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ASSESSMENT OF PREMARITAL SCREENING PROGRAM OVER FIVE YEARS IN KARBALA CITY

Sumaya A. Hussein*[1], Prof. Dr. Ali Abdulridha Abutiheen[2], Dr. Muntassir K. Saod[3]

[1]M.B.Ch.B., Student of Arab Board of Medical Specialization, Karbala/ Iraq.
[2]M.B.Ch.B., F.I.B.M.S. (FM). Professor of Family and Community Medicine Department_ College of Medicine/University of Kerbala.
[3]M.B.Ch.B., F.I.B.M.S. (CM). Consultant of Community Medicine at Patient Safety Unit.

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***Corresponding Author: Sumaya A. Hussein**
M.B.Ch.B., Student of Arab Board of Medical specialization, Karbala/ Iraq.

ABSTRACT

Background: Premarital screening (PMS) is an effective preventive strategy to reduce genetic and infectious diseases by identifying carrier couples. **Objective**: To identify high-risk couples (carriers or confirmed cases) and estimate the prevalence of conditions included in the PMS program in Karbala over five years. **Methods**: A retrospective cross-sectional study included adult couples aged 18–45 years registered in five PMS clinics in Karbala governorate between 2019 and 2023. Data on hemoglobinopathies and infectious diseases were extracted from medical records and analyzed using SPSS 24. Ethical approval was obtained on 17/4/2024 from the Karbala Health Directorate Research Ethical Committee.**Results:** Among 102,512 individuals screened, anemia was found in 2.1% (higher in females). Thalassemia was identified in 0.9%, sickle cell anemia in 0.04%, with no sex difference. HIV cases were rare (4 total), while syphilis (44), hepatitis B (97), and hepatitis C (35) were more prevalent among males. **Conclusion:** The PMS program effectively identifies carriers of genetic and infectious diseases. Improved coverage, awareness campaigns, and counseling are essential to address consanguinity and early marriage.

KEYWORDS: premarital screening program, infectious diseases, hemoglobinopathies, thalassemia, Iraq.

INTRODUCTION

Premarital screening (PMS) is an effective strategy for the primary prevention against infectious diseases such as hepatitis B, hepatitis C, HIV, and syphilis, and genetic diseases such as thalassemia and sickle cell anemia by identifying asymptomatic carriers through history taking, physical examination, and laboratory tests[1], couples with abnormal results are referred for further investigations, treatment, health education, and counseling, while the final decision regarding marriage remains with the couples.[2] Process evaluation of PMS programs helps assess outcomes, efficiency, staff performance, and goal achievement.[3] PMS has been shown to be superior to neonatal screening programs with a positivity rate of 0.17% compared to antenatal screening at 0.05%, and is considered inexpensive, sensitive and specific.[4] It has reduced the birth rate of hemoglobinopathies by 21.1% and identifies carrier couples for thalassemia through simple, cost-effective blood tests.[5] In Iraq, PMS became mandatory in 2004, covering genetic and infectious diseases, with Karbala starting its program in 2012 due to high thalassemia rates.[6] However, there are many challenges influencing the PMS program, such as ethical considerations, confidentiality, and the stigma associated with some infectious diseases.[7] Consanguinity is a common traditional practice in the Arab region, with rates around 25–60%, and in Iraq specifically ranging from 24–71% of all certified marriages.[8,9] Early marriage also remains a significant factor, often leading to fewer couples accessing premarital screening services and increasing the transmission of diseases to offspring, especially in poorer families.[10] Thalassemia is a genetic disorder affecting globin chain synthesis, in which asymptomatic parents carry the thalassemia trait, resulting in a 25% chance of having a severely affected child.[11] Thalassemia traits are linked to higher pregnancy risks like hypertension and preeclampsia.[12] Sickle cell disease results from inheriting two abnormal genes; while carriers are asymptomatic, they can still pass it on.[13] Approximately 300 million people worldwide have the trait, with 5,124 cases reported in Iraq in

2015.[14] Premarital screening in Iraq also includes tests for hepatitis B and C, HIV, syphilis, and tuberculosis. High HBV and HCV prevalence.[15,16,17] HIV prevalence is low (<0.1%) but increased by 25% from 2010 to 2019.[18,19] Syphilis is a longstanding public health issue, screened using the VDRL test[20] and tuberculosis remains a major cause of death.[21] Another important aspect of the PMS program is counseling, which is considered strength but faces challenges such as couples undergoing testing shortly before the ceremony and considering cancellation as a stigma.[22] In contrast, in countries such as the UK, termination of pregnancy after antenatal screening is accepted but is not acceptable in Arab regions.[23] This study assesses the effectiveness of this program in identifying high-risk couples who are carriers or confirmed cases and estimates the prevalence of diseases covered by the PMS program.

METHOD

Study design, setting, and time

A retrospective cross-sectional study was conducted using premarital screening records from Karbala governorate over a five-year period between January 1, 2019, and January 1, 2024.

Data were collected from five premarital screening clinics in Karbala governorate:

- Al Imam Al Hussein Medical City
- Gynecological and Obstetric Teaching Hospital
- Al Hindiya Teaching Hospital
- Ein Al-Tamur General Hospital
- Al Husaniya General Hospital

Adult couples attending the PMS clinics for mandatory premarital screening were included. Both male and female partners were eligible.

Retrospective data were obtained from record files in the five PMS clinics. The records included marriage proposals, laboratory results of screening tests for hemoglobin level, Rh type, inherited hemoglobinopathies (sickle cell disease and thalassemia), and selected infectious diseases (hepatitis B, hepatitis C, HIV/AIDS, and syphilis).

The study was approved by the Arabic Board for Medical Specialization. Ethical approval was granted by the Karbala Health Directorate Research Ethical Committee (approval No. 775, dated 17/4/2024). Verbal consent was obtained from healthcare workers in the units responsible for the premarital screening clinics in Karbala.

Data were entered and analyzed using SPSS version 24. Descriptive statistics were presented as frequencies and percentages in tables and graphs. Associations between categorical variables were tested using the Chi-square test. Statistical significance was considered at $p < 0.05$.

RESULTS

The present study included an evaluation of premarital screen program in Karbala governorate over 5 years (2019-2023) throughout analysis of records of premarital screen program, the total partner was 102512. Available records ranged from 14770 couples in 2021 and 5856 couples in 2020.

The results of the current study revealed that proportion of anemia varied from 0.9% in 2022 to 3.4% in 2023 (table-1) and these differences were statistically significant ($p<0.001$) and total anemic partner was 2%.

Table 1: proportions of anemia among study individuals for years 2019-2023.

		Anemia		Total	P value
		Yes	No		
Year	2019	490 (3.3)	14404 (96.7)	14894 (100)	< 0.001*
	2020	305 (2.6)	11407 (97.4)	11712 (100)	
	2021	282 (1)	29258 (99)	29540 (100)	
	2022	212 (0.9)	23504 (99.1)	23716 (100)	
	2023	779 (3.4)	21871 (96.6)	22650 (100)	
	Total	2068 (2)	100444 (98)	102512 (100)	

The results showed that proportion of RH negative varied from 1.2% in 2021 to 3.4% in 2023 (table-2 and figure-2) and these differences were statistically significant ($p<0.001$) and total RH negative was 2.1%

Table 2: proportions of RH negative among study individuals for years 2019-2023.

		Rh		Total	P value
		Rh negative	Rh positive		
Year	2019	405 (2.7)	14489 (97.3)	14894 (100)	< 0.001*
	2020	220 (1.9)	11492 (98.1)	11712 (100)	
	2021	345 (1.2)	29195 (98.8)	29540 (100)	
	2022	380 (1.6)	23336 (98.4)	23716 (100)	
	2023	764 (3.4)	21886 (96.6)	22650 (100)	
	Total	2114 (2.1)	100398 (97.9)	102512 (100)	

There were significant statistical differences in proportions of Thalassemia and Sickle cell anemia among study individuals for years 2019-2023 as described in table 3 and table 4 below.

Table 3: proportions of Thalassemia among study individuals for years 2019-2023.

		Thalassemia trait		Total
		Yes	No	
Year	2019	64 (0.4)	14830(99.5)	14894(100)
	2020	99 (0.8)	11613(99.1)	11712 (100)
	2021	116 (0.3)	29424(99.6)	29540 (100)
	2022	145 (0.6)	23571(99.3)	23716 (100)
	2023	589 (2.6)	22061(97.3)	22650(100)
	Total	1013 (0.9)	101499(99)	102512 (100)

Table 4: proportions of Sickle cell anemia among study individuals for years 2019-2023.

		Sickle cell trait		Total
		Yes	No	
Year	2019	4 (0.02)	14890 (99.9)	14894 (100)
	2020	0	11712(100)	11712 (100)
	2021	7 (0.02)	29533 (99.9)	29540 (100)
	2022	10 (0.04)	23706 (99.9)	23716 (100)
	2023	23 (0.1)	22627 (99.8)	22650 (100)
	Total	44 (0.04)	102468 (99.9)	102512 (100)

There were significant statistical differences in adjusted frequencies of Syphilis, Hepatitis B and Hepatitis C among study individuals for years 2019-2023 as described table 5-8.

Table 5: Frequency of HIV among study individuals for years 2019-2023.

		HIV		Total	P value
		Frequency	Adjusted frequency (100,000)		
Year	2019	0	0	14894	0.303
	2020	0	0	11712	
	2021	0	0	29540	
	2022	2	8	23716	
	2023	2	9	22650	
	Total	4	17	102512	

Table 6: Frequency of Syphilis among study individuals for years 2019-2023.

		Syphilis		Total	P value
		Frequency	Adjusted frequency (100,000)		
Year	2019	2	13	14894	< 0.001*
	2020	0	0	11712	
	2021	8	27	29540	
	2022	15	63	23716	
	2023	19	84	22650	
	Total	44	187	102512	
* Significant P value of less than 0.05. Chi-square test or Mann-Whitney test were used as appropriate.					

Table 7: Frequency of Hepatitis B among study individuals for years 2019-2023.

		Hepatitis B		Total	P value
		Frequency	Adjusted frequency (100,000)		
Year	2019	13	87	14894	< 0.001*

	2020	1	9	11712	
	2021	24	81	29540	
	2022	20	84	23716	
	2023	39	172	22650	
	total	97	433	102512	

Table 8: Frequency of Hepatitis C among study individuals for years 2019-2023.

		Hepatitis C		Total	P value
		Frequency	Adjusted frequency (100,000)		
Year	2019	1	7	14894	0.002*
	2020	0	0	11712	
	2021	9	31	29540	
	2022	17	72	23716	
	2023	8	35	22650	
	total	35	145	102512	

In regard to the sex difference among RH negative individuals, the study revealed that there were no significant statistical differences between males and females.

Table 9: Sex difference of RH negative among study individuals over 5 years.

	Sex	Rh		Total	P value
		negative	positive		
	Male	1024	50232	51256	0.147
		1.9%	98.1%	100.0%	
	Female	1090	50166	51256	
		2.1%	97.9%	100.0%	

Regarding the sex difference among HIV and Syphilis individuals, the current study showed that there was significant statistical difference between males and females among Syphilis patient as showed in table 10 below.

Table 10: Sex difference of HIV and Syphilis among study individuals over 5 years.

	Sex	Positive	Negative	Total	P value
HIV	Male	2	51254	51256	1
		0.004%	99.996%	100%	
	Female	2	51254	51256	
		0.004%	99.996%	100%	
Syphilis	Male	32	51224	51256	0.003*
		0.1%	99.9%	100.0%	
	Female	12	51244	51256	
		0.023%	99.976%	100.0%	

Regarding the sex difference among anemic individuals also no sex difference in positive cases of thalassemia and sickle cell anemia.

Table 11: Sex difference of anemia, thalassemia and sickle cell anemia among study individuals over 5 years.

	Sex	Tests		Total	P value
		Positive	Negative		
Anemia	Male	854	50402	51256	$p < 0.01$
		1.67%	98.3%	100.0%	
	Female	1214	50042	51256	
		2.36%	97.7%	100.0%	
	total	2068	100444	102512	
		2.1%	97.9%	100.0%	
Thalassemia	Male	391	50865	51256	$p < 0.01$

		0.7%	99.2%	100.0%	
	Female	622	50634	51256	
		1.2%	98.7%	100.0%	
	Total	1013	101499	102512	
		0.9%	99%	100.0%	
Sickle cell anemia	Male	22	51234	51256	p < 0.01
		0.04%	99.9%	100.0%	
	Female	22	51234	51256	
		0.04%	99.9%	100%	
	Total	44	102468	102512	
		0.04%	99.9%	100%	
* Significant P value of less than 0.05. Chi-square test or Mann-Whitney test were used as appropriate.					

In regard to the sex difference among Hepatitis B individuals, the study revealed that there were significant statistical differences between males and females, i.e. males showed significantly higher proportion of Hepatitis B than females. Regarding Hepatitis C, no significant statistical differences between males and females was detected (as showed in table 12 below).

Table 12: Sex difference of Hepatitis B and Hepatitis C among study individuals over 5 years.

	Sex	Positive	Negative	Total	P value
Hepatitis B	Male	68	51188	51256	< 0.001*
		0.1%	99.9%	100.0%	
	Female	29	51227	51256	
		0.1%	99.9%	100.0%	
Hepatitis C	Male	19	51237	51256	0.612
		0.037%	99.963%	100.0%	
	Female	16	51240	51256	
		0.031%	99.969%	100.0%	

DISCUSSION

The premarital screening program is especially important in Iraq due to high rates of consanguineous marriage and a significant prevalence of hemoglobinopathies. HIV and viral hepatitis remain global public health concerns. In Iraq, PMS is mandatory and aims to identify couples at high risk of genetic and infectious diseases to reduce the community burden. This study highlights demographic changes in the number of couples undergoing PMS before and after the COVID-19 pandemic. In 2020, the number of screened couples declined due to pandemic-related factors such as poverty, reduced access to healthcare, lower well-being, social isolation, and limited access to services like marriage licensing. These findings are consistent with studies from Iran, Japan, and the United States.[24,25,26]

Anemia was detected in 2.1% of cases overall, with 1.67% in males and 2.36% in females, reflecting normal sex differences in hemoglobin levels. Lower hemoglobin and ferritin levels in females are often due to diet, menstrual blood loss, and biological factors.[27] The prevalence of thalassemia was 0.9% (0.7% in males, 1.2% in females). This increase may be due to improved access to electrophoresis, better equipment accuracy, improved technician training, and greater public awareness. The main goal of improving the program is to reduce missed cases. Previous studies showed the β-thalassemia trait prevalence in PMS was highest in Karbala (3.8%), followed by Al-Hamdaniya (5.8%) and Erbil (7.04%).[6,28,29] Other centers in Iraq reported similar rates: Sulaimania (4.14%), Duhok (3.7%), Baghdad (4.4%), and Basra (4.6%). In contrast, Numan Teaching Hospital reported a lower rate of 1.92%. A broader study in Kurdistan found an overall prevalence of 3.98% across Iraq, ranging from 3.7% in the north to 4.6% in the south.[6,28,29] No significant gender difference was observed ($p < 0.01$), consistent with findings in Kirkuk.[30]

Several factors influence thalassemia prevalence, including birth rates, community education, genetic factors, consanguinity[5], early unregistered marriages, and limited awareness about premarital and antenatal screening, often shaped by cultural and religious norms. In Western countries, some women choose to continue pregnancies with affected fetuses, while others opt for termination. However, termination is not accepted in this region due to cultural and religious norms.[23] The proportion of sickle cell anemia was notably low at 0.04% for both sexes. Data from PMS clinics showed the highest prevalence among referrals from Ein Al-Tamur General Hospital. A study in Karbala reported a lower prevalence of 0.56%[28], while studies in Diyala and Nineveh reported 0.39% and 0.89%, respectively. Reported sickle cell carrier rates in Iraq range from 0%

to 16%. Erbil reported 0.064%, Duhok 1.2%, and Basra the highest at 6.5%.[31,32,33] Physicians counsel couples about risks but leave the final decision to them. Many couples refuse to cancel marriages due to stigma, especially when testing is done shortly before the ceremony. Counseling remains a strength of the program.

The frequency of positive HBsAg cases was 97, with an increase in 2023 likely linked to higher PMS coverage, immigration, and foreign nationals marrying in Iraq. A study in Baghdad (2023) also noted an increase in hepatitis cases over the past decade. Iraq has a low endemic rate for HBV and HCV compared to neighboring countries.[34] Awareness of hepatitis B vaccination is critical; a study in Kurdistan found only half of medical students were vaccinated due to limited programs.[35] Another study in Kurdistan identified risk factors such as dental surgery, illicit sex, drug use, and tattoos.[36] Males showed a significantly higher prevalence of hepatitis B than females. For hepatitis C, 35 cases were reported, consistent with studies showing low prevalence.[29] HIV was rare in this study, with 4 cases and no gender difference. Iraq has a low HIV/AIDS epidemic (<0.1%).[37] A similar study found 0% prevalence, while Saudi Arabia reported 9 cases, all in males. Syphilis was found in 44 cases with a significant gender difference. A study in Karbala noted an increase in syphilis prevalence linked to local and foreign visitors, while the global prevalence in 2020 was 0.6%.[38,39]

CONCLUSION

The premarital screening program in Karbala effectively identified carriers of inherited and infectious diseases, helping to prevent transmission to offspring. In 2020, the number of screenings declined due to the COVID-19 pandemic. Anemia was found in 2.1% of couples, with 0.9% having thalassemia trait and 0.04% having sickle cell anemia. Hepatitis B prevalence was low overall but higher in males, with cases increasing in 2023. Hepatitis C and HIV prevalence remained low with no significant gender differences. To improve the program's effectiveness, it is important to enhance awareness campaigns, increase staff and equipment support, improve laboratory services (including electrophoresis), and address consanguinity and early marriage while reducing the social stigma associated with infectious diseases.

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