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Original Research Article

Assessment of knowledge, awareness and attitude concerning premarital screening of hemoglobinopathies among medical students: a cross-sectional study

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ABSTRACT

Background: Hemoglobinopathies represent a significant challenge for healthcare systems, particularly in resource-limited settings. Comprehensive prevention strategies, including education, screening programs, and policy support are essential to mitigate the burden of these disorders.
Methods: A cross-sectional study was conducted among MBBS students of GIMS, Kalaburagi to evaluate the knowledge, awareness and attitude concerning premarital screening of hemoglobinopathies among medical students. Convenience sampling method was used. Data was collected using a semi-structured questionnaire. Scoring system was used and data was analysed using SPSS version 26.
Results: In our study involving 426 MBBS students (226 females, 200 males) with a mean age of 20.85 years, most respondents were phase III students, predominantly from an urban background, and 73.7% identified as Hindu. 81.2% were aware of premarital screening, mainly through academic courses (52.2%). 91.3% recognized premarital screening as a reliable diagnostic tool and 73% acknowledged the role of genetic counselling in prevention. Knowledge was significantly associated with the year of study ($p<0.001$). 66.9% supported mandatory premarital screening. While 65% wanted to raise awareness about hemoglobinopathies, 97.65% were willing to donate blood, and 55.86% expressed readiness to donate bone marrow. Positive attitudes were more prevalent among females ($p<0.001$) and those with a family history of genetic diseases ($p=0.002$).
Conclusions: This study highlights critical gaps in knowledge and awareness about premarital screening for hemoglobinopathies among medical students. Addressing these gaps through targeted educational and advocacy efforts can play a pivotal role in reducing the global burden of hemoglobinopathies.

Keywords: Hemoglobinopathies, Premarital screening, Prevention, Medical students

INTRODUCTION

An ounce of prevention is worth a pound of cure and this holds true for most of the genetic diseases including hemoglobinopathies. Hemoglobinopathies are a group of inherited disorders of red blood cells in which there is abnormal production or structure of the hemoglobin molecule. This group of disorders includes hemoglobin C disease, hemoglobin S-C disease, sickle cell anemia, and thalassemias.[1,2]

Hemoglobinopathies are the commonest genetic disorders worldwide. They include thalassemia and abnormal variant hemoglobins such as hemoglobin S, D, E etc. They constitute a major burden of disease, mainly in malaria endemic countries, but have now become global due to population migration. They consist of two major

groups-Thalassemia and Sickle cell syndromes. Sickle cell syndromes are more frequent and constitute 70% of affected births world-wide, the rest are due to thalassemias.[3]

Thalassemias are clinically divided into Thalassemia Major (TM), Thalassemia Intermedia (TI) and Thalassemia Minor or Trait according to severity. Thalassemia Major (TM) and the severe form of Thalassemia Intermedia (TI) constitute the major burden of disease as management of both requires lifelong blood transfusions and iron chelation.[2] While Thalassemia minor is the carrier state in which the person is clinically normal and is commonly referred to as β (beta) Thalassemia Trait (BTT). The thalassemia syndromes (TM, TI) are caused by inheritance of abnormal β thalassemia genes from both carrier parents, or abnormal β Thalassemia gene from one parent and an abnormal variant hemoglobin gene (HbE, HbS) from the other parent. Sickle Cell Disease (SCD) is another hemoglobin disorder that requires lifelong management and contributes to infant and childhood morbidity and mortality. SCD is caused by inheritance of two abnormal HbS genes, one from each parent or HbS gene from one parent and HbE or β thalassemia gene from the other. Sickle cell syndromes include Sickle Cell Disease (SCD, HbSS), also called Sickle Cell Anemia (SCA), as well as disorders due to sickle cell gene combined with another hemoglobinopathy such as Hb C, E, or β thalassemia.[3]

Hemoglobinopathies are a major public health problem among millions of people around the world.[4] WHO reported that 7% of world's populations are carriers of haemoglobin disorders.[5] In India, the cumulative gene frequency of hemoglobinopathies is 4.2% due to its large population, high birth rate and common practice of consanguineous marriage.[6] In India, β-Thalassemia is prevalent across the country, with an average frequency of carriers being 3-4%.[7] HbS is highly prevalent in the tribal populations of Southern, Central and Western states reaching as high as 48% in some communities. HbE is common in the North Eastern states, and has a carrier frequency as high as 50%, in some areas. It is found in lower frequencies in the Eastern states of West Bengal, Bihar and Uttar Pradesh, while HbD is present in about 2% of people in Punjab.[3]

Being an important cause of morbidity and mortality, they impose a heavy burden on families and health sector in our country.[3] Prevention is the only practical option for many genetic diseases including hemoglobinopathies in developing countries like India.[14]

Premarital screening is a primary preventive measure to decrease the incidence of certain genetic disorders and sexually transmitted diseases. Premarital screening aims to identify carriers of hemoglobin disorders, in order to assess the risk of having children with severe form of disease.[3] Effective prevention can maximize the available resources if it is instituted properly, preventing up to 95% of affected births. Healthy carriers of beta thalassemia can be identified inexpensively and accurately by a simple blood test. Couples who undergo testing can be informed about genetic risks and given options for reducing risk, including prenatal diagnosis.[13]

As medical students are future practitioners, it is important for them to know about premarital screening to be able to counsel patients about different potential outcomes. Reduction in the burden of genetic diseases can only be achieved if we give adequate training to medical undergraduate students about premarital screening. Hence this study was conducted to assess medical students' knowledge, awareness and attitude regarding premarital screening concerning hemoglobinopathies, its epidemiology, social impact and management options.

METHODS

Study setting and design

This study conducted at Gulbarga Institute of Medical Sciences (GIMS), Kalaburagi. An institutional based cross-sectional study was carried out among medical undergraduates of GIMS, Kalaburagi.

Study population

All undergraduate medical students of Gulbarga Institute of Medical Sciences (GIMS), Kalaburagi were included.

Study duration

This study conducted from November 2024 to January 2025.

Sample size

Out of 600 students, only 426 medical students gave consent and responded.

Sampling method

Convenience sampling method was used to select the participants.

Inclusion criteria

All MBBS students who gave consent to participate in study were included.

Exclusion criteria

The MBBS students who did not give consent and those students who did not completely fill the questionnaire were excluded from the study.

Data collection method

Participants were enrolled in the study after taking informed consent detailing the need and implications of study. A pre-designed, pre-tested and semi-structured questionnaire was designed and sent via WhatsApp as google forms to all undergraduate medical students of Gulbarga Institute of Medical Sciences, Kalaburagi. The questionnaire consisted of four sections. Section I- included sociodemographic details such as age, gender, phase of MBBS, residence. Section II- questions pertaining to knowledge of hemoglobinopathies (8 in number). Section III - questions regarding awareness of premarital screening (7 in number). Section IV- questions on attitude of management of hemoglobinopathies (10 in number).

For knowledge, the responses were Yes/No/Don't know. Each correct response was given a score of 1. So, the maximum score was 8. The scores were graded into good (6-8), average (3-5) and poor (0-2).

For awareness, the responses were Yes/No. Each correct response was marked as 1. The scores ranged between 0 to 7. So, a score more than or equal to 4 was considered good awareness while a score less than 4 was taken as poor awareness.

The attitude of medical students towards the occurrence and management of hemoglobinopathies was evaluated using a 5-point Likert scale. Higher scores were indicative of stronger agreement to the statements regarding hemoglobinopathies management and positive attitude.

Statistical methods

Data was entered in Microsoft excel spreadsheet and analysed using SPSS version 26. Results were analysed in the form of frequency and proportion. Appropriate tests were applied. Chi square test was used to find out association between different variables. A p value of <0.05 was considered significant. Results were presented in the form of tables and graphs.

RESULTS

In our study, 426 students responded to questionnaire. There were 226 female and 200 male students in our study. The mean age of respondents was 20.85 years. The maximum responses were given by phase III students followed by phase II, followed by phase 1 and least responses from phase IV students. According to the responses obtained, 73.7% of the students belonged to Hindu religion, 17.6% were Muslims and 8.7% were Christians. The results showed that majority of the respondents were from urban background and 22.1% were from rural areas (Table 1). It was also noted that 22.5% of the participants responded with a history of consanguineous marriage in the family and 6.1% of the participants had a history of genetic disease in their family.

Table 1: Sociodemographic profile of participants.

Characteristics		Frequency (N=426)	Percentage (%)
Year of MBBS	Phase 1	89	20.9
	Phase 2	113	26.5
	Phase 3	138	32.4
	Phase 4	86	20.2
Gender	Male	200	46.9
	Female	226	53.1
Religion	Hindu	314	73.7
	Muslim	76	17.6
	Christian	37	8.7
Residence	Urban	332	77.9
	Rural	94	22.1
Marital status	Single	423	99.3
	Engaged/ married	3	0.7
H/o consanguineous marriage in family	Yes	96	22.5
	No	330	77.5
H/o any genetic diseases in family	Yes	26	6.1
	No	400	93.9

Awareness about premarital screening for hemoglobinopathies

346(81.2%) were aware of premarital screening. Figure 1 shows the main source of information was from their academic course (52.2%). Majority of (391, 91.8%) the students knew that premarital screening involved testing of both partners. 91.3% aware that premarital screening is a reliable tool for diagnosing and predicting hemoglobinopathies (Table 2).

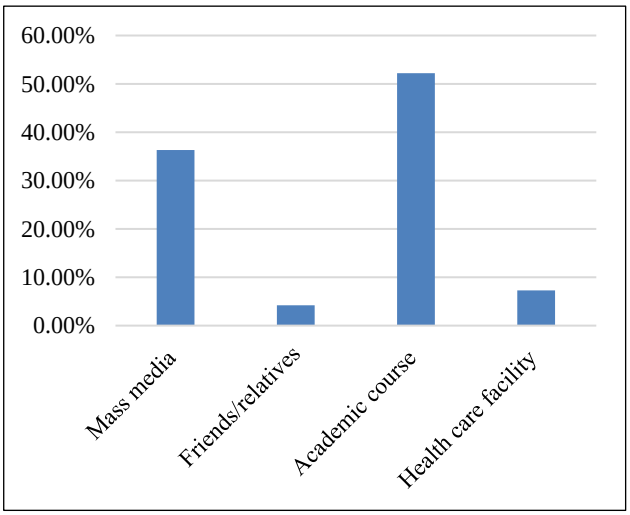

Figure 1: Source of Information.

Table 2: Awareness regarding premarital screening.

	Yes, N (%)	No, N (%)
Have you heard the term "premarital screening"?	346, (81.2)	80, (18.8)
Premarital screening causes physical harm?	32, (7.5)	394, (92.5)
Do you think that premarital screening is very expensive?	212, (49.8)	214, (50.2)
Premarital screening is carried out by a simple blood test?	245, (57.5)	181, (42.5)
Premarital screening is a reliable tool for diagnosing and predicting diseases?	389, (91.3)	37, (8.7)

Knowledge about hemoglobinopathies

54.2% of students knew that aetiology of hemoglobinopathies is always genetic inheritance. 80.7% agreed that consanguineous marriage had an important role to play in incidence of hemoglobinopathies. 57.5% students agreed that hemoglobinopathies can be diagnosed by a blood test. 73% students knew that hemoglobinopathies can be prevented by genetic counselling. 60.8% had knowledge that treatment of major hemoglobinopathies is hematopoietic stem cell transplantation. 47.4% knew that patients of hemoglobinopathies are protected against parasitic diseases. 47.4% agreed that splenectomy had a major role to play in hemoglobinopathies. 53.3% agreed that prevention is the best management for genetic disorders in society. 79.8% agreed that there is lack of social awareness for hemoglobinopathies. 60.5% of students had knowledge that post marriage and preconception counselling provide a better way to prevent common genetic diseases in lower socio-economic families.

There was statistically significant association (p<0.001) between different phases of MBBS and knowledge about hemoglobinopathies. Most of the phase IV students (25.9%) had good knowledge about hemoglobinopathies. Very less students (2.2%) from phase I had good knowledge. This shows that students of MBBS had more knowledge at the end of MBBS course than their first and second years. Students of rural background (16%) had good knowledge and it was statistically significant (p=0.034) (Table 4).

Attitude towards hemoglobinopathies and its management

Our study tried to focus on the attitudes of the participants toward hemoglobinopathies. There was statistically significant association between year of study and attitude regarding management of hemoglobinopathies (p=0.001). Majority of female students had positive attitude (p<0.001). The history of genetic disease in family also was statistically significant with attitude towards management (p=0.002) (Table 5).

Table 3: Association of awareness regarding premarital screening with sociodemographic profile.

Variables	No, N (%)	Yes, N (%)	P value
Phase of MBBS			
Phase 1	63 (70.8)	26 (29.2)	0.977
Phase 2	77 (68.1)	36 (31.9)	
Phase 3	93 (67.4)	45 (32.6)	
Phase 4	57 (66.7)	29 (33.3)	
Gender			
Male	136 (68.0)	64 (32.0)	0.975
Female	154 (68.2)	72 (31.9)	
Religion			
Hindu	217, (69.1)	97, (30.9)	0.486
Muslim	49, (65.3)	26, (34.7)	
Christian	24, (61.8)	13, (38.2)	
Residence			
Urban	224, (67.5)	108, (32.5)	0.615
Rural	66, (70.2)	28, (29.8)	
Marital status			
Single	289, (68.3)	134, (31.7)	0.195
Engaged/married	1, (33.3)	2, (66.7)	
History of consanguineous marriage in family			
Yes	63, (65.6)	33, (34.4)	0.558
No	227, (68.8)	103, (31.2)	
Any family member diagnosed with genetic disease			
Yes	18, (69.2)	8, (30.8)	0.896
No	272, (68.0)	128, (32.0)	

Table 4: Association of knowledge about hemoglobinopathies with sociodemographic profile.

Variables	Poor N (%)	Average N (%)	Good N (%)	P value
Phase of MBBS				
Phase 1	47 (52.8)	40 (44.9)	2 (2.2)	<0.001*
Phase 2	39 (34.5)	65 (57.5)	9 (8.0)	
Phase 3	32 (23.2)	90 (65.2)	16 (11.6)	
Phase 4	4 (3.7)	54 (70.4)	28(25.9)	
Residence				
Urban	87 (26.2)	205 (61.7)	40 (12.0)	0.034*
Rural	35 (37.2)	44 (46.8)	15 (16.0)	
Religion				
Hindu	94 (29.2)	178 (56.7)	42 (13.4)	0.382
Muslim	15 (20.0)	50 (66.7)	10 (13.3)	
Christian	13 (35.3)	21 (58.8)	3 (5.9)	
H/O consanguineous marriage in family				
Yes	26(27.1)	59(61.5)	11(11.5)	0.779
No	96(29.1)	190(57.6)	44(13.3)	
H/O any genetic disease in family				
Yes	6 (23.1)	18 (69.2)	2 (7.7)	0.488
No	116 (29.0)	231 (57.8)	53 (13.3)	

Table 5: Association of attitude regarding management of hemoglobinopathies and sociodemographic profile.

Variables	Negative N (%)	Positive N (%)	P value
Year of study			
Phase 1	45 (50.6)	44 (49.4)	0.001*
Phase 2	82 (72.6)	31 (27.4)	
Phase 3	105 (76.1)	33 (23.9)	
Phase 4	64(77.8)	22(22.2)	
Gender			
Male	156 (78.0)	44 (22.0)	<0.001*
Female	140 (61.9)	86 (38.1)	
Religion			
Hindu	210 (66.9)	104 (33.1)	0.006
Muslim	60 (80.0)	15 (20.0)	
Christian	26 (76.5)	11 (23.5)	
Marital status			
Single	294 (69.5)	129 (30.5)	0.915
Engaged/married	2 (66.7)	1 (33.3)	
History of consanguineous marriage in family			
Yes	66, (68.8)	30, (31.3)	0.859
No	230, (69.7)	100, (30.3)	
History of genetic disease in family			
Yes	11 (42.3)	15 (57.7)	0.002*
No	285 (71.3)	115 (28.7)	

*-Significant

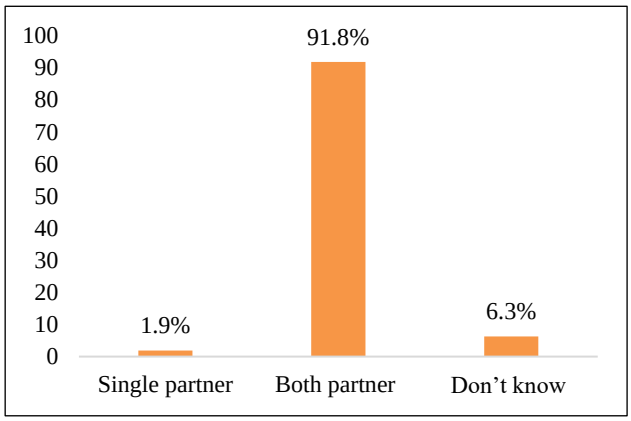

Figure 2: Premarital screening.

Most of the participants (27.45%) did not want to marry a person with hemoglobinopathies and 48.82% participants responded to not answer the question. 66.9% felt that premarital screening should be mandatory before marriage. However, contrasting to this only 61.98% agreed to undergo premarital screening before marriage and 29.35% of the participants chose not to answer the question and remain neutral.

Our study also noted that 65% of the participants wanted to inform others (the known people) about its consequences and raise an awareness about hemoglobinopathies. One of the most important revelations regarding the willingness to donate blood for a patient of hemoglobinopathies was a staggering 97.65%. 55.86% of the participants wanted to donate bone marrow for transplantation if someone from their circle of family and friends had a treatment requirement. However, 35.69% chose to remain neutral and did not respond to the question.

DISCUSSION

This study evaluated medical students' attitudes, knowledge, and understanding of premarital hemoglobinopathy screening. Despite the participants' medical background, the results show a notable knowledge and awareness gap. This emphasizes the necessity of increased emphasis and education initiatives to raise awareness of premarital screening and its public health consequences.

Knowledge and awareness of premarital screening

Our findings showed that although most participants were aware of premarital screening programs, only a smaller percentage showed a thorough understanding of hemoglobinopathies and the genetic consequences associated with them. Analogous research, like that carried out in Saudi Arabia (Al-Farsi et al), have also revealed that medical students have a poor awareness of the hereditary and preventative components of hemoglobinopathies.[17] This research raises the possibility that genetic counselling and preventative healthcare may not be sufficiently included in medical school curricula. Improving these facets of medical education may prepare aspiring medical professionals to successfully promote premarital screening. Study conducted by Pujani et al found that medical students had differing degrees of knowledge of thalassemia.[11] Similar findings were observed in our study, where medical students lacked awareness of specific hemoglobinopathies. While some had sufficient knowledge regarding its genetic transmission, clinical presentation, and management, others did not, particularly with regard to preventive measures. According to research by Johar et al medical genetics is taught by several departments over different semesters at the undergraduate level.[14] It results in a loss of integrity and continuity. According to this study, medical students have a positive outlook on managing genetic disorders in society, a limited understanding of fundamental medical genetics, and a modest awareness of the epidemiological and social effects of genetic diseases.[14] According to research Al-Qahtani et al, there were gaps in students' understanding of the precise tests and processes required, even though many of them acknowledged the value of premarital counselling in preventing viral and genetic illnesses.[15] Okyay et al study showed many students had little understanding of hemoglobinopathies, and many were especially unaware of hereditary transmission and carrier status. Although the media and schools were the main information sources, there were clear gaps in thorough instruction on the

subject.[21] However, the findings of our study highlight the fact that, despite widespread awareness and favourable views about prevention, there are still knowledge gaps, especially among rural students and in the early stages of MBBS. The benefit of medical education is demonstrated by the notable increase in knowledge by the last year of MBBS. The results, however, highlight the necessity of addressing socioeconomic and geographical inequities through focused awareness efforts and the early incorporation of genetic teaching into medical curriculum. This might improve the management of hemoglobinopathies in society and strengthen preventive initiatives.

Attitudes toward premarital screening

The study also revealed that most students held favourable attitudes toward premarital screening, recognizing its importance in reducing the incidence of inherited disorders. However, a subset of students expressed concerns about the ethical and social implications of mandatory screening programs. This aligns with findings from other regions, such as a study in Pakistan (Ahmed et al, 2018), where ethical dilemmas and concerns about personal freedoms were highlighted as barriers to acceptance.[18] Addressing these concerns through ethical frameworks and community engagement is essential for the successful implementation of premarital screening programs. Study conducted by Pujani et al showed people's perceptions of thalassemia patients and preventative strategies like premarital screening were largely favourable.[11]The majority of students agreed with our study's findings that early diagnosis and education are crucial for lowering the burden of disease. Johar et al study showed, curriculum instruction and hands-on experience may assist students become more knowledgeable and conscious while also instilling a practical mindset.[14] However, this aspect of attitude was not addressed in our study. Al-Qahtani et al, studies revealed that some participants voiced worries about the possible social stigma and confidentiality difficulties related to premarital screening findings, while the majority had favourable attitudes on premarital counselling, seeing it as advantageous for married life and the health of kids.[15] Okyay et al study showed that most students supported screening programs and expressed willingness to participate in premarital screening for genetic conditions.[21] Our study highlights generally positive attitudes toward managing and preventing hemoglobinopathies, particularly among female students and those in advanced academic years. The willingness to donate blood was notably high, reflecting strong altruistic tendencies, whereas bone marrow donation garnered a more cautious response. Premarital screening was broadly supported, though some participants hesitated to commit to personal participation, indicating potential stigma or cultural sensitivities. The findings suggest a need to address gaps in attitudes and awareness, particularly around premarital screening and bone marrow donation. Educational and social campaigns can further enhance understanding, reduce stigma, and encourage proactive behaviours in managing hemoglobinopathies.

Implications for public health

Hemoglobinopathies, such as sickle cell anaemia and thalassemia, are among the most common genetic disorders worldwide, with significant implications for morbidity and mortality.[19] Premarital screening programs have been shown to reduce the incidence of these disorders in countries with established programs, such as Cyprus and Iran.[20] However, for such programs to succeed, healthcare providers must be well-informed and capable of delivering accurate genetic counselling. This study highlights the need for targeted educational interventions to prepare medical students for their roles in these programs.

Limitations of the study

While the study provides valuable insights, it is not without limitations. The cross-sectional design limits the ability to establish causality between educational exposure and knowledge levels. Furthermore, the sample was limited to medical students from a single institution, which may limit the generalizability of the findings. Future research should include a more diverse and representative sample, as well as longitudinal designs to evaluate the impact of educational interventions on knowledge and attitudes over time.

CONCLUSION

This study highlights critical gaps in knowledge and awareness about premarital screening for hemoglobinopathies among medical students. Addressing these gaps through targeted educational and advocacy efforts can play a pivotal role in reducing the global burden of hemoglobinopathies. As future healthcare providers, medical students must be equipped to champion premarital screening programs and support their ethical implementation.

Recommendations

Integrating genetic counselling into medical curriculum: Comprehensive modules on premarital screening and genetic counselling should be included in medical training.

Community awareness programs: Medical students should be engaged in community-based initiatives to raise awareness about the importance of premarital screening.

Policy advocacy: Medical institutions and health policymakers should collaborate to address ethical concerns and ensure culturally sensitive implementation of screening programs.

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