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The Prevalence of People about to get Married who Carry Genes for Hereditary Blood Diseases and their Relationship to the Occurrence of the Disease

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Abstract:

Hereditary hematologic disorders originate from genetic factors that cause disruptions of blood homeostasis. Clinics for couples planning to get married have all the data on people carrying genetic diseases, while the Center for Hereditary Blood Diseases has all the data on people affected. This study aimed to conduct an epidemiological study to obtain a comprehensive epidemiological picture regarding the percentage of people about to marry who carry hereditary diseases and the percentage of recent infections recorded in the same years studied. The current study was recorded among 58,958 couples who visited the upcoming marriage clinic during the period from 2019 to 2023, the study showed 12602 (21.37%) of people were have hereditary and non-hereditary anemia, the highest percentage of anemia patients was showed in the year 2023, 37.32%, followed in the year 2022, 20.33%, in contrast the lowest anemia patients recorded in year 2022, 14.13%. The present study was noted that the hereditary anemia was beta thalassemia 3.36%, followed alpha thalassemia 2.02%, in contrast the lowest hereditary anemia was trait 0.05%. also, showed 910 (7.22%) of people had hereditary anemia, in contrast a 11692 (92.78%) had non-hereditary anemia. This study was investigated a positive correlation between people carried beta-thalassemia anemia gene, trait thalassemia gene and sickle cell anemia gene, and the birth of children with genetic diseases, while non-significant correlation with regard alpha-thalassemia.

Keywords: Genes, Hereditary Blood, Relationship, Disease

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Introduction

Blood disorders syndromes encompass a broad spectrum of medical conditions affecting the components of blood, including red blood cells, white blood cells, platelets, and plasma. These syndromes can manifest as abnormalities in blood cell production, function, or regulation, leading to a variety of clinical manifestations ranging from mild to life-threatening. The human circulatory system relies on the proper functioning of blood cells to maintain essential physiological processes such as oxygen transport, immune defense, and blood clotting. Any disruption in the normal production or function of blood cells can result in significant health consequences [1, 2]. Blood disorders syndromes are diverse and can be categorized based on various criteria, including the type of blood cell affected, the underlying cause, and the clinical presentation. Some syndromes primarily affect one type of blood cell, while others may involve multiple cell types or stem from systemic disorders affecting the bone marrow or immune system. One of the most prevalent categories of blood disorders syndromes is anemia, characterized by a deficiency in red blood cells or hemoglobin, the oxygen- carrying protein within red blood cells. Anemia can be caused by various factors, including nutritional deficiencies(such as iron, vitamin B12, or folate deficiency), chronic diseases, genetic disorders (such as sickle cell disease or thalassemia), or autoimmune conditions[3]. On the other hand, disorders affecting white blood cells, such as leukemias, lymphomas, and myeloproliferative neoplasms, represent another significant subset of blood disorders syndromes. These conditions involve abnormal proliferation or dysfunction of white blood cells, impairing the body's ability to fight infections and maintain immune homeostasis [4].

Furthermore, blood disorders syndromes may also encompass rare genetic conditions, such as hemophagocytic lymph histiocytosis (HLH), paroxysmal nocturnal hemoglobinuria (PNH), or acquired disorders like myelodysplastic syndromes (MDS), which can present with a wide range of hematologic abnormalities and systemic complications [5]. Understanding the pathophysiology, clinical features, and management strategies for blood disorders syndromes is essential for healthcare providers to accurately diagnose and effectively treat affected individuals. Advances in medical research and technology have led to improved diagnostic techniques, targeted therapies, and supportive care measures, enhancing the overall prognosis and quality of life for patients with these conditions [6].

Aim of the Study

This study was aimed for

- Evaluation the hereditary blood disorder for those about to get married.
- Studying the relationship between couples who are about to marry that carrying BD gene and the rate of giving birth to sick children in those years.

Blood Disorders

Blood disorders are conditions that affect the components of blood, including red blood cells, white blood cells, platelets, and plasma. These disorders can affect the body's ability to produce and/or function with these blood components, leading to various health problems and symptoms. Examples of blood disorders include anemia, leukemia, hemophilia, thrombocytopenia, and sickle cell disease [7].

Types of Blood Disorders

There are several types of blood disorders

- Anemia: a condition caused by a deficiency in red blood cells, which can result in fatigue, weakness, and shortness of breath.
- Thalassemia is a genetic blood disorder characterized by abnormal production of hemoglobin, the protein in red blood cells that carries oxygen throughout the body. It is caused by mutations in the genes that control the production of hemoglobin, leading to a reduced amount or abnormal structure of the protein. Thalassemia can range from mild to severe, with symptoms including anemia, fatigue, jaundice, and bone deformities. Treatment may involve blood transfusions, iron chelation therapy, and stem cell transplantation.

- Sickle cell disease: a genetic disorder that affects the shape and function of red blood cells, causing them to become rigid and misshapen.
- Hemophilia: a disorder that affects the clotting of blood, which can lead to excessive bleeding or bruising.
- .5Leukemia: a cancer that originates in the bone marrow and causes the overproduction of abnormal white blood cells.

Thalassemia

Thalassemia is a normal blood disorder that causes a low level of hemoglobin in the body. Hemoglobin enables red blood cells to carry oxygen. May be filled with thalassemia anemia, which feels exhausting. If you have thalassemia mild, you may not need treatment. But more severe forms may require regular blood transfusions. You can take steps to cope with fatigue, such as choosing a healthy diet and exercising regularly [12]

Causes of Thalassemia

Thalassemia occurs due to mutations in the DNA of cells responsible for producing hemoglobin a substance in red blood cells responsible for carrying oxygen throughout the body. Mutations associated with thalassemia are inherited from parents to children [13].

Hemoglobin molecules are composed of chains called alpha and beta chains that may be affected by mutations. In thalassemia, the production of alpha or beta chains is reduced which leads to either alpha thalassemia or beta thalassemia [14]

Risk factors

Factors that may increase your risk of developing thalassemia include:

- Family history of thalassemia. Thalassemia is transmitted from parents to children through hemoglobin genes resulting from a mutation.
- Race. People most affected by thalassemia are African Americans, people of Mediterranean descent, and Southeast Asian descent [15, 16].

Complications

Possible complications of moderate to severe thalassemia include:

Ordinary complication

a. Iron overload. The amount of iron increases excessively in people with thalassemia, either because of the disease or because of constant blood transfusions. Excessive iron in your body can damage your heart, liver, and endocrine system, which contains hormone-secreting glands that regulate the processes of your entire body.

b. Infection. People with thalassemia have an increased risk of developing infectious diseases. This especially happens if you had your spleen removed.

Severe Complication: In cases of severe thalassemia, the following complications can occur:

a. Bone deformities. Thalassemia causes your bone marrow to expand, causing your bones to stretch wider. This may lead to abnormal bone structure, especially in your face and skull. Expansion of the bone marrow also leads to thinning and brittle bones, which increases the chances of bone fractures.

b. Splenomegaly. The spleen helps your body fight infections and filter out unwanted substances such as old or damaged blood cells. Thalassemia is usually accompanied by the destruction of a large number of red blood cells. This makes your spleen enlarge and make it work harder than normal.

c. Slow growth rates. Anemia slows a child's growth and delays puberty.

d. Heart problems. Congestive heart failure and cardiac arrhythmia may be linked to thalassemia severe [17, 18]

Alpha Thalassemia

Alpha thalassemia is a hereditary blood disorder that the sick child is born with. Alpha thalassemia is one of the many types of thalassemia, but at the same time it is one of the less common types of the disease. Alpha thalassemia occurs as a result of a defect in the genes of the alpha protein chains, which constitute one of the types of protein chains that make up hemoglobin in the blood, which may negatively affect the processes of producing hemoglobin in the blood. Hemoglobin is an important substance that is included in the composition of red blood cells and is responsible for transporting oxygen to various parts of the blood.[19]

Types of alpha thalassemia

The severity of alpha thalassemia varies and its type varies depending on the number of defective genes the patient has, as follows

Silent alpha thalassemia: a mutation in a single gene: This type occurs as a result of inheriting a genetic mutation in only one of the four genes responsible for the formation of alpha chains. In this type, the person does not actually have the disease, but is a carrier of the disease, and can pass the gene that causes the disease to his children, so the person with this condition is called the silent carrier of the disease [20]

Alpha thalassemia minor: mutations in two genes: This type arises as a result of inheriting mutations in two of the four genes responsible for the formation of alpha chains. This type of disease often causes only minor symptoms and nothing more. A person with this condition is usually called a carrier of the disease [21]

Beta thalassemia

Beta-thalassemia are a group of hereditary blood disorders characterized by anomalies in the synthesis of the beta chains of hemoglobin resulting in variable phenotypes ranging from severe anemia to clinically asymptomatic individuals. The total annual incidence of symptomatic individuals is estimated at 1 in 100,000 throughout the world and 1 in 10,000 people in the European Union. Three main forms have been described: thalassemia major, thalassemia intermedia and thalassemia minor [23]. Individuals with thalassemia major usually present within the first two years of life with severe anemia, requiring regular red blood cell (RBC) transfusions. Findings in untreated or poorly transfused individuals with thalassemia major, as seen in some developing countries, are growth retardation, pallor, jaundice, poor musculature, hepatosplenomegaly, leg ulcers, development of masses from extramedullary hematopoiesis, and skeletal changes that result from expansion of the bone marrow [24]

Types of Beta Thalassemia

Thalassemia intermedia

Thalassemia intermedia patients are asymptomatic until adult life, whereas others are symptomatic from as young as 2 years of age. A number of clinical complications commonly associated with thalassemia intermedia are rarely seen in thalassemia major, including extramedullary hematopoiesis, leg ulcers, gallstones and thrombophilia. Prevention of these complications, possibly with blood transfusion therapy, is ideal since they may be difficult to manage.

Beta Thalassemia Major

Beta thalassemia major is a genetic disease resulting from a deficiency or complete deficiency of beta globin chains. Patients with this disease need frequent blood transfusions to survive. This may cause oxidative stress and tissue injury due to iron overload. Changing antioxidant enzymes and levels of other essential trace elements. The aim of this review is to examine the relationship between oxidative stress and trace elements in serum, the degree of damage caused by oxidative stress, and the role of antioxidant enzymes in thalassemia major. The results indicate that oxidative stress in patients occurs mainly due to tissue injury due to excessive production of free radicals due to secondary iron overload and change in serum trace elements and the level of antioxidant enzymes. The role of trace elements such as selenium, copper, iron and zinc in beta thalassemia major patients reveals a significant change in this trace element [26, 27]

Approximately 12,000 children are born with thalassemia major each year. These children often develop significant anemia along with enlargement of the liver and spleen during infancy and require early diagnosis and treatment

institution with frequent blood transfusions and chelation therapy. An adequate dose of chelation therapy is necessary to maintain serum ferritin at about 1000. ng/ml with current administration protocol [28]

Beta Thalassemia Minor

It is an inherited form of hemolytic anemia that is less severe than thalassemia major and is a type of beta thalassemia, which causes anemia whose severity ranges from mild to severe. In this case, the individual is a carrier of the thalassemia trait but does not suffer from thalassemia. Thalassemia minor occurs as a result of a mutation that affects only one recessive C nucleotide. The affected person often does not show any symptoms, or they may be mild in severity. Patients with thalassemia minor may not need treatment [29]

Sickle Cell Anemia

Sickle cell anemia (SCA) is a genetic blood disorder characterized by the production of abnormal hemoglobin, known as hemoglobin S (HbS), which leads to the formation of sickle-shaped red blood cells (RBCs). This inherited condition is caused by a point mutation in the beta-globin gene, resulting in the substitution of valine for glutamic acid at the sixth position of the beta-globin chain. Individuals with sickle cell anemia inherit two copies of the abnormal gene (HbSS. genotype), one from each parent. Pathophysiology normal hemoglobin (HbA) consists of two alpha-globin and two beta-globin chains, forming a tetrameric structure [30]. In sickle cell anemia, the presence of HbS leads to the polymerization of hemoglobin molecules under conditions of low oxygen tension. This results in the characteristic sickling of RBCs, leading to reduced deformability, increased viscosity, and impaired blood flow. Sickled RBCs are prone to hemolysis, causing anemia, and can obstruct small blood vessels, leading to tissue ischemia, infarction, and organ damage [31]

Clinical Manifestations

The clinical presentation of sickle cell anemia varies widely, ranging from mild to severe symptoms. Common manifestations include:

Anemia: Due to chronic hemolysis and decreased RBC lifespan.

Vaso-Occlusive Crises: Episodes of severe pain due to microvascular occlusion by sickled RBCs, leading to tissue ischemia and infarction. These crises can occur unpredictably and affect various organs, including bones, joints, lungs, abdomen, and central nervous system.

Acute Chest Syndrome: A life-threatening complication characterized by fever, chest pain, cough, and pulmonary infiltrates, often triggered by infection or vaso-occlusion in the pulmonary vasculature.

Splenic Sequestration Crisis: Rapid enlargement of the spleen due to entrapment of sickled RBCs, leading to splenic congestion, abdominal pain, and potentially life-threatening hypovolemic shock.

Stroke: Increased risk of ischemic stroke due to vascular occlusion by sickled RBCs, particularly in children.

Chronic Organ Damage: Including renal dysfunction, pulmonary hypertension, leg ulcers, and avascular necrosis of bones.

Growth Delay and Pubertal Delay: Due to chronic anemia and hypoxia [32, 33]

Factors Induce Blood Disorder Anemia

- Genetic Factors: Inherited Mutations: Many blood disorders have a genetic basis, resulting from inherited mutations in specific genes responsible for hematopoiesis (blood cell production). Examples include sickle cell anemia (HBB gene mutation), thalassemia (mutations in the globin genes), and hemophilia (mutations in clotting factor genes).
- Environmental Factors: Exposure to Toxins: Environmental toxins such as benzene, radiation, certain chemicals, and heavy metals can disrupt normal hematopoiesis and increase the risk of blood disorders, including aplastic anemia and myelodysplastic syndromes. Nutritional Deficiencies: Inadequate intake of essential nutrients like iron, vitamin B12, and folate can impair erythropoiesis and lead to anemia. Iron deficiency anemia is particularly common worldwide, often due to poor dietary intake or chronic blood loss.

- Infections: Certain viral infections, such as parvovirus B19 and Epstein- Barr virus, can cause transient or chronic suppression of bone marrow function, resulting in aplastic anemia or other hematologic complications.
- Acquired Conditions: Autoimmune Disorders: Autoimmune diseases like systemic lupus erythematosus (SLE) and autoimmune hemolytic anemia (AIHA) involve immune-mediated destruction of blood cells, leading to anemia, thrombocytopenia.[34, 35, 36]

Symptoms of Blood Disorders Anemia

The common symptoms of thalassemia and sickle cell anemia are including:

Thalassemia patients (Fatigue and weakness, Pale skin, Jaundice (yellowing of the skin and eyes), Delayed growth and development in children, Abdominal swelling or bloating, Bone deformities in severe cases [37]

Diagnosis of Blood Disorders

Diagnosis of blood disorders involves several tests and procedures, including:

- Blood Tests: Blood tests like complete blood count (CBC), hemoglobin electrophoresis, clotting factor tests, and blood typing can help diagnose various blood disorders.
- Bone Marrow Aspiration and Biopsy: A bone marrow aspiration and biopsy test can be performed to extract a sample of bone marrow for examination under a microscope. This test can help diagnose various blood disorders such as leukemia, lymphoma, and multiple myeloma.
- Imaging Studies: Imaging tests such as X-rays, CT scans, MRI, and ultrasound can help diagnose certain blood disorders such as blood clots, enlarged spleen, and tumors.
- Genetic Testing: Genetic testing can help diagnose hereditary blood disorders such as sickle cell anemia, thalassemia, and hemophilia.
- Coagulation Tests: Coagulation tests like prothrombin time (PT), activated partial thromboplastin time (aPTT), and thrombin time (TT) can help diagnose bleeding disorders.

Complication of Blood Disorder

Complications resulting from blood transfusion in blood disorder patients including:

- Iron Overload: Receiving frequent blood transfusions can cause an excessive build-up of iron in the body. This can lead to complications such as joint pain, abdominal pain, diabetes, and organ damage.
- Transfusion reactions: Occasionally, patients may develop an allergic reaction to the transfused blood, which can cause symptoms such as hives, fever, and shortness of breath. In severe cases, transfusion reactions can lead to shock or even death.
- Transmitted infections: Although modern blood screening techniques have reduced the risk of transmitting infectious diseases through blood transfusions, there is still a small risk of getting infections such as HIV, Hepatitis B or C, and other viruses.
- Graft-versus-host disease: This is a rare complication that can occur when the transfused blood contains immune cells that recognize the patient's body as foreign and attack it. This can lead to serious complications such as liver and lung damage.

Prevention of Blood Disorders

There are several criteria to prevent blood disorders including:

Genetic Counseling: If you have a family history of blood disorders like sickle cell anemia or thalassemia, genetic counseling can help determine the risk of having or passing on the condition to future generations.

Maintaining a Healthy Lifestyle: A healthy lifestyle can help prevent blood disorders. Eating a balanced diet, engaging in regular exercise, avoiding smoking, and limiting alcohol consumption can help reduce the risk of developing blood disorders.

Blood Screening: Screening of blood before transfusion has been instrumental in reducing the risk of transmitting blood-borne diseases and avoiding blood-type incompatibility issues.

Preventing Iron Overload: Patients requiring frequent blood transfusions may develop iron overload. Treatment options like chelation therapy can help prevent iron accumulations.

The relationship between Consanguineous Marriage and Hereditary Blood Diseases

Consanguineous marriage refers to a union between two individuals who are related to each other by blood, such as cousins or siblings. The relationship between consanguineous marriage and hereditary blood diseases is complex. Hereditary blood diseases are genetic disorders that are passed down from parents to their children through their DNA. These diseases are caused by mutations in genes that affect the development or function of blood cells or clotting factors [48]

Consanguineous marriage increases the likelihood that both parents carry the same genetic mutation that causes hereditary blood diseases. When two carriers of the same mutation have children together, there is a higher chance that their offspring will inherit the mutation and develop the disease. For example, sickle cell anemia is a hereditary blood disease that is prevalent in certain populations, such as those of African descent [49]. When two carriers of the sickle cell trait (meaning they each have one copy of the mutated gene) have children together, there is a 25% chance that their offspring will inherit two copies of the mutated gene and develop sickle cell anemia. Studies have shown that consanguineous marriage is a risk factor for hereditary blood diseases such as Thalassemia, Hemophilia, sickle cell anemia, and more. The incidence of these diseases is higher in populations where consanguineous marriage is more common [50]

Materials and Method

.3.1Study Design

.1This study was designed as a survey and statistical study to determine the extent of the prevalence of hereditary blood diseases.

.2Statistics of people about to get married and the extent of the prevalence of hereditary blood disease genes in society, as well as the prevalence of blood disease genes among consanguineous couples.

.3Statistics of children registered with the Center for Hereditary Blood Diseases during the same years.

.3.2Statistical Analysis

The data of the current study was statistically analysis by using SPSS version 26, based in using chi-square and Sperman correlation at p. value < 0.05.

.4Chapter Four the Results

.4.1Prevalence of Anemia Patients Among People about to Get Married

The current study was recorded among 58,958 couples who visited the upcoming marriage clinic during the period from 2019 to 2023, the study showed 12602 (21.37%) of people were have hereditary and non-hereditary anemia, while 46356 (78.63%) of people were healthy, the current study also noted a significant difference at p. value < 0.05, as in the Figure 4-1.

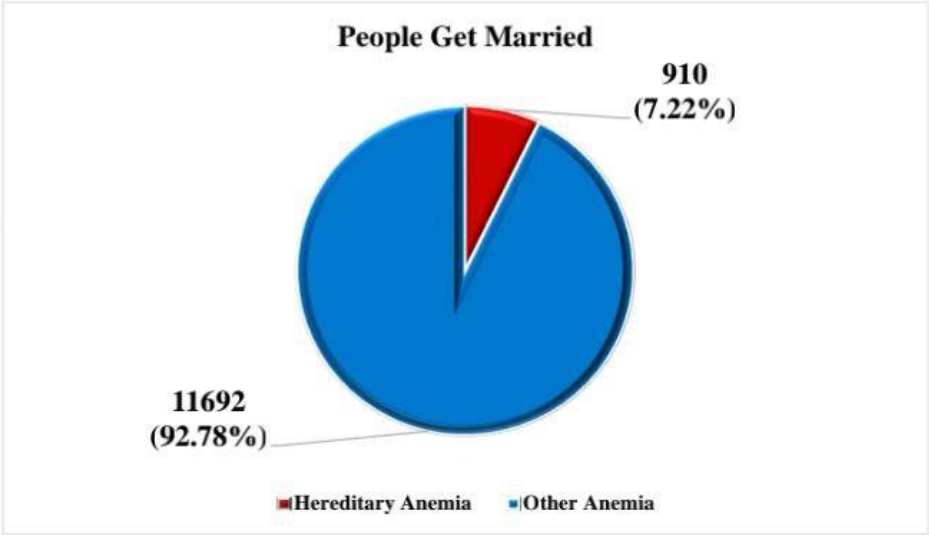

Figure 4-2: A Comparison between hereditary and non-hereditary anemia

Figure 4-1: Prevalence of anemia patients among people about to get married

.4.2Prevalence of Anemia Patients Among People aboukj0jjkt to Get Married According to Year of Diagnosis

The current study was recorded a significant difference in the incidence of anemia patients among people about get married according to years of diagnosis, was showed the most anemia patients in the year 2023, 37.32%, followed in the year 2022, 20.33%, in contrast the lowest anemia patients recorded in year 2022, 14.13%, as in the Table 4-1.

Table 4-1: Prevalence of anemia patients among people about to get married according to year of diagnosis

Years	Healthy People		Diseased People		Total	
	No.	%	No.	%	No.	%
2020	12735	85.48	2163	14.52	14898	25.27
2021	12867	85.87	2117	14.13	14984	25.41
2022	11859	79.67	3027	20.33	14886	25.25
2023	8895	62.68	5295	37.32	14190	24.07
Total	46356	78.63	12602	21.37	58958	100
$CalX^2 = 20.2$ $TabX^2 = 7.81$ DF=3 p. value < 0.001						

Diagnosis of Hereditary and other Anemia According to Year of Clinic Visited

The current study was recorded a non-significant difference in the incidence of hereditary and non-hereditary anemia patients among people about get married according to years of diagnosis, was showed 92.87% among people had non-hereditary anemia, while the most hereditary anemia was beta thalassemia 3.36%, followed alpha thalassemia 2.02%, in contrast the lowest hereditary anemia was trait 0.05%, as in the Table 4-2.

		β thalassemia		α thalassemia		Trait		Sickle cell		Hb below 12	
		No.	%	No.	%	No.	%	No.	%	No.	%
2020	Male	38	4.00	21	2.21	0	0.00	12	1.26	880	92.53
	Female	38	3.14	29	2.39	0	0.00	26	2.15	1119	92.33
2021	Male	49	4.96	14	1.42	2	0.20	34	3.44	889	89.98
	Female	47	4.16	16	1.42	0	0.00	55	4.87	1011	89.55
2022	Male	19	2.33	14	1.72	0	0.00	23	2.83	758	93.12
	Female	11	0.50	24	1.08	0	0.00	32	1.45	2146	96.97
2023	Male	121	6.19	52	2.66	4	0.20	23	1.18	1754	89.76
	Female	100	2.99	84	2.51	0	0.00	22	0.66	3135	93.83
Total	Male	227	4.82	101	2.15	6	0.13	92	1.95	4281	90.95
	Female	196	2.48	153	1.94	0	0.00	135	1.71	7411	93.87
Overall Total		423	3.36	254	2.02	6	0.05	227	1.80	11692	92.78
p. value		0.592		0.809		-----		0.309		< 0.001	

4.4.Diagnosis of Hereditary and other Anemia According to Year of Clinic Visited and Sex

The current study was recorded a non-significant difference at p. value < 0.05 in the incidence of hereditary anemia patients among people about get married according to both years of diagnosis and sex of people, in contrast a significant difference with regard non-hereditary anemia, as in the Table 4-3.

Table 4-3: Diagnosis of hereditary and non-hereditary anemia according to year of clinic visited and sex

		β thalassemia		α thalassemia		Trait		Sickle cell		Hb below 12	
		No.	%	No.	%	No.	%	No.	%	No.	%
2020	Male	38	4.00	21	2.21	0	0.00	12	1.26	880	92.53
	Female	38	3.14	29	2.39	0	0.00	26	2.15	1119	92.33
2021	Male	49	4.96	14	1.42	2	0.20	34	3.44	889	89.98
	Female	47	4.16	16	1.42	0	0.00	55	4.87	1011	89.55
2022	Male	19	2.33	14	1.72	0	0.00	23	2.83	758	93.12
	Female	11	0.50	24	1.08	0	0.00	32	1.45	2146	96.97
2023	Male	121	6.19	52	2.66	4	0.20	23	1.18	1754	89.76
	Female	100	2.99	84	2.51	0	0.00	22	0.66	3135	93.83
Total	Male	227	4.82	101	2.15	6	0.13	92	1.95	4281	90.95
	Female	196	2.48	153	1.94	0	0.00	135	1.71	7411	93.87
Overall Total		423	3.36	254	2.02	6	0.05	227	1.80	11692	92.78
p. value		0.592		0.809		-----		0.309		< 0.001	

4.5.A Comparison between Hereditary and non-Hereditary Anemia

The current study was recorded a significant difference at p. value < 0.05 between hereditary anemia and non-hereditary among people about get married, was showed 910 (7.22%) of people had hereditary anemia, in contrast a 11692 (92.78%) had non-hereditary anemia, as in the Figure 4-2.

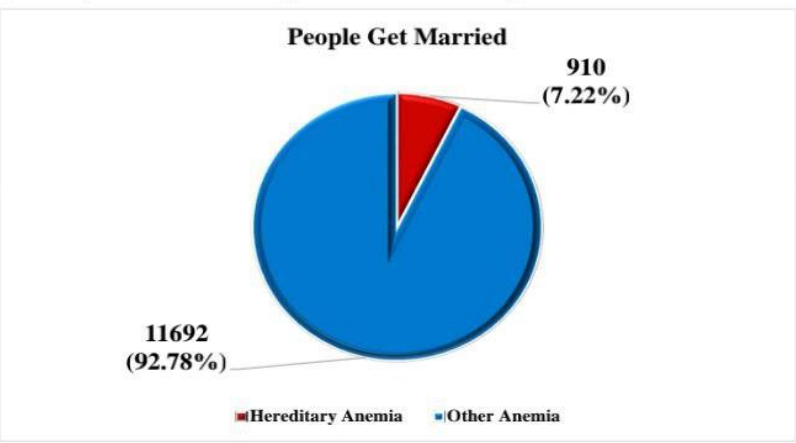

Figure 4-2: A Comparison between hereditary and non-hereditary anemia

Association between Incidence of People Carried Hereditary Anemia Gene and Registered New Patients

The present study was noted a positive correlation between people carried beta-thalassemia anemia gene, trait thalassemia gene and sickle cell anemia gene, and the birth of children with genetic diseases, while non-significant correlation with regard alpha-thalassemia, as in the Table 4-4.

Table 4-4: Association between incidence of people carried hereditary anemia gene and registered new patients

People Get Married Carried Gene			Incidence New Cases of Patients							
			β thalassemia		α thalassemia		Trait		Sickle cell	
Years	No.	%	No.	%	No.	%	No.	%	No.	%
2020	164	18.02	19	20.00	8	15.09	0	0.00	14	13.59
2021	217	23.85	22	23.16	7	13.21	1	33.33	21	20.39
2022	123	13.52	18	18.95	13	24.53	0	0.00	22	21.36
2023	406	44.62	36	37.89	25	47.17	2	66.67	46	44.66
Total	910	100	95	37.40	53	20.87	3	1.18	103	40.55
r. value p. value			1.00 < 0.001		0.20 0.800		0.949 < 0.001		0.40 0.032	

Discussion

Hereditary diseases in Iraq are a significant public health concern. Several factors contribute to the prevalence of these diseases, including consanguineous marriages, environmental factors, and limited healthcare resources.

The prevalence of ß-thalassemia in Thi-Qar province during 2019-2023 was 1 per 10,000 people, and percentage of carriers of the ß-thalassemia gene among those about to get married 0.007% (423 per 58958), while the number of newly registered cases during the same period was 95 cases. The percentage of carriers of the a-thalassemia gene among those about to get married 0.004% (254 per 58958), and incidence of disease in Thi-Qar 2 per 100,000, while the new cases during the same period was 53 cases. The percentage of carriers of the sickle cell anemia gene among those about to get married 0.003% (227 per 58958), and incidence of disease in Thi-Qar 3 per 100,000, while the new cases during the same period was 103 cases.

ß-thalassemia is the most frequent disease, followed by intermediate thalassemia and thalassemia with the sickle, whereas other types of HHD have a lower prevalence in Thi-Qar province. A previous study in Najaf was performed by Al-Hakeim et al. [51], showed that thalassemia major and intermediate subtypes are the most prevalent HHDs in Najaf city. Major thalassemia, intermediate thalassemia, and thlassemia+Sickle disease comprise 77.71% of all HHD cases. ß-thalassemia is the most frequent disease, followed by intermediate thalassemia and thalassemia with the sickle, whereas other types of HHD have a lower prevalence in Najaf province. In study of Mondal [52], sex differences in hemoglobinopathies have been detected, where ß thalassemia heterozygous (trait) was the most frequently encountered hemoglobinopathy (17.64%) and β- thalassemia homozygous (major and intermediate) was 2.92%.

Thalassemia occurs in approximately 44 cases among 100,000 new births worldwide [53]. Thalassemia disorder is also prevalent in other countries among other types of hereditary hematologic disorders [54]. Globally the inherited ß-thalassemia are the most frequent single-gene disorders [55], and the most common chronic hemolytic anemia among children and adolescents worldwide [56]. Also, in geographic areas that endemic with malaria such as Africa, Mediterranean countries, the Middle East, the Indian subcontinent, and Southeast Asia, B-Thalassemia is most prevalent hereditary hematologic disorders [57]. Among another types of thalassemia, there is a huge diversity all over

different countries, for example in UAE (3% athalassemia and 2.40% β-thalassemia) [58], Qatar (28% a thalassemia and 17% ß-thalassemia) [59], and Jordan (3.3% α- thalassemia and 3.5% ß-thalassemia) [60]

Consanguineous marriages, where individuals marry their cousins, are prevalent in Iraq. It is estimated that more than half of all marriages in Iraq are consanguineous. Such marriages increase the risk of inherited genetic disorders because they increase the likelihood of individuals carrying the same recessive genes to marry [61]. According to a study published in the Journal of Genetic Counseling, the most common hereditary diseases in Iraq are thalassemia and sickle cell anemia. Around 20-30% of Iraqis are carriers of thalassemia, and sickle cell anemia carriers are estimated to be around 20% in some regions. Other hereditary diseases that are prevalent in Iraq include cystic fibrosis, neurofibromatosis, and hemophilia [62]. Due to the lack of awareness, limited healthcare facilities, and testing centers, many individuals with hereditary diseases may go undetected. It is essential to increase awareness and provide access to education, genetic counseling, and early screening to tackle the issue and limit the prevalence of hereditary diseases in Iraq [63]

Turkey has a high prevalence of hereditary diseases, with approximately 8 million people affected by some form of genetic disorder [64]. According to a study published in the Journal of Community Genetics, the most common genetic disorders in Turkey include thalassemia, sickle cell anemia, and G6PD (glucose- 6-phosphate dehydrogenase) deficiency [65]. The rate of consanguineous marriages, where individuals marry their cousins, is also high in Turkey, accounting for approximately 20% of all marriages. This increases the likelihood of individuals carrying the same recessive genes, which increases the risk of these genetic disorders [66.[According to a study published in the Global Journal of Health Science, genetic disorders are a significant health concern in KSA, with an estimated prevalence of 5-10% of the population affected [67]. Consanguineous marriages are prevalent in KSA, accounting for approximately 60% of all marriages, which increases the risk factor of genetic diseases. The most common genetic disorders in KSA include sickle cell anemia, beta-thalassemia, and glucose-6-phosphate dehydrogenase (G6PD) deficiency [68, 69]

Conclusions and Recommendations

Conclusions

The present study was recorded the following points: The most common blood disorder in Thi-Qar province were ß-thalassemia 3.36%, a-thalassemia 2.02%, sickle cell anemia 1.80%, and thalassemia trait 0.05. The percentage of anemia is non-hereditary that Hb below 12.0 mg/dl among people was 21.3%. The percentage of ß-thalassemia and trait thalassemia were increased in males than in females, while a-thalassemia and sickle cell anemia was increased in females than men.

Recommendations

The present study was recommended the following point: It is necessary to follow pre-marital examinations because they have a positive impact on the birth of healthy children. Marrying before undergoing the examination is a dangerous procedure that leads to dangerous consequences. Consanguineous marriage is a risk factor for the birth of children with various diseases as well as genetic diseases, so it should be avoided.

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