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ORIGINAL RESEARCH

Prevalence and Demographic Analysis of Hemoglobinopathies in Newborns: A Three-Year Study at Thumbay Teaching Hospital, Ajman-UAE

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Background and Purpose: Hemoglobinopathies are hereditary blood disorders affecting hemoglobin in red blood cells. This study aimed to determine the prevalence and types of hemoglobinopathies among newborns in Thumbay Teaching Hospital, Ajman-UAE, over three years (2020–2022), and to analyze demographic trends.

Method and Population: A laboratory-based retrospective cross-sectional study was conducted, involving 6,050 newborns screened using High-Performance Liquid Chromatography (HPLC).

Results: We consider this study and its results as a new effort in the field of hemoglobinopathy research and management in Ajman in the United Arab Emirates. The final main findings revealed different hemoglobinopathy cases. In 2020 Two cases (2) involving Hb C variant were recorded, both of African origin (from Sudan and Egypt). The third case was Hb D variant which was also of African origin (Egypt). In 2021 no case was found. In 2022, the results showed a widespread of cases; A patient from Nigeria reported having Hb C, three cases of Hb D from Pakistan, two cases of Hb E trait from people in Bangladesh and India, one case of Hb S from Malawi, five cases of Hb S trait from people in Africa (two from Kenya, one from Tanzania), and two cases from Asian people from Yemen. The total number of detected hemoglobinopathies was 15 cases, accounting for a percentage of (0.2%).

Conclusion: The study reveals a diverse presence of hemoglobinopathies among newborns in Ajman and underscores the importance of newborn screening programs to facilitate early diagnosis and treatment, particularly in regions with high genetic disorder prevalence. The study revealed almost an obvious African origin of Hb C and S cases and Asian one of Hb E and D cases.

Keywords: hemoglobinopathy, neonatal screening, Hb-S disease, Hb C, Hb E, Hb D, thalassemia

Introduction

Newborn Screening (NBS) Program

For almost four decades, Newborn screening (NBS) has been a major part for the prevention of hemoglobinopathies such as Sickle cell disease (SCD), Thalassemia and other abnormal hemoglobin which aim in avoiding serious health complications from an early age. It was first attempted in the 1970s in the United States of America, Great Britain, and Jamaica.[1] Beginning with Alkaline Electrophoresis to more sophisticated and faster method like High Performance Liquid Chromatography (HPLC). A revolutionary method of newborn screening (NBS) was discovered in the early 1960s by Robert Guthrie, who experimented with bacterial inhibition to identify phenylketonuria in infants, which, if not

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diagnosed early can lead to irreversible brain damage caused by phenylalanine in the diet. In the next ten years, the advancement of radio immunoassay allows for the detection of congenital hyperthyroidism.

The development of Tandem mass spectrometry in the 1990s, which allowed for the simultaneous and economical screening of many samples for multiple conditions at once, changed the game for NBS.[2]

Several health experts are involved in the newborn screening procedure, which consists of more than just a laboratory test. Parental education is the initial step in the process.

A positive result on a screening test does not indicate a diagnosis. Additional clinical and biochemical tests are indispensable as well to decrease the possibility of false negatives and false positives.

Discovering any inborn error of metabolism will lead to a reduction of 50% in medical expenses, as stated in research done by Khneisser et al.[3] A later discovered case expenditure costs USD 82,000 more than a case discovered during NBS. It is without doubt that implementing NBS program with the latest technologies comes with a high cost. However, the predicted cost of detecting each case of an inborn metabolic mistake was projected to be USD 10,295. In areas with a high rate of consanguineous marriages (as shown in Figure 1), NBS could be deemed cost-effective despite the relative infrequency of these disorders.

Through screening more than 1,300,000 infants, with 86% of them participating in 2019, more than 2700 infants have been spared from death and/or physical, mental, and other related morbidity since 1995.[5] Due to the high percentage of carriers (5.0% −12.0%), screening for hemoglobinopathies is mandatory in the United Arab Emirates, as are other disorders like hearing screening programs and congenital heart disease. According to research conducted by L.I. al-Gazali et al in Al Ain and Dubai in 1997, the level of consanguinity between each woman and their spouse as well as their parents was recorded to be as high as 50.5% with an inbreeding coefficient of 0.0222.[4] This high level of consanguineous marriage is the main cause of genetic disease in the UAE and the leading cause of neonatal mortality. Since then, there has been an increase in preventive programs and to raise awareness for genetic disorders by the ministry of health science.

Hemoglobinopathies

The most common monogenic disorder worldwide is hemoglobinopathies. A paper that was presented at the "WHO working group" sixth annual meeting in 1989 claims between 300,000 and 400,000 kids are born every year with significant hemoglobinopathy disorders, such as sickle cell disease (SCD) or any other sort of hemoglobin anomaly.[6] The

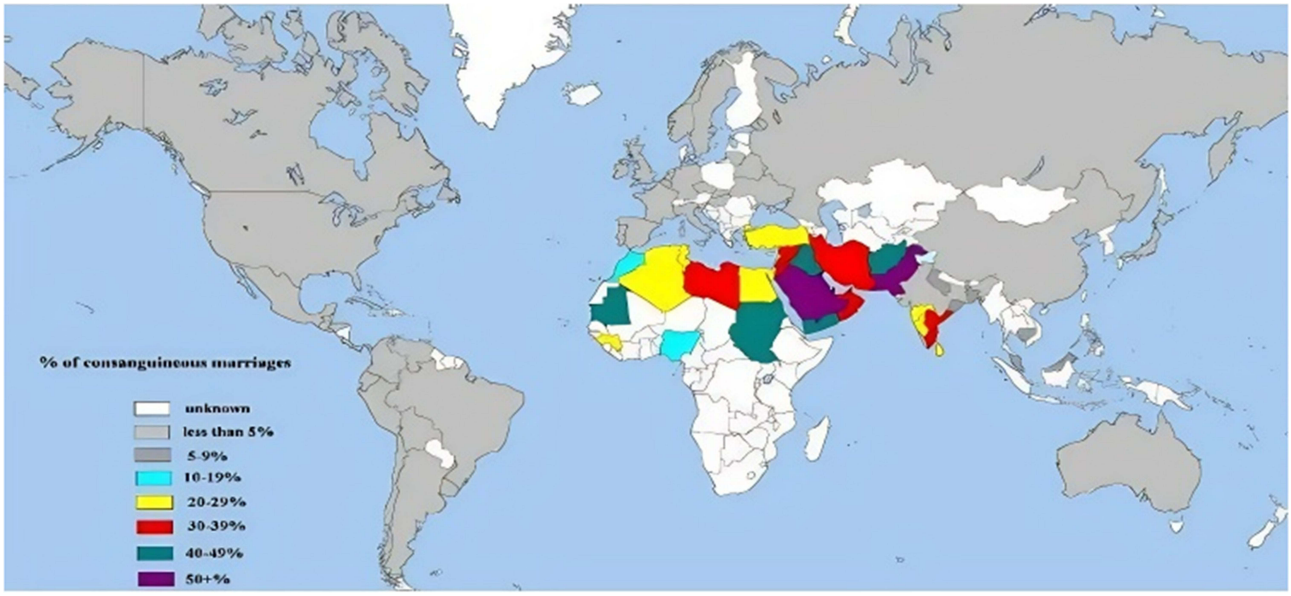

Figure 1 Illustrates a significant concentration of countries with elevated consanguinity levels, particularly in communities across North Africa, the Middle East, and West Asia.[4]

Mediterranean region, South and East Asia, India, and the Middle East, as well as subtropical areas like west and east Africa where malaria is most widespread, were the early hotspots for hemoglobinopathies.

Nowadays, hemoglobinopathies has been spread all over the world due to international migration. (Table 1).

In a recent study, published in 2024 on the prevalence and regional Distribution of Beta-Hemoglobin Variants in Saudi Arabia among 1,871,184 individuals, 112,618 (6.0%) individuals had abnormal test results. Study showed higher rates in regions near the Red Sea and Arabian Gulf compared to the central region. The Eastern and Jazan regions in particular had five and six-times higher prevalence rates than Riyadh. Table 2 showing the detailed results.[8]

Table 1 Prevalence of Hemoglobinopathy Carriers in the World[7]

Region	Carrier
Arab nations	5–40%
Africa	5–30%
South East Asia	5–40%
Central Asia and India	10–20%
USA and Central America	5–20%
Some part in Europe	0.5–1%

Table 2 Results of the National Premarital Screening Program for Hemoglobinopathies in Saudi Arabia From 2011 to 2018.[8]

Category	Male no. (%)	Female no. (%)	Total no. (%)
Number of Tested Individuals	931,099	940,085	1,871,184
HbS			
HbSA	41,062 (4.4)	41,951 (4.5)	83,013 (4.4)
HbSS	2,402 (0.3)	2,326 (0.3)	4,728 (0.3)
HbS-β0/+ thalassemia	354 (0.04)	322 (0.03)	676 (0.04)
HbSC	3 (0.0003)	2 (0.0002)	5 (0.0003)
HbSD	3 (0.0003)	6 (0.0006)	9 (0.0005)
Beta thalassemia			
Carrier State	10,443 (1.1)	11,069 (1.2)	21,512 (1.1)
β+/+, β+/0, β0/0	607 (0.07)	301 (0.03)	908 (0.05)
HbC			
HbCA	392 (0.04)	372 (0.04)	764 (0.04)
HbCC	5 (0.0005)	4 (0.0004)	9 (0.0005)
HbD			
HbDA	345 (0.04)	381 (0.04)	726 (0.04)

(*Continued*)

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Table 2 (Continued).

Category	Male no. (%)	Female no. (%)	Total no. (%)
HbDD	8 (0.0009)	11 (0.0012)	19 (0.001)
HbO-Arab trait	59 (0.006)	67 (0.007)	126 (0.007)
HbG trait	61 (0.007)	55 (0.006)	106 (0.006)
HbE trait	9 (0.001)	4 (0.0004)	13 (0.0007)
Hb Lepore trait	3 (0.0003)	2 (0.0002)	5 (0.0003)

The most common types of hemoglobinopathies are abnormal hemoglobin variants like Hb S, Hb E, Hb C, Hb D, and Thalassemia syndrome (α and β thalassemia).[9] In UAE and many other countries, newborn screening program for hemoglobinopathies such as SCD and thalassemia can be identified shortly after birth (48–72 hrs) which is a major key to prevent early mortality.

Types of Hemoglobinopathies

All hereditary illnesses connected to hemoglobin are referred to as hemoglobinopathies. They are divided into two categories: structural hemoglobin variations and thalassemia. Hemoglobinopathies include a wide range of clinical presentations, from mild hypochromic anemia to moderate abnormalities, and in more severe cases, lifelong transfusion-dependent anemia involving numerous organs.[10]

Abnormal Hemoglobin. (Structural Hemoglobin Variants)

The primary cause of hemoglobin variations is mutations that alter the nucleotide sequence or amount in the corresponding globin gene. Less frequently, mispairing and crossover between comparable genes during meiosis lead to anomalies like these, where a fusion protein containing both gene sequences is produced.

Hb S and Sickle Cell Disease

In 1910, James Herrick identified sickle cell morphology for the first time on a blood film from a black dental student. He described the shape as thin, elongated crescents.[11]

Hemoglobin S (HbS) is the result of a missense mutation in the β globin chain-coding region of the HBB gene. This mutation is identified by a T→A substitution, which causes the GTG codon (GAG → GTG) to replace the typical GAG codon. The hydrophobic valine (p. Glu6val) of the β-chain of hemoglobin, also known as hemoglobin S (HbS), replaces the hydrophilic amino acid glutamic acid, which is situated at position 6 in the β globin chain.[12,13]

Sickle cell disease (SCD) develops when fetal hemoglobin (HbF) approaches the adult level by the time the kid is five to six months old. It can lead to both acute and chronic problems and impacts several organs and systems.[9]

Hb C Diseases

Hemoglobin C (HbC) is a hemoglobin variation that is less severe than sickle cell anemia (HbS) due to a mutation in the beta globin gene that results in glutamic acid being substituted for lysine at position 6 of the globin chain. Complete clinical health is exhibited by heterozygous HbC.[14] In regions of Africa where malaria is prevalent, such as the southeast and western Atlantic, it is more prevalent.

Hb E Disease

The hemoglobinopathy known as hemoglobin E (Hb E) is typified by an aberrant hemoglobin form. In Bangladesh, India, and Southeast Asia, it is highly prevalent. The pattern of this disease is comparable to that of β-thalassemia. Although

this illness usually does not cause any symptoms, people with it may have very slight anemia. When thalassemia (Hb H) and hemoglobin E are coupled, it can lead to significant hemoglobinopathies.[15–17]

Thalassemia Syndrome

Thalassemia was discovered in 1925 by Thomas Benton Cooley an American pediatrician and hematologist.[18] It is mostly common in the sub-Sahara Africa, the Middle East and South East Asia.

One of the most severe and prevalent genetic disorders, thalassemia poses a significant health risk to the United Arab Emirates. They are frequently inherited autosomal recessively and are caused by mutations in the β globin (HBB) and α (HBA1/HBA2) genes. They may result from the loss of specific important gene segments or from a genetic mutation.[19]

The degree of chain imbalance determines the severity of thalassemia, which can range from mild symptoms to serious consequences.[17] There are two forms of thalassemia; alpha and beta thalassemia.

Hemoglobinopathies in United Arab Emirates

The Ministry of Health of the United Arab Emirates started a pilot program in 2005 to screen newborns for sickle cell disease in three districts: Abu Dhabi, Al-Ain, and the western regional districts.[20] Ninety-five percent of all live newborns, or 22,200 out of 23,344, were screened between January 1 and December 31. Hemoglobinopathies were detected in 342 infants (1.5%). The prevalence of sickle-cell disease was 0.04%, with UAE citizens having a higher rate of 0.07% than non-citizens at 0.02%.[20]

A study published in 2009 revealed results of a screening program for hemoglobinopathies conducted by Dubai Thalassemia and genetic center. Sickle cell-beta thalassemia (0.002%), homozygous hemoglobin C (0.01%), homozygous hemoglobin D-Punjab (0.01%), homozygous hemoglobin E (0.01%), and beta-thalassemia trait (0.5%) were detected.[21]

A recent screening study in the United Arab Emirates-Dubai of 14733 neonates born between October 2012 and October 2017 revealed 14 (0.1%) cases of inborn errors of metabolism and 161 (1.1%) newborns of glucose-6-phosphate dehydrogenase deficiency and 172 (1.2%) were carriers. 296 (2%) newborns were found to have a variety of hemoglobinopathy spectrum with only another 13 (0.09%) being positive for a hemoglobinopathy disorder.[22]

High number consanguineous marriages, which are still common in the country, is thought to be the cause of the prevalence of hemoglobinopathies in the United Arab Emirates. This raises the risk of congenital diseases. Furthermore, the population of the Emirate is diverse and is growing in number of immigrants, which results in a larger genetic pool and higher carrier rates.[16,21]

To further lessen the incidence of hemoglobinopathies, the UAE has explored extending this effective newborn screening program countrywide; nevertheless, difficulties still exist. It needs constant work to guarantee good screening coverage and follow-up rates, especially for communities of non-citizens.[17,20]

To address issues and increase knowledge about hemoglobinopathies and G6PDH (glucose-6-phosphate dehydrogenase), a program known as "Emirates Free of Newly Born Thalassemic Children" was started with the goal of fostering a healthy environment in the United Arab Emirates.[17]

Materials and Methods

Study Design and Population

This study is a Laboratory based retrospective cross-sectional study, conducted in Ajman-UAE during the period of three years from January 2020 to December 2022.Population was (6.050). Study samples data were obtained from Thumbay teaching Hospital laboratory data.

Inclusion and Non-Inclusion Criteria

Data of a properly labeled blood spot samples of Thumbay teaching Hospitals laboratory was included in this study.

Data of Mislabeled or charred or soiled blood spot samples was not included in this study.

Methodology of Newborn Screening

Following the receipt of blood spot samples for newborn screening tests at Thumbay Hospital Laboratory or from other medical facilities throughout the Northern Emirates in the United Arab Emirates (UAE), the samples were appropriately labeled and the screening process was carried out. The screening test was conducted using high performance liquid chromatography (HPLC) technology.

Data Collection and Analysis

The study data came from the laboratory data of the Thumbay Teaching Hospital, organized confidentially by a responsible scientist into a single file containing the data from Thumbay and other hospitals. Primary data file was prepared from the results data and a medical statistician performed the data analysis. SPSS version 25 was used for data analysis.

Ethical Consideration

All isolates used in the study already de-identified so as to maintain patient confidentiality. Study Ethical approval was obtained from the Institutional Review Board (IRB) of Gulf Medical University, Ref. no. IRB/COHS/FAC/47/AUG-2022.

Informed consent was waived by the review board due to the retrospective tincture of the study and the anonymous study data used.

This Study Complies with the Declaration of Helsinki

Results

Analysis of results and categorization was done to include participants by years, continents, sub continents, genders, final results and the comparison of the results among years and nationalities. For all these categories, statistics are given as frequency and percentage as shown in Figures 2 and 3 and Tables 3–7.

Discussion

The main goal of our study was to screen and evaluate the prevalence of hemoglobinopathies among newborns over three years in Thumbay hospital Ajman-UAE. Examination of the demographic characteristics of newborn, including their ethnic backgrounds, their gender and geographical distribution, beside analysis of the types and specific variants of hemoglobinopathies were achieved by this study.

Our study archived a total number of 6050 participants for the years 2020, 2021

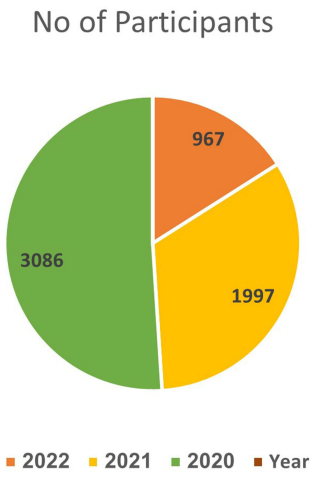

Figure 2 Shows the different numbers of study participants in each year during the study period.

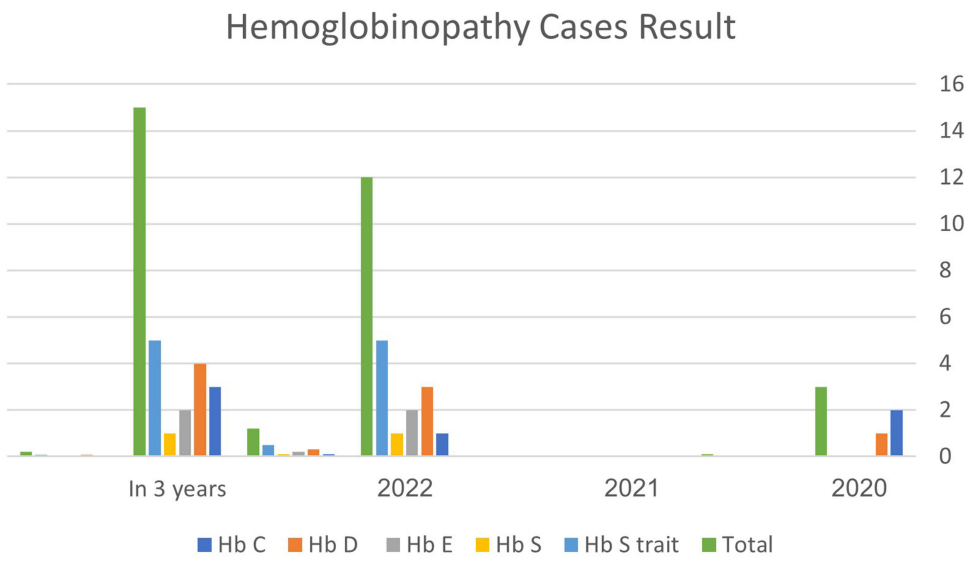

Figure 3 Presenting Number and of Hemoglobinopathy cases among participants of each year and total participants.

and 2022 as shown in Table 3. The highest number of participants was from Asia with more than 83.63% of total, and the lowest from Europe and America with only 0.13%.

The number of participants in this study showed a significant decrease in 2021 (1822) and 2022 (829), compared to 2020 (2581), especially among participants of European and American origin. This could be due to the restrictions imposed by the Covid pandemic at that time.

Analysis of data shows 3,441 male participants which is more than females (2,609) as described in Table 3. A study done by Khawla et al in 2013 shows similar values with a percentage of 52.8% males and 47.2% females.[16] By sub-continents, the highest number of participants from all the three years were from South Asia with a total percentage of 60.51% and the lowest from Europe and America (0.13%).

The most commonly observed hemoglobinopathy among the participants was reported to be the Hb S trait with a total number of 5; 2 from Kenya, 1 from Tanzania and 2 from Yemen in 2022 as shown in Table 4. However, in the year 2020 and 2021 no positive Hb S trait was reported. In contrast to our research, a study observed by H. Al Hosani et al in 2002

Table 3 Population Distribution of Participants by Years and Continents

Continent	2020		2021		2022	
	Count	Count %	Count	Count %	Count	Count %
Asia	**2581**	**83.63%**	**1822**	**91.2%**	**829**	**86.2%**
Africa	**501**	**16.24%**	**175**	**8.8%**	**138**	**13.8%**
Europe and America	4	0.13%	0	0.0%	0	0.0%
Total Participants	3086		1997		967	

Notes: shows the population distribution of participants by years (2020,2021,2022) and continents.3086 people took the test in 2020, with 2,581 (83.63%) coming from Asia being the most common origin. With 501 participants, Africa accounted for 16.24% of the total. With only 4 participants, Europe and America as a whole contributed the least amount (just 0.13%). A total of 1997 people took the test in 2021, which is fewer than in 2020. Asia accounted for 1822 participants, the majority. Africa's share dropped to 175%, or 8.8%. In 2021, there was no participant from America or Europe.The total number of participants dropped to 967 in 2022. Asia continues to be the majority, with 829 participants, or 86.2%. Thirteen percent of the participants, or 138 people, were from Africa. Once more, no participants in 2022 from America or Europe. With nearly 80% of the entrants each year, Asians dominated the competition year after year. The percentage of Africans fluctuated, falling from 16.24% in 2020 to 8.8% in 2021 before rising in 2022. Participants from America and Europe were hardly represented.

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Table 4 Population Distribution of Participants by Years and Sub-Continents

Sub-Continent		Years					
		2020		2021		2022	
		Count	Count %	Count	Count %	Count	Count %
Europe and America		4	0.13%	0	0.0%	0	0.0%
Asia	North Asia	5	0.15%	5	0.25%	1	0.12%
	Central Asia	56	1.81%	49	2.44%	6	0.72%
	Western Asia	600	19.40%	221	10.98%	77	9.29%
	Southern Asia	1862	60.51%	1403	69.73%	678	81.79%
	Eastern Asia	5	0.15%	1	0.05%	1	0.12%
	Southeastern Asia	53	1.72%	143	7.11%	66	7.96%
Africa	Northern Africa	387	12.49%	80	3.98%	78	56.52%
	Western Africa	41	1.33%	30	1.49%	18	13.04%
	Middle Africa	9	0.29%	63	3.13%	8	5.80%
	Eastern Africa	59	1.87%	1	0.05%	33	23.91%
	Southern Africa	5	0.15%	1	0.05%	1	0.72%

Notes:. Shows the population of participants by year and sub-continents.
The bulk of people who underwent the hemoglobinopathy screening test at Thumbay Hospital in 2020—1,862 participants, or 60.51% of the total—were from South Asia. Western Asia accounted for the second highest percentage (19.40%) with 600 participants. Conversely, with only 5 individuals from each region (0.15%), the least number of participants came from southern Africa, North Asia, and eastern Asia. Only four people (0.13%) were counted from Europe and America.As of 2021, 1,403 people, or 69.73% of the total, were from South Asia, still accounting for the majority of participants. With 221 participants, Western Asia had the second-highest number, making up 10.98% of the total year's participants. At the lowest end, there are no participants from Europe or America. Similar to this, only one person, or 0.05% of the total, came from southern Africa, eastern Africa, or eastern Asia.In 2022 southern Asia still with the highest participants of 678 making up to 81.79%. North Asia, Eastern Asia and southern Africa had the lowest with one participant each representing a percentage of 0.12%, 0.12% and 0.72% respectively.

Table 5 Population Distribution of Participants by Gender and Sub-Continents

		Gender			
		Male		Female	
		Count	Count %	Count	Count %
Europe and America		0	0.0%	4	0.15%
Asia	North Asia	10	0.32	1	0.04%
	Central Asia	55	1.65	56	2.15%
	Western Asia	475	12.71	423	16.21%
	Southern Asia	2,274	67.17	1,669	63.97%
	Eastern Asia	5	0.16	2	0.08%
	Southeastern Asia	155	5.13	107	4.10%

(*Continued*)

Table 5 (Continued).

		Gender			
		Male		Female	
		Count	Count %	Count	Count %
Africa	Northern Africa	312	8.17	233	8.93%
	Western Africa	53	1.58	36	1.38%
	Middle Africa	47	1.62	33	1.26%
	Eastern Africa	52	1.43	41	1.57%
	Southern Africa	3	0.06	4	0.15%

Notes:. Shows the population distribution of participants by gender and sub-continents. The data indicates a larger participation rate in the male gender, with 3,441 males taking the test overall, compared to 2,609 females. The highest record was set in southern Asia, where 2,274 men and 1,669 women took the exam, representing 67.17% and 63.97% of the total. With 475 (12.71%) and 423 (16.21%) for males and females, respectively, Western Asia had the second-highest numbers. Conversely, the sub-continents with the lowest numbers of males and females were South Africa, with only 3 males (0.06%), and North Asia, with only 1 female (0.04%).

Table 6 Comparison of Hemoglobinopathy Results Across years and Nationalities

year		Hb C		Hb D	Hb E Trait		Hb S	Hb S Trait		
2020	Count	2		1	0		0	0		
	Nationality	Sudan	Egypt	0	0		0	0		
	Continent	Africa		Africa	0		0	0		
2021	Count	0		0	0		0	0		
	Nationality	0		0	0		0	0		
	Continent	0		0	0		0	0		
2022	Count	1		3	2		1	5		
	Nationality	Nigeria		Pakistan	Bangladesh	India	Malawi	2 Kenya	Tanzania	2 Yemen
	Continent	Africa		Asia	Asia		Africa	Africa		Asia

Notes:. Shows the comparison of the results of hemoglobinopathies across the years and nationalities. There were three cases of hemoglobinopathies found in 2020. Two examples involving the Hb C variant, from Sudan and Egypt, both in Africa. Additionally, a single instance of Hb D from Egypt was noted. There were no documented cases of hemoglobinopathy in 2021. The results of the study conducted in 2022 revealed a high number of cases: one case of Hb C was reported from a patient who was originally from Nigeria; three cases of Hb D were from Pakistan; two cases of Hb E trait were found in people from Bangladesh and India; one case of Hb S was from Malawi; five cases of Hb S trait were from people who were originally from Africa (two from Kenya and one from Tanzania); and two cases were Asians from Yemen.

Table 7 Number and Percentages of Hemoglobinopathy Cases Among Participants of Each year and Total Participants

case	2020 (3086 Participant)		2021 (1997 Participant)		2022 (967 Participant)		In 3 years (6050 Participant)	
	No of cases	%	No of cases	%	No of cases	%	No of cases	%
Hb C	2	0.06	0	0	1	0.1	3	0.05
Hb D	1	0.03	0	0	3	0.3	4	0.07

(*Continued*)

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Table 7 (Continued).

case	2020 (3086 Participant)		2021 (1997 Participant)		2022 (967 Participant)		In 3 years (6050 Participant)	
	No of cases	%	No of cases	%	No of cases	%	No of cases	%
Hb E	0	0	0	0	2	0.2	2	0.03
Hb S	0	0	0	0	1	0.1	1	0.02
Hb S trait	0	0	0	0	5	0.5	5	0.08
Total	3	0.1	0	0	12	1.2	15	0.2

Notes:. Shows the numbers and percentages of hemoglobinopathies in each year (2020,2021 and 2022) and the total numbers and percentages in the total 3 years.Total number of hemoglobinopathies cases in 2020 was 3 cases with percentage of 0.1% of the total (3086) participants.In 2021 no cases detected among the (1997) total participants. In 2022 total number of hemoglobinopathies was 12, representing a percentage of (1.2%) in (967) participants.The total number of hemoglobinopathy cases in the 3 years total population (6050) was 15 cases, which accounts for a percentage of (0.2%).

in three districts of Abu Dhabi emirates, shows a total number of Hb S trait to be 240 which is way higher.[20] In 2013, Khawla et al research resulted in a 2.9% prevalence of Hb S trait in the UAE and it was compared to other neighboring countries to be fewer.[16] In a recent study done by Mohammed Makkawi et al in Saudi Arabia from November 2017 to October 2020 showed Hb S trait prevalence to be 6.79% (2017), 7.23% (2018) and 6.90% (2019).[9]

The second most common hemoglobinopathy observed in our results was reported to be Hb D. Cases were 4; 1 case from Africa in 2020 and 3 from Pakistan in 2022. No results were reported in 2021. A research study conducted by Khawla et al in 2013 in UAE shows a higher prevalence of Hb D with total of 41 cases (0.78%)[16] however, the study conducted by H. Al Hosani et al in 2002 shows lower results in Abu Dhabi compared to our findings with a total of only 2 cases.[20]

The third most common hemoglobinopathy in Thumbay hospital Ajman is Hb C with a total of 2 cases (1 originating from Egypt and 1 from Sudan) in the year 2020 and 1 from Nigeria in the year 2022. No results were reported in the year 2021. To compare with the study done by Al Hosani et al in 2002 in the emirate of Abu Dhabi a lower result of one case was reported.[20]

The fourth most common hemoglobinopathy in Thumbay Hospital Ajman during the of 2020 to 2022 was Hb E with a total of 2 cases from Bangladesh and India nationality in the year 2022, which is similar to the research conducted by Khawla et al in 2013 in Dubai emirate[16] and higher than the UAE research done by Al Hosani et al.[20]

Our result was far lower than a western result of Jennifer Michlitsch et al who did a study on the prevalence of hemoglobinopathies in California from January 1st 1998, to June 30th 2006, 514 individuals were identified as having Hb E disease.[23]

The lowest common hemoglobinopathy in our finding was HbS homozygous disease (HbSS) found in only 1 participant from Malawi in the year 2022, which is contradictory to a study done by Mohammed Makkawi in Saudi Arabia from 2017 to 2020[9] as their results concluded on the facts that HbSS is the most prevalent hemoglobinopathy with a total of 2,302 cases; 657 (2017 to 2018), 1000 (2018 to 2019) and 645 (2019 to 2020).

The final total number of hemoglobinopathies in our study population was 15 (0.2%), which is far lower than the result of the pilot program done in the United Arab Emirate - Abu Dhabi by the ministry of health when 22,200 out of 23,344 infants were screened, 342 babies screened positive for hemoglobinopathies (1.5%).[20]

In our data analysis, we observed that a high prevalence of hemoglobinopathy positive participants hail from Africa compared to Asia.

Conclusion

The study's primary goal is to assess the frequency of hemoglobinopathies in infants at the Thumbay Hospital in Ajman, United Arab Emirates. Based on the findings, this study illustrates important patterns in the distribution of participants, gender differences, and hemoglobinopathy incidence over a range of continents and subcontinents between 2020 and 2022.

The high number of Asian study participants confirms that Asians are in the majority in this study area, which can be attributed to possible reasons such as the excessive immigration of Asians to the Gulf region and mixed marriages.

In conclusion, this study shows that hemoglobinopathies are present in a variety of nations and continents, with instances of the Hb S trait in Africa (Malawi) and the Hb E trait in Asia. This study also shows that throughout those three years, a greater number of men than women underwent screening tests for hemoglobinopathies.

The prevalence of hemoglobinopathy in Thumbay Hospital resulting from these findings confirms the importance of screening programs in the UAE. We hope that with this study we add help to increase awareness of this disease, refine genetic counseling and develop targeted screening initiatives.

Recommendations

Based on the finding of the study, further research should focus on expanding geographic scope, developing robust approach in collecting data to maintain consistency over time and enhance more accurate and reliable analysis and examine the causes of gender disparities.

Additional research should be done on hemoglobinopathies given the varying occurrence among different nationalities and continents to better inform for public health initiatives. Investigating the effectiveness of different screening technologies could also help in the selection of better screenings in the future.

Form partnerships with regional health organizations and agencies to improve access to participant data and build trust, which will attract a larger and more diverse participant base.

Strengths

The obvious strengths of this study were the research topic, which considered to be unique, very important in public health and early diagnosis and treatment of hemoglobinopathies. And the large size study population compared to previous studies in the study area.

Limitations

The main limitation of this study was the small study area, as it was conducted in Thumbay Hospital-Ajman-UAE, which is considered a limited area, which may lead to some limitations in the effectiveness of the final findings.

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Disclosure

No conflict of interest has been declared.

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