handful of genetic diseases have reached epidemic levels (more than
100 cases per 100,000) in several Gulf countries. This of course includes Down syndrome, as the usual incidence is around 1 in 800 (varying on the basis of maternal age), but it does seem that some complex disorders of multi-factorial causation, and not only those of autosomal recessive inheritance, are more frequent in populations with high levels of consanguinity. The report also found that Arabs have one of the world's highest rates of genetic disorders, nearly two-thirds of which are linked to consanguinity [2-3, 17-19].

These results indicate that more effort needs to be made in developing public health strategies to improve the population's understanding of the chances of disease arising in the children of consanguineous marriages. In many Muslim countries, meanwhile, cousin marriage represents about 35-40% of all unions. It is also increasing across the Gulf. In fact, the children of wealthy families tend to marry the children of other wealthy families or of their own extended family; perhaps the rich like to protect their wealth. Therefore, consanguinity remains a common custom, at least partly for economic reasons, and perhaps also partly for cultural reasons. Meanwhile, Qatar's Supreme Council of Health aims to change that culture, with an outreach campaign that includes workshops, online information, university lectures and the distribution of educational CDs, brochures and pamphlets [1]. The screening programme is meant to reinforce that process. Couples are tested for both communicable and genetic diseases. Doctors warn of any disorders likely to be passed to each other or to their potential future offspring, but cannot withhold a marriage license due to any health risks. The final decision rests with the betrothed. It might be worthwhile to develop standardized protocols that address knowledge, awareness and practice in relation to the PMSGC programme in daily clinical practice. In addition, increasing the number of educational programs in media, such as Internet web pages, religious scholars, TV channels, radio and newspapers is an option which should be considered for mass outreach.

There are several limitations of this study. First, this is a cross sectional study and, therefore, subjects might be misclassified in this analysis and it is not possible to conclude that the associations recognized are necessarily causal. Second, although the study sample was diverse in terms of geographic region of origin within Qatar and race/ethnicity, it may not have been entirely representative of the Qatari population as it (a) was based on couples visiting PHC Clinics and (b) the sample included a modest excess of females (54%). Hence, the results may not be generalizable to the population of all pre-marriage subjects. The results must be interpreted in the context of these limitations.

**Conclusion**
The current study revealed that knowledge, in relation to the PMSGC programme was low in the population, attitudes were not highly positive and practical engagement was only modest. School and university educational campaigns to reinforce knowledge about the programme and enhance motivation to comply with it are very important. Improved counselling and the addition of information on new topics including genetic conditions, chronic disease and mental illness are also important for the building of healthy families. Reproduction and fertility are top priorities for health care in this community.

Contributors

AB and MA were involved in data collection, statistical analysis, interpretation of data and writing the manuscript. AC was involved in analysis, interpretation of data, writing and editing the manuscript. All authors approved the final version.

Conflict of interest

All authors declare that they have no conflicts of interest.

ACKNOWLEDGEMENT

The authors would like to thank the Hamad Medical Corporation and Primary Health Corporation for their support and ethical approval (HMC RC#12240/12).

REFERENCES

1. Qatar National Development Strategy 2011-216 Ministry of Planning and Development, Qatar General Secretariat for Development Planning. March 2011, Doha, Qatar.
2. Bener A, Hussain R. Consanguineous unions and child health in Qatar. Paediatr Perinat Epidemiol 2006; 20:372-378.
3. Bener A, Hussain R, Teebi AS. Consanguineous marriages and their effects on diseases: studies from an endogamous population. Medical Princip & Practice 2007; 16(4):262-7.
4. Abd Al Azeem ST, Elsayed ET, El Sherbiny NA, Ahmed LA. Promotion of knowledge and attitude towards premarital care: an interventional study among medical student in Fayoum University. J Public Health Epidem 2011;3(3):121-8.
5. Ibrahim NK, Al Bar H, Fakeeh A, Al Ahmadi J, Qadi M, Al-Bar A, et al. An educational program about premarital screening for unmarried female students in King Abdul Aziz University, Jeddah. J Infect Public Health;4(1):30-40.
6. Alam AA. Perception of female students of king Saud University towards premarital screening. J Family Community Med 2006;13(2): 83-8.
7. Al Sulaiman A, Suliman A, Al Mishari M, Al Sawadi A, Owaidah TM. Knowledge and attitude toward the hemoglobinopathies premarital screening program in Saudi Arabia: population-based survey. Hemoglobin 2008;32(6):531-8.

8. Memish ZA, Saeedi MY. Six-year outcome of the national premarital screening and genetic counselling program for sickle cell disease and β-thalassemia in Saudi Arabia. Ann Saudi Med. 2011;31(3):229-35

9. Alswaidi FM, O, Brien SJ. Premarital screening programs for haemoglobinopathies, HIV and hepatitis viruses: review and factors affecting their success. J Medical Screen 2009;16:22-8.

10. Carroll JS, Doherty WJ. Evaluation the effectiveness of premarital programs: a meta-analytic review of outcome research. Family Relations, Minneapolis 2003;52(2):105-29.

11. Bener A, Alali KA: Consanguineous marriage in a newly developed country: the Qatari population. J Biosoc Sci. 2006;38(2):239-46

12. Adibi P, Hedayati S, Mohseni M. Attitude towards premarital screening for hepatitis B virus infection in Iran. Medical Screening 2007;14:43-5.

13. Gilani AI, Jadoon AS, Qaiser R, Nasim S, Meraj R, Nasir N, Naqvi FF, Latif Z, Memon MA, Menezes EV, Malik I, Memon MZ, Kazim SF, Ahmad U. Attitudes towards genetic diagnosis in Pakistan: a survey of medical and legal communities and parents of thalassemic children. Community Genet. 2007;10(3):140-6.

14. Al-Hamdan NA, Al-Mazrou YY, Al-Swaidi FM, Choudary AJ. Premarital screening for thalassemia and sickle cell disease in Saudi Arabia. Genetics in Medicine 2007;9:372-7.

15. Gan-Schreier H, Kebbewar M, Fang-Hoffmann J, Wilrich J, Abdoh G, Ben-Omran T, Shahbek N, Bener A, Al Rifai H, Al Khal AL, Lindner M, Zschocke J, Hoffmann GF. Newborn population screening for classic homocystinuria by determination of total homocysteine from Guthrie cards. J Pediatr. 2010 Mar;156(3):427-32.

16. Lindner M, Abdoh G, Fang-Hoffmann J, Shabeck N, Al-Sayrati M, Al-Janahi M, Ho S, Abdelrahman MO, Ben-Omran T, Bener A, Schulze A, Al-Rifai H, Al-Thani G, Hoffmann GF. Implementation of extended neonatal screening and a metabolic unit in the State of Qatar: developing and optimizing strategies in cooperation with the Neonatal Screening Center in Heidelberg. J Inherit Metab Dis. 2007 Aug;30(4):522-9

17. Teebi AS, El-Shanti HI. Consanguinity: implications for practice, research, and policy. Lancet. 2006 Mar 25;367(9515):970-1

18. Teebi AS, Teebi SA. Genetic diversity among the Arabs. Community Genet.2005;8(1):21-6

19. Teebi AS, Teebi SA, Porter CJ, Cuticchia AJ. Arab genetic disease database (AGDDDB): a population-specific clinical and mutation database. Hum Mutat. 2002 Jun;19(6):615-21.
Table 1. The socio-demographic of studied subjects by gender N = 873

| Variable                        | Total (n=873) | Males(n=401) | Females (n=472) | p   |
|---------------------------------|---------------|--------------|-----------------|-----|
| **Age in Years**                |               |              |                 |     |
| 18-29 Years old                 | 481 (55.1)    | 237 (59.1)   | 244 (51.7)      | 0.028 |
| 30-40 Years old                 | 392 (44.9)    | 164 (40.9)   | 228 (48.3)      |     |
| **Education Level**             |               |              |                 |     |
| Illiterate                      | 33 (3.8)      | 6 (1.5)      | 27 (5.7)        | 0.002 |
| Elementary                      | 44 (5.0)      | 18 (20.0)    | 26 (20.2)       |     |
| Intermediate                    | 114 (13.1)    | 57 (14.2)    | 57 (12.1)       |     |
| Secondary                       | 393 (45.0)    | 170 (42.4)   | 223 (47.2)      |     |
| University                      | 289 (33.1)    | 150 (37.4)   | 139 (29.4)      |     |
| **Occupation**                  |               |              |                 |     |
| Student                         | 126 (14.4)    | 31 (7.7)     | 95 (20.1)       |     |
| Sedentary Professional          | 196 (22.5)    | 109 (27.2)   | 87 (18.4)       |     |
| Clerk/Manual                    | 337 (38.6)    | 150 (37.4)   | 187 (39.6)      | <0.001 |
| Businessman                     | 61 (7.0)      | 43 (10.7)    | 18 (3.8)        |     |
| Arm/Police                      | 85 (9.7)      | 68 (17.0)    | 17 (3.6)        |     |
| Housewife                       | 68 (7.8)      | 0 (0)        | 68 (14.4)       |     |
| **Household Income**            |               |              |                 |     |
| <$1,500 US Dollars              | 46 (5.3)      | 15 (3.7)     | 31 (6.6)        |     |
| $1,500-$3,499                   | 274 (31.4)    | 120 (29.9)   | 154 (32.6)      | <0.001 |
| $3,500-$5,499                   | 286 (32.8)    | 175 (43.6)   | 111 (23.5)      |     |
| =>$5,500                       | 267 (30.6)    | 91 (22.7)    | 176 (37.3)      |     |
| **Consanguinity**               |               |              |                 |     |
| Yes                             | 299 (34.2)    | 153 (38.2)   | 146 (30.9)      | 0.025 |
| No                              | 574 (65.8)    | 248 (61.8)   | 326 (69.1)      |     |
| **BMI**                         |               |              |                 |     |
| Normal (<25 Kg/m²)              | 267 (24.3)    | 145 (27.8)   | 122 (21.0)      | 0.031 |
| Overweight (25-30 Kg/m²)        | 548 (49.7)    | 246 (47.2)   | 302 (52.1)      |     |
| Obese (30+ Kg/m²)               | 286 (26.0)    | 130 (25.0)   | 156 (26.9)      |     |
| **Place of Living**             |               |              |                 |     |
| Urban                           | 732 (83.8)    | 335 (83.5)   | 397 (84.1)      | 0.820 |
| Semi-Urban                      | 141 (16.2)    | 66 (16.5)    | 75 (15.9)       |     |
| **Cigarette smokers**           |               |              |                 |     |
| Yes                             | 103 (11.8)    | 62 (15.5)    | 41 (8.7)        | 0.002 |
| No                              | 770 (88.2)    | 339 (84.5)   | 431 (91.3)      |     |
| **Sheesha smokers**             |               |              |                 |     |
| Yes                             | 130 (14.9)    | 49 (12.2)    | 81 (17.2)       | 0.041 |
| No                              | 743 (85.1)    | 352(87.8)    | 391(82.8)       |     |
### Table 2 Knowledge of Premarital Screening and Genetic Counseling program: (N = 873)

|   | Description                                                                 | Males (%) | Females (%) | p-value |
|---|------------------------------------------------------------------------------|-----------|-------------|---------|
| 1-| **What are the genetic conditions the programme screens for?**               |           |             |         |
| a-| (Haemoglobinopathies, Cystic Fibrosis, Homocystinuria, HIV, and Hepatitis)  | 30.9      | 27.8        | 0.591   |
| b-| (Haemoglobinopathies, Down syndrome, Cystic Fibrosis, HIV, and Hepatitis)  | 21.9      | 24.4        |         |
| c-| (Homocystinuria, Cystic Fibrosis, HIV, and Hepatitis)                       | 23.4      | 25.6        |         |
| d-| Don’t know                                                                  |           |             |         |
| 2-| **Which of the following statements best describes Haemoglobinopathy:**     |           |             |         |
| a-| It is a skin disease                                                        | 23.2      | 23.9        | 0.792   |
| b-| Mental illness                                                              | 24.2      | 26.5        |         |
| c-| Blood disorder                                                              | 24.7      | 24.2        |         |
| d-| Don’t know                                                                  | 27.9      | 25.4        |         |
| 3-| **Which of the following statements best describes Homocystinuria:**        |           |             |         |
| a-| It is a brain disorder                                                       | 23.7      | 24.8        | 0.880   |
| b-| It is a eye disorder                                                        | 20.9      | 21.0        |         |
| c-| It is a food metabolism disorder                                            | 29.9      | 27.5        |         |
| d-| Don’t know                                                                  | 25.4      | 26.7        |         |
| 4-| **Which of the following statements best describes Cystic Fibrosis:**       |           |             |         |
| a-| It is a lung disorder                                                       | 24.2      | 27.8        | 0.636   |
| b-| It is a muscle disorder                                                     | 24.2      | 24.2        |         |
| c-| It is a bone disorder                                                       | 24.4      | 23.5        |         |
| d-| Don’t know                                                                  | 27.2      | 24.6        |         |
| 5-| **Which of the following statements best describes Glucose 6 phosphate**    |           |             |         |
| d-| dehydrogenase deficiency (G6PD)?                                            | 23.4      | 26.1        | 0.735   |
| a-| It is a hereditary abnormality in the activity of an erythrocyte (red blood cell) enzyme | 26.9      | 24.2        |         |
| b-| It is a lung disease                                                        | 24.2      | 24.6        |         |
| c-| It is brain disorder                                                        | 25.4      | 25.2        |         |
| d-| Don’t know                                                                  |           |             |         |
| 7-| **Which of the following statements best describes hepatitis?**             |           |             |         |
| a-| It is the final stage of infection, when your body can no longer fight life-threatening infec. | 26.2      | 22.2        | 0.59    |
| b-| It is a muscle disorder                                                     | 24.7      | 26.5        |         |
| c-| It is an inflammation of the liver or condition can be self-limiting or can progress to fibrosis (scarring), cirrhosis or liver cancer | 23.4      | 25.0        |         |
| d-| Don’t know                                                                  | 25.7      | 26.3        |         |
| 8-| **Which of the following statements best describes AIDS:**                  |           |             |         |
| a-| It is a chronic, potentially life-threatening & caused by the human immunodeficiency virus | 27.9      | 23.3        | 0.067   |
| b-| It is a lung disorder                                                       | 20.7      | 26.7        |         |
| c-| It is a Liver disorder                                                      | 27.2      | 23.1        |         |
| d-| It is kidney disorder                                                       | 24.2      | 26.9        |         |
Table 3. Knowledge and Attitude of subjects towards Premarital Screening and Genetic Counselling Program [PMSGC]

| Sentences for PMSGC and Genetics Counseling | 1 Strongly agree M / F | 2 Agree M / F | 3 Moderate agree M / F | 4 Moderate disagree M / F | 5 Disagree M / F | 6 Strongly disagree M / F |
|--------------------------------------------|------------------------|--------------|------------------------|--------------------------|----------------|--------------------------|
| 1 Premarital Care Screening is important (p<0.001) | 22.4 / 16.3 | 17.7 / 19.9 | 19.0 / 19.5 | 19.7 / 13.8 | 17.5 / 20.1 | 3.7 / 10.4 |
| 2 Consanguinity may lead to hereditary diseases with increased risk for affected babies (p=0.046) | 24.9 / 22.7 | 21.7 / 16.7 | 16.0 / 18.9 | 17.0 / 14.6 | 14.7 / 16.7 | 5.7 / 10.4 |
| 3 PMSGC will help reduction of genetics and STDs diseases (p<0.001) | 28.2 / 27.8 | 22.7 / 15.3 | 16.0 / 16.7 | 16.0 / 14.2 | 14.7 / 15.6 | 2.5 / 10.5 |
| 4 Inclusion PMSGC in Curricula is essential | 29.4 / 28.4 | 20.7 / 17.8 | 18.0 / 15.0 | 13.0 / 14.0 | 12.2 / 14.8 | 6.7 / 10.0 |
| 5 Implementation of PMSGC by law may reduce risk of STDs and Hereditary diseases | 26.4 / 26.9 | 20.0 / 16.3 | 17.5 / 13.6 | 15.0 / 18.6 | 17.0 / 14.4 | 4.2 / 10.2 |
| 6 Monitoring PMSGC by MoH (p<0.001) | 29.2 / 21.6 | 14.7 / 12.7 | 15.5 / 18.6 | 18.5 / 17.6 | 18.0 / 18.4 | 4.2 / 11.0 |
| 7 Monitoring strictly Confidentiality of test results (p<0.005) | 25.4 / 19.7 | 23.2 / 23.5 | 16.7 / 17.8 | 19.2 / 18.6 | 11.0 / 9.3 | 4.4 / 11.0 |
| 8 Religious people should deliver message as importance of PMSGC (p<0.001) | 25.4 / 19.7 | 23.2 / 23.5 | 16.7 / 17.8 | 19.2 / 18.6 | 11.0 / 9.3 | 4.4 / 11.0 |
| 9 Raising awareness about PMSGC before marriage to reduce risk of genetics STDs disease (p<0.001) | 36.7 / 26.3 | 15.2 / 19.9 | 16.7 / 13.8 | 14.5 / 14.0 | 12.7 / 15.2 | 4.2 / 10.8 |
| 10 Do you believe that the compulsory law can obligate all future couple to conduct PMSGC? (p=0.016) | 26.7 / 25.0 | 20.7 / 14.4 | 19.5 / 18.2 | 13.5 / 17.8 | 15.5 / 16.1 | 4.2 / 8.5 |
| 11 In a case having STDs, marriage decision must be left for freedom of the couple (p=0.172) | 30.7 / 29.7 | 22.4 / 24.4 | 19.2 / 17.2 | 13.7 / 12.3 | 9.7 / 8.0 | 4.2 / 8.6 |
| 12 PMSGC may breaks personal privacy (p<0.001) | 30.7 / 23.5 | 17.2 / 17.2 | 14.0 / 17.8 | 15.5 / 14.2 | 18.5 / 16.1 | 4.2 / 11.2 |
| 13 In a case of carrying genetics or inherited diseases, marriage decision must be left for freedom of the couple (p<0.006) | 32.4 / 29.2 | 16.7 / 15.5 | 16.0 / 13.8 | 16.7 / 17.6 | 14.2 / 12.9 | 4.0 / 11.0 |
| 14 Positive test results that indicates presence of genetic disease should affect and change marriage decision (p=0.004) | 30.2 / 28.4 | 15.7 / 17.4 | 18.7 / 16.5 | 15.7 / 13.3 | 15.7 / 13.1 | 4.0 / 11.2 |
| 15 Marriage appointment and certificate can be provided conditionally PMSGC document (p=0.03) | 26.4 / 25.6 | 18.2 / 18.9 | 20.9 / 15.7 | 15.7 / 13.8 | 14.7 / 14.6 | 4.0 / 11.4 |
| ‘Do you think performing PMSGC at school level is helpful? (p=0.115) | 30.4 / 30.7 | 21.4 / 19.5 | 12.2 / 13.8 | 14.2 / 13.6 | 17.2 / 14.2 | 4.5 / 8.3 |
| 17 Do you believe testing would make future marriage difficult=0.088 | 27.2 / 29.7 | 23.4 / 22.2 | 17.5 / 15.9 | 11.5 / 8.3 | 16.5 / 15.7 | 4.0 / 8.3 |
| 18 PMCS and Genetics Counseling is avoiding unnecessary risks (p=0.049) | 27.4 / 26.3 | 20.0 / 24.2 | 18.2 / 14.2 | 16.6 / 14.6 | 13.4 / 12.5 | 4.6 / 8.3 |
| 19 Cousin marriage may involve too much parental intervention (p<0.001) | 24.2 / 23.9 | 20.7 / 13.3 | 19.2 / 18.2 | 17.5 / 17.8 | 14.5 / 16.1 | 4.0 / 10.6 |

(All percentages are rounded to the nearest whole number.)
Table 4. Stepwise multiple regression analysis as predictors affecting Premarital Screening and Genetic Counselling Program [PMSGC] *.

| Parameter                                               | Regression Coefficient | Std Error | t-test Value | p-value |
|---------------------------------------------------------|------------------------|-----------|--------------|---------|
| Cousin marriage involve too much parental interventions | 3.832                  | 1.020     | 3.745        | <0.001  |
| Educational level                                       | 7.958                  | 0.916     | 8.687        | <0.001  |
| Lack knowledge of Genetics Counseling                   | 5.474                  | 0.856     | 6.394        | <0.001  |
| Parental interventions for cousin marriage decision     | 0.109                  | 0.021     | 5.190        | <0.001  |
| Positive test results affect & change marriage decision | 0.804                  | 0.196     | 4.102        | <0.001  |
| Religious impact                                        | 0.786                  | 0.212     | 3.707        | <0.001  |
| Household income                                        | 2.773                  | 0.816     | 3.398        | 0.002   |
| Consanguinity                                           | 3.708                  | 1.350     | 2.746        | 0.007   |
| Hereditary diseases knowledge                           | 0.586                  | 0.221     | 2.652        | 0.008   |
| Occupation status                                       | 0.051                  | 0.022     | 2.318        | 0.032   |
| Love factor                                             | 0.796                  | 0.385     | 2.07         | 0.039   |

*Adjusted for age, gender and other variables.