ORIGINAL ARTICLE

PREVALENCE OF THALASSEMIA AND SICKLE CELL DISEASE IN NORTHERN BORDER REGION OF SAUDI ARABIA

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Background: Inherited haemoglobin disorders (haemoglobinopathies) are predominantly single-gene autosomal recessive disorders that result in production of structurally abnormal haemoglobin variants (sickle-cell disease) or a reduction in the synthesis of structurally normal globin (β-thalassemia). The objective of this study was to see the prevalence of thalassemia and sickle cell disease in Northern Border Region of Saudi Arabia and to counsel the couples for pre-marital screening of blood to avoid the disease. **Methods:** This was retrospective study carried out in the Department of Physiology, College of Medicine, Northern Border University with Collaboration of Central Hospital Arar, during Muharram to Zulaghaeda 1434 H. We collected data of 23,522 male and female patients who visited the Central Hospital Arar, Marriage Center of Northern Border Region in Arar during 1425 H to 1431 H; where the couples were counselled for pre-marital screening of blood to avoid the disease. **Results:** Prevalence of haemoglobinopathies in 1425 H was 2.8% compared to the prevalence of haemoglobinopathies in 1430 H (0.4%). Prevalence of sickle cell carriers was 44.75% in 1427 compared to prevalence in 1427 H (5.4%). Prevalence of β-Thalassemia was (92.7%) in 1425 H compared to prevalence in 1427 H (55.3%). **Conclusion:** The cases of haemoglobinopathies are present in our area. Premarital screening and genetic counselling markedly reduced the number of at-risk marriages, which may considerably reduce the genetic disease over the coming decades.

Keywords: β-thalassemia, Sickle Cell Disease, Saudi Arabia, haemoglobinopathies, autosomal recessive disorders

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INTRODUCTION

Thalassemia and sickle-cell disease affect as much as 5% of the world population, constituting a major public health problem in certain parts of the world including the Mediterranean area and the Middle East.[1] Inherited haemoglobin disorders (haemoglobinopathies) are predominantly single-gene autosomal recessive disorders that result in production of structurally abnormal haemoglobin variants (sickle-cell disease) or a reduction in the synthesis of structurally normal globin (β-thalassemia).[2] Thalassemia is said to be one of the most frequent haemoglobinopathies and single gene disorders that is becoming a major health problem in the world, especially in Mediterranean region, the Middle East, the Indian subcontinent and South Asia.[3] In individuals with β-thalassemia, there is either a complete absence of β-globin production (β-thalassemia major) or a partial reduction in β-globin production β-thalassemia.[4] Each year, 300,000–400,000 babies with severe forms of haemoglobin disorders are born.[5] The α-Thalassemia is caused by decreased or absent synthesis of the α-globin chains coded by four α-genes, two on each chromosome, while β-thalassemia is caused by decreased or absent synthesis of the β-globin chains coded by two β-globin genes, one on each chromosome.[6] The majority of the mutations that cause α-thalassemia are commonly due to deletional mutations, while those that cause β-thalassemia are usually due to point mutations.[7] A number of studies have been conducted to analyse the spectrum of α-thalassemia mutations in Saudi Arabia.[8] Like many other countries, thalassemia also poses an important public health problem in Saudi Arabia.[9] Management of patients with thalassemia constitutes a heavy burden for affected families and the health caresystem.[10] Moreover, social stigma associated with having thalassemia have significant psychosocial and emotional impact on patients and their families.[11] Premarital screening for genetic diseases is superior to neonatal screening since the former is primary prevention while the latter is secondary or tertiary prevention.[12] Premarital screening can potentially reduce the burden of inherited haemoglobin diseases by reducing the number of high-risk marriages.[14] This was proven to be beneficial in nearby countries with similar endemicity levels of hemoglobinopathies.[14–16] Prevention of the birth of children with thalassemia major is, therefore, important to reduce the prevalence of this disorder. Empirical evidence indicates that prenatal diagnosis has dramatically reduced the disease burden.[17] Additionally, a number of studies worldwide showed that attitudes toward prenatal diagnosis were related to religious convictions. Muslim couples, for instance, have been reported to refuse prenatal diagnosis on religious grounds.[18] A number of studies have been conducted to analyse the spectrum of α-thalassemia mutations in

Saudi Arabia.[19–22] Saudi Arabia is well-known for its high prevalence of hereditary blood disorders. In Saudi Arabia, 4.20% of the participants had sickle cell trait, 0.26% had sickle cell disease, and 3.22% had β-thalassemia trait, while 0.07% had β-thalassemia disease.[23] Certain cultural factors in Saudi Arabia, including the high frequency of consanguineous marriages (exceeding 55%), the large family size, and the high paternal and maternal ages may contribute to the high prevalence of sickle-cell disease and β-thalassemia in Saudi Arabia.[24–26] Because of the burden on the healthcare system and effect on the quality of life in patients with sickle-cell disease or β-thalassemia, premarital genetic screening was mandated in Saudi Arabia in 2004.[27] Studies on knowledge, attitudes and practices related to thalassemia are relatively scarce in this part of KSA. From our study, we try to highlight the prevalence of haemoglobinopathies in our region. Since optional treatment now is only through abortion of affected pregnancy, which is not convenient for the majority because of religious reasons, prevention should be the aim, and this can be achieved through provision of screening materials in rural and remote areas and educate about the disease in local population. Discouraging of cousin marriages, since accumulation of the diseased gene make the disease more prevalent.

This study aimed to determine the prevalence of thalassemia and sickle cell disease in Northern Border Region of Saudi Arabia and to counsel the couples for pre-marital screening of blood to avoid the disease.

MATERIAL AND METHODS

This retrospective descriptive study was carried out in the Department of Physiology with Collaboration of Haematology Department of Central and other Hospitals in the Northern Border Region of Saudi Arabia, from Muharram 1425 H to Dhul Qa'ida 1431H.

Men and women who voluntarily wished to be screened for the disease before marriage were included in the study. Data of 23,522 men and women who visited the Central Hospital in Arar, Marriage Center of Northern Border Region in Arar, during 1425 H to 1431 H were collected. The Couples were counselled for pre-marital screening of blood to avoid the disease. The data were analysed using SPSS-10. Frequencies and percentages were calculated.

RESULTS

Prevalence of haemoglobinopathies in 1425 H was 2.8% compared to the prevalence of haemoglobinopathies in 1430 H (0.4%) (Table-1). Prevalence of sickle cell carriers was (44.75%) in 1427 H compared to the prevalence in 1425 H (5.4%). The prevalence of β-Thalassemia was 92.7% in 1425 H and 55.3% in 1427 H (Table-2).

Table-1: Prevalence of haemoglobinopathies among premarital screening in NBR during 1425–1431 H

Year (H)	Positive [n (%)]	Negative [n (%)]	Total
1425	85 (2.8)	2,956 (97.2)	3,041
1426	62 (1.9)	3,134 (98.1)	3,169
1427	47 (1.4)	3,322 (98.6)	3,369
1428	28 (0.8)	3,658 (99.2)	3,686
1429	18 (2.4)	2,571 (97.6)	2,633
1430	36 (0.4)	4,529 (99.6)	4,546
1431	29 (1.0)	3,022 (99)	3,051

Table-2: Distribution of haemoglobinopathies among premarital screening in NBR during 1425–1431 H

Year (H)	Sickle Cell Carrier [n (%)]	Sickle Cell Affected [n (%)]	β-thalassemia Carrier [n (%)]	Total
1425	5 (5.4)	2 (1.9)	78 (92.7)	85
1426	7 (11.3)	1 (1.6)	54 (87.1)	62
1427	21 (44.75)	0 (0)	26 (55.3)	47
1428	3 (10.7)	0 (0)	25 (89.2)	28
1429	3 (16.7)	2 (11.1)	13 (72.2)	18
1430	15 (41.7)	0 (0)	21 (58.3)	36
1431	8 (27.9)	0 (0)	21 (72.4)	29

Note: β-thalassemia affected not considered because it was zero

DISCUSSION

This study reports the impact of premarital screening and genetic counselling on the prevalence of sickle-cell disease and β-thalassemia as well as the frequency of at-risk marriages in Northern part of Saudi Arabia. Mandating the premarital screening for inherited haemoglobinopathies was long awaited in Saudi Arabia and was preceded by religious and scientific debate.[28] In this highly conservative population, premarital screening in Saudi Arabia is practically the main preventive measures against inherited hemoglobinopathies.[29] Neonatal screening may be of limited importance as it represents only secondary or tertiary prevention. As expected, the current study showed that NBR of Saudi Arabia has a high prevalence of sickle-cell disease (1.9%) and β-thalassemia (7.25%). An earlier report in other parts of KSA covering the screening program showed a prevalence of sickle-cell disease (4.2% carriers and 0.26% cases), and prevalence of β-thalassemia (3.2% carriers and 0.07% cases).[30] The study shows clearly the success of the screening program in reducing the detection and prevention of at-risk marriages. Detection of at-risk marriages was reduced by about 60% (from 10.1 in 2004 to 4.0 in 2010 per 1,000 examined persons). This was mainly driven by a more than 70% reduction of the prevalence of β-thalassemia during the same period. However, it is not clear why sickle-cell disease was essentially constant over the program period.

The completion of 48% of at-risk marriages indicates the huge cultural challenges that remain to be addressed by the counsellors. Even years after program implementation, the knowledge of premarital screening was good but not adequate.[31] In the current report, the

overall marriage cancellation among at-risk marriages was 26.5% and increased to more than 50%. In a recent survey, more than 60% of the participants were in favour of cancelling at-risk marriages.[32] However, in another study among 129 at-risk candidates identified in premarital screening; only 2% cancelled their marriage proposals. In almost half of cases, cultural pressure was the main reason to proceed with marriage.[33] An earlier report covering the first 2 years of the PMSGC program showed that only 10% of at-risk couples cancelled their marriage proposals.[27] Genetic counselling obtained towards the end of marriage process is not likely to be effective. It has been proposed that screening singles on admission to university prior to any commitment may be preferable than screening immediately before the marriage certificate is issued.[34] The Eastern region that had 58% of all detected at-risk marriages during the program period had a lower overall cancellation of at-risk marriages compared to other regions (22.6% vs 34.3%). This may be explained by the fact that cancellation of at-risk marriages at the beginning of the program implementation (2004) was lower in the Eastern region compared to other regions (5% vs 21%). This probably masked the improvement of at-risk marriage prevention in the Eastern region compared to other regions (8.0 fold vs 1.7 fold). Another potential explanation is the higher positivity of sickle-cell disease and/or β-thalassemia in Eastern region compared to other regions (19.3% vs 3.8%), which could make it difficult for at-risk couples to find an alternative socially and suitably safe match.[35] In addition to the huge efforts already accomplished by the Saudi Ministry of Health (MoH) to prevent at-risk marriages for sickle-cell disease and β-thalassemia, additional efforts are underway. These include increasing the number of specialized health care reception clinics to cover more regions[36] as well as connecting all clinics in the country by state-of-the-art web-based database software that will enhance instant rate calculation and research. This will overcome the limitation of aggregate data as seen in the current study because there was no access to raw or individual data for analysis. Saudi MoH may enhance the effects of counselling by encouraging couples to seek testing earlier in the marriage process, engage religious figures in counselling, include program information in high school curriculum, allow singles to voluntarily seek genetic testing, and finally augment the help of community figures to publicise the program in media and religious gatherings.

CONCLUSION

Cases of haemoglobinopathies are present in our area. Premarital screening and genetic counselling markedly reduced the number of at-risk marriages, which may considerably reduce the genetic disease over the coming decades.

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