ejpmr, 2024, 11(2), 164-175

SJIF Impact Factor 6.222

EUROPEAN JOURNAL OF PHARMACEUTICAL AND MEDICAL RESEARCH

www.ejpmr.com

Review Article

ISSN 2394-3211

EJPMR

STUDY OF THALASSEMIA CONDITION IRAQI CHILDREN

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Article Received on 07/12/2023 **Article Revised on 27/12/2023** **Article Accepted on 17/01/2024**

ABSTRACT

Thalassemia is an autosomal recessive disease that is common in Iraq with a prevalence of 35.7 per 100,000. It is the most common type of hereditary anemia registered in 2015. It is a life-threatening condition with many complications which if not managed could cause death in early age. This study aimed to assess the awareness of Iraqi people about thalassemia transmission and prevention and to find their source of information about the disease, as developing good awareness is the first and the most advantageous road to establish a successful prevention program. This cross-sectional study involved 417 participants who were from medical and non-medical fields. It was conducted as an online survey in addition to participants interview using a self-structured questionnaire which was tested for content and face validity, unidimensionality and test-retest reliability in a pilot study of 50 participants. Each participant who had heard about the disease was given a score (0-5) based on their knowledge: 68.8% of the people had heard about the disease previously, those had a mean score of 3 out of5; 84% claimed that thalassemia is a no communicable disease which resembles the highest awareness aspect. The lowest one was about the preventability of the disease. Significant correlation was found between the score of awareness and the age. People awareness about thalassemia was relatively good. A control strategy should be directed to elevate the awareness level about thalassemia in the community with the application of the national program for thalassemia control.

INTRODUCTION

In order to understand how thalassemia influences the human body, we first need to understand how blood lays created. If the body does not generate enough globin alpha and beta chains, the red blood cells will not shape correctly and will not be able to carry enough oxygen. The effect is anemia that begins in early childhood and persists for life. Genes involved are those regulating the development of hemoglobin-containing alpha and beta-globin **(**Čokić *et al*., 2013). Thalassemia may be identified by signs or by the impaired genes. The two major forms of thalassemia, alpha, and beta, are named for the two normal adult hemoglobin protein chains **(**Sabri, 2017). Beta thalassemia major is an inherited defect hemolytic state in the synthesis of the beta-globin chain, individuals with beta-thalassemia major usually present with severe anemia in the first two years of life, requiring regular transfusions of red blood cells (RBCs) to survive in life **(**Jiffri *et al*., 2010). Impaired beta-globin biosynthesis contributes to an aggregation of unpaired alpha globin string, the shorter life span of red cells, and iron deficiency triggering functional and physiological defects in many organ systems such as the pancreas, which lead to diabetic in some of the patients **(**Khattak *et al*., 2006), **(**Saleh *et al*., 2019).

Thalassemia is a term referring to a class of genetic disorders caused by inadequate hemoglobin development, with a deficiency in hemoglobin synthesis. It is sometimes referred to as Mediterranean anemia. **(**Saleh *et al*., 2018), **(**Ward *et al*., 2002). Thalassemia is one of the world's most severe genetic disorders. It is the most common cause middle east persistent hemolytic anemia **(**Galanello *and* Origa *al*., 2010), **(**Mehmetçik *et al*., 2019).

Thalassemia is the most common type of hereditary anemia registered in Iraq in 16 thalassemic centers in 2015. Both males and females are equally affected by thalassemia and this disorder occurs in approximately4.4/10,000 live births. Also, it was estimated that the prevalence of beta-thalassemia carrier state is 1.5% in general population.[1] Thalassemic patients are susceptible to many complications, like marked hepatosplenomegaly, which occurs due to excessive red cell destruction (25.8% of the patients in Iraq have splenomegaly, and4.4% of them have hepatomegaly), extramedullary hematopoiesis, iron overload, osteoporosis (67.5% of the patients in Iraq) and osteopenia (9.4% of the patients in Iraq).[1,2] And in a study done in -2023, 66.4% of thalassemia patients were under 15 years with splenomegaly and growth retardation representing the most frequent complications.

High proportions of consanguineous marriages have resulted in a high incidence of genetically based disorders, particularly autosomal recessive ones, and thalassemia is one of them.[3,4] Thalassemia is a preventable disease, and many countries had succeeded in its prevention through a comprehensive approach starting from spreading knowledge and awareness and developing program to control the disease through premarital investigation and antenatal detection with therapeutic abortion.[5,6] As awareness is critical in the prevention, it needs assessment in order to identify its level among the general population as well as students from the medical field because some studies showed that even the medical field required more education about the disease prevention methods.[4] Our aim is to assess the awareness among people about this chronic genetic disease since Thalassemia awareness assessment among population represents the first step in the prevention program, and there is little data available in Iraq about this subject.

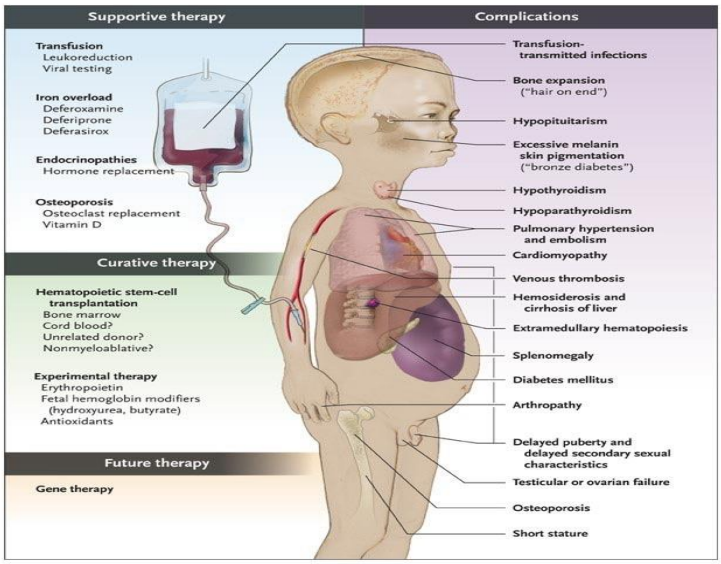


Figure 1.
www.NEJM.COM

1. Type of thalassemia

1.1. Alpha thalassemia There are 2 copies of the alpha-globin gene in the human genome both located on chromosome 16, therefore in a normal diploid cell, 4 copies of the gene are available, to produce the protein. Alpha-thalassemia is caused by an underproduction of α-globin proteins due to mutation or deletion of one of the four α globin genes.

1.1.1 Alpha thalassemia minor It is an asymptomatic carrier condition that occurs due to the deletion of the one α- globin gene. This condition usually causes no symptoms or signs of anemia and does not need treatment due to negligible alpha protein deficiency.

1.1.2 Alpha thalassemia trait \The trait is also known as mild alpha-thalassemia. The patients are deficient in two alpha-globin genes.

1.1.3 Alpha thalassemia intermedia Also, it is known as hemoglobin H disease. Individuals lacking three alpha globin genes become severely anemic and mostly cannot survive without blood transfusion.

1.1.4. Alpha thalassemia major "Hydrops fetalis" or alpha thalassemia major is a condition in which no alpha genes are found in the patients' genome, resulting in four gamma-globin chains production by the fetus that produces malfunctioning hemoglobin known as hemoglobin Bart's. Most affected individuals having Hemoglobin Bart's cannot survive or otherwise die in just a few hours after birth .Alpha thalassemia with four deletions in the gene has rarely been diagnosed in the uterus, especially in a family with a history of the disorder occurring in early childhood. Reportedly, some of these children have been saved through blood transfusions during pregnancy. (Shafique *et al.,* 2021).

1.2.2 BETA-THALASSEMIA

Beta-thalassemia is described by the absence or reduction in the rate of production of the β-globin chain. It was the first time defined by Cooley and Lee in 1925. The β-thalassemia is a consequence of substitutions of bases on introns, exons as well as on the promoter regions of β-globin genes while α-thalassemia is a consequence of deletions that remove α gene . It is further categorized according to decreased (β+) or absent (β0) globin chain production which might lead to microcytic and hypochromic anemia as well as a wide range of syndromicforms .[3]

Types of beta-thalassemia

1.2.2. **Beta-thalassemia minor**

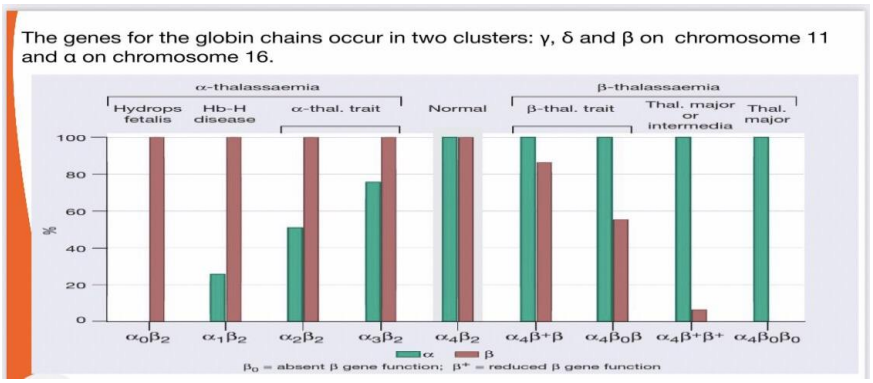
It is also termed as thalassemia carrier/trait that occurs when one copy of β globin gene is normal and one copy is defective **(**B0/B, B+/B). Thalassemia minor mostly occurs during physiological stress or pregnancy and in childhood. It is an asymptomatic condition; sometimes has mild anemia due to abnormalities in the morphology of erythrocyte. The level of Hb might be >10g/dl in β-thalassemia minor or carrier patients. There is a 25% possibility of homozygous thalassemia at each gestation if both maternities are carriers.

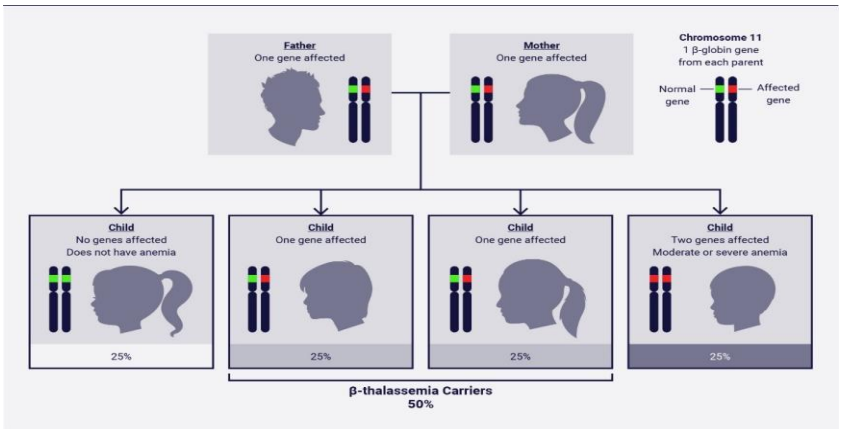
1.1.2.2 **Beta-thalassemia intermedia**

Thalassemia intermediate is a heterogeneous genetic mutation in which individuals have a little bit ability for the production of β chain of Hb (B+/B+, B+/B0). In some situations, both α and β mutations present simultaneously . It occurs between 2 and 6 years of age. Thalassemia intermediate has milder anemia. In this case, level of Hb varies between 7 and 9–10 g/dl and transfusion of blood is not needed. The sufferer can survive without or only occasionally require blood transfusion When bone marrow expands with age, several complications like growth retardation, bone abnormalities, and infertility may develop in patients. On the other hand, the hemolysis raise the level of iron in different tissues.

1.2.4 **Beta-thalassemia major**

It is the most severe type of thalassemia which is known as Cooley's anemia that occurs either when individuals are homozygous (B+/B0, B0/B0) or compounds heterozygous (B+/B+) for more severe mutations in β chain .It usually induces between 6 months and 2 years. In major thalassemia, patients undergo severe anemia (heart failure, fatigue, and cachexia). The level of Hb might be <7 g/dl and Hb F <90%. The reduction in Hb resulted bone marrow expansion to compensate the loss of RBCs which led to bone abnormalities, enlargement of spleen and restriction of growth. The extreme hemolysis leads to pulmonary hypertension, lithiasis, and formation of the leg ulcer. Furthermore, hypercoagulability is also an impediment to this disorder. Regular management with transfusions of blood or blood products might be overload the iron in various organs which result in diabetes, hypopituitarism complications in the liver and endocrine glands such as hypothyroidism, hypopituitarism, hypoparathyroidism, dark metallic pigmentation of the skin, cirrhosis, cardiac arrhythmia, and myopathy which can lead to 71% death of patients who have thalassemia major . Other complications are HIV infection like prolonged hepatitis B and C, osteoporosis, and occlusion in blood.





Causes

Thalassemia is caused by mutations in the DNA of cells that make hemoglobin the substance in red blood cells that carries oxygen throughout your body. The mutations associated with thalassemia are passed from parents to children.

Hemoglobin molecules are made of chains called alpha and beta chains that can be affected by mutations. In thalassemia, the production of either the alpha or beta chains are reduced, resulting in either alpha-thalassemia or beta-thalassemia.

In alpha-thalassemia, the severity of thalassemia you have depends on the number of gene mutations you inherit from your parents. The more mutated genes, the more severe your thalassemia. **Figure 2.**

In beta-thalassemia, the severity of thalassemia you have depends on which part of the hemoglobin molecule is affected.

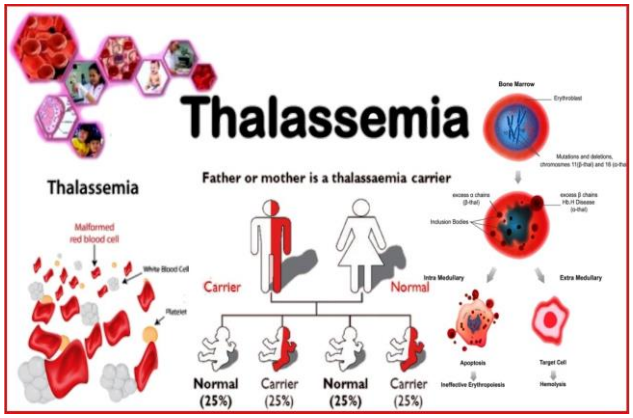


Figure 2.
www.Cambridge.COM

Thalassemia signs and symptoms can include

A- Fatigue
B- Weakness
C- Pale or yellowish skin
D- Facial bone deformities
E- Slow growth
F- Abdominal swelling
G- Dark urine **Figure 3.**

Figure 3.
www.CFCH.COM

Thalassemia Testing

Testing can be done before a baby is born to find out if he or she has thalassemia and determine how severe it might be.

Tests used to diagnose thalassemia in fetuses include.

Chorionic villus sampling

Usually done around the 11th week of pregnancy, this test involves removing a tiny piece of the placenta for evaluation.

Amniocentesis

Usually done around the 16th week of pregnancy, this test involves examining a sample of the fluid that surrounds the fetus. **Figure 4.**

Figure 4.
www.HEALTH.COM

Thalassemia Treatment
Mild forms of thalassemia trait don't need treatment.

For moderate to severe thalassemia, treatments might include

- **Frequent blood transfusions**

More severe forms of thalassemia often require frequent blood transfusions, possibly every few weeks. Over time, blood transfusions cause a buildup of iron in your blood, which can damage your heart, liver and other organs.

- **Chelation therapy**

This is treatment to remove excess iron from your blood. Iron can build up as a result of regular transfusions. Some people with thalassemia who don't have regular transfusions can also develop excess iron. Removing the excess iron is vital for your health.

To help rid your body of the extra iron, you might need to take an oral medication, such as deferasirox (Exjade, Jadenu) or deferiprone (Ferriprox). Another drug, deferoxamine (Desferal), is given by needle.

- **Stem cell transplant.**

Also called a bone marrow transplant, a stem cell transplant might be an option in some cases. For children with severe thalassemia, it can eliminate the need for lifelong blood transfusions and drugs to control iron overload.

This procedure involves receiving infusions of stem cells from a compatible donor, usually a sibling. Figure 5.

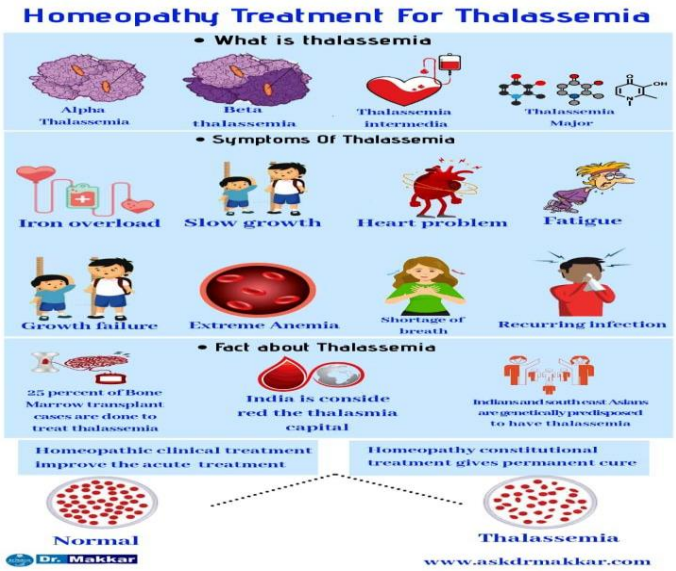


Figure 5.
WWW.Clinic.COM

Effect thalassemia in spleen
An increased susceptibility to infections with encapsulated bacteria, as a consequence of splenectomy, has been recognized for many years The spleen, in fact, is a major site of antibody production (in particular the splenic marginal zone).

Overwhelming postsplenectomy sepsis (OPSI) appears to be more frequent in thalassemia patients than in other non-immunodeficient patients splenectomized for different causes.

The most frequently responsible bacteria are Streptococcus pneumoniae, Hemophilus influenzae,

Neisseria meningitidis, E. coli, and Staphylococcus aureus. Klebsiella is a frequent causative pathogen especially in the Far East.

It has been demonstrated that iron overload further increases the pathogenicity of these bacteria, probably through an inhibitory effect of iron on the activity of interferon gamma. As a consequence, iron-loaded macrophages lose the ability to kill intracellular pathogens via the interferon-gammamediated pathways. Part of this loss of ability is related to the reduced formation of nitric oxide in the presence of iron.

Malaria and babesiosis can be particularly severe after splenectomy an observation of particular interest for patients of the developing countries.

Young children and patients recently splenectomized are at the highest risk of severe infections.

The risk, however, although decreasing with the passing of years, never disappears. A study from Thailand reported the frequency of postsplenectomy sepsis to be 4%, but the mortality associated with it was 89%.[7]

All splenectomized patients should undergo prophylactic measures against infections. **Figure 6,7**

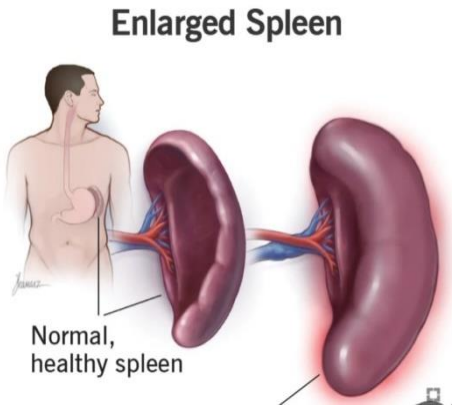


Figure 6.

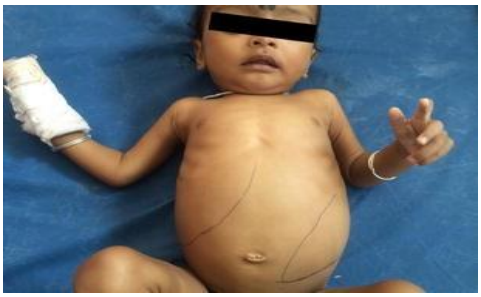


Figure 7.
WWW.Myolabo.COM

Ferritin is a protein found inside cells that stores iron. When the body needs iron, ferritin releases it into the bloodstream. High levels of ferritin in the blood can indicate that there is too much iron in the body, which can cause damage to organs such as the liver, heart, and pancreas.[13]

Ferritin is a protein that plays an important role in the storage and regulation of iron in the body. It is found in cells throughout the body, particularly in the liver, spleen, and bone marrow. Ferritin binds to excess iron in the body, which helps prevent iron toxicity and provides a reserve of iron for when the body needs it.[14]

Ferritin is a protein that plays a crucial role in the storage and regulation of iron in the body. It is synthesized and secreted by several organs, including the liver, spleen, and bone marrow, and serves as a marker of iron status in the body. Ferritin testing is a common diagnostic tool used to evaluate iron levels in the blood.

Thalassemia and ferritin are related in several ways. First, people with thalassemia often need frequent blood transfusions to manage their anemia. Blood transfusions can lead to.

A ferritin level test measures the amount of ferritin in the blood. The normal range for ferritin levels can vary depending on age, sex, and other factors, but generally ranges from 12 to 300 ng/mL. A ferritin level above the normal range can indicate the presence of iron overload disorders, such as hemochromatosis or iron poisoning, or certain medical conditions such as liver disease, inflammation, or cancer. A ferritin level below the normal range can indicate iron deficiency anemia or chronic disease.[15]

Overall, monitoring ferritin levels can be an important diagnostic tool for identifying and managing various conditions related to iron metabolism and storage in the body.

There are several reasons why ferritin testing may be recommended. One of the most common reasons is to evaluate iron deficiency anemia, which is a condition characterized by low levels of red blood cells due to a lack of iron. Ferritin testing can help diagnose iron deficiency anemia by assessing the body's iron stores. Low ferritin levels indicate low iron stores, which may be a sign of iron deficiency anemia.[16]

Another reason why ferritin testing may be recommended is to diagnose hemochromatosis, a genetic disorder that causes the body to absorb too much iron from the diet. Hemochromatosis can lead to organ damage and other serious complications if left untreated. Ferritin testing can help diagnose hemochromatosis by measuring the body's iron stores. High ferritin levels can indicate iron overload, which may be a sign of hemochromatosis.

Ferritin testing may also be used to monitor iron levels in individuals with chronic diseases such as inflammatory bowel disease, chronic kidney disease, and rheumatoid

arthritis. These conditions can cause inflammation in the body, which can interfere with the absorption and utilization of iron. Ferritin testing can help monitor iron levels in individuals with chronic diseases and ensure that they receive appropriate treatment if their iron levels are low.[17]

The ferritin test is a simple blood test that measures the amount of ferritin in the blood. The test is typically performed in a laboratory, and results are usually available within a few days. The test is often performed in conjunction with other tests that evaluate iron status, such as a complete blood count (CBC) and iron panel.

There are several factors that can affect ferritin levels in the blood. These include age, sex, and certain medical conditions. For example, ferritin levels tend to be higher in men than in women, and higher in children than in adults. Ferritin levels may also be affected by liver disease, inflammation, and certain cancers.[18]

Interpreting ferritin test results can be complex and requires the expertise of a healthcare provider. In general, however, normal ferritin levels are usually between 12 and 300 ng/mL, depending on age and sex. Ferritin levels that are too high or too low may indicate an underlying medical condition that requires further evaluation and treatment.

If ferritin levels are too low, treatment typically involves iron supplementation. Iron supplements can help replenish the body's iron stores and improve symptoms of iron deficiency anemia. If ferritin levels are too high, treatment typically involves removing excess iron from the body through a process called phlebotomy. During phlebotomy, a healthcare provider will remove blood from the body, which can help reduce iron levels in the blood and prevent further complications.[19]

In summary, ferritin testing is a common diagnostic tool used to evaluate iron levels in the blood. The test is often used to diagnose iron deficiency anemia, hemochromatosis, and other conditions related to iron metabolism and storage in the body. Ferritin testing is a simple and relatively non-invasive procedure that can provide valuable information about a person's iron status and help guide appropriate treatment.[20]

MATERIALS AND METHODS

This is a cross-sectional study held for three month in 2023. This study included 417 participants who were from medical (185) and non-medical fields (232). Sample collection methods included using an online survey in social media sites in addition to participants interview using a self-structured questionnaire.

The questionnaire was tested for validity, unidimensionality, and reliability in a pilot study of 50 participants Regarding validity, the questionnaire was developed after reviewing the literature8-.10 to establish both construct and face validity.

Regarding unidimensionality, it was tested using principal component analysisand only one factor was found to account for the finding; the result can be shown in Table 1. Regarding reliability, test-retest reliability was obtained with interclass correlation coefficient (ICC), the smallest value was 0.69, and all were statistically significant.

The questionnaire included information about sociodemographic data (age, gender, education level and job, marital status and consanguinity).

The total score was calculated for all those who have heard about the disease so that *Do not know* answers were considered as incorrect and given a score of (0), whereas the correct answer was given a score of (1). Each of them was given a score (0-5) based on their knowledge in answering the following five questions
i) *Is thalassemia a chronic disease?*;
ii) *Is a consanguineous marriage related to thalassemia occurrence?*;
iii) *Is thalassemia a contagious disease?*;
iv) *Is thalassemia a preventable disease?*;
v) *Can thalassemia be transmitted by food?*

Analytic statistics and Descriptive
were done in the term of mean, standard deviation, minimum, maximum, proportions, chi-square, t-test, and one-way ANOVA with95% confidence level which means that a Pvalue less than 0.05 is considered statistically significant.

All participants were informed about the goal of the survey, and informed consent was obtained from them.

The data was analyzed using Social Sciences program (SPSS) version 24.
Table 1 represents unidimensionality testing.

Table 1: Unidimensionality testing.

Component	Total variance explained					
	Initial Eigen values			Extraction sums of squared loadings		
	Total	%of variance	Cumulative%	Total	%of variance	Cumulative%
1	2.032	40.646	40.646	2.032	40.646	40.646
2	0.930	18.594	59.240			
3	0.817	16.340	75.580			
4	0.680	13.606	89.187			
5	0.541	10.813	100.000			

Extraction method: principal component analysis.

RESULTS

Results of non-medical sample (n=232)

The mean age of the sample is 26.25 years with standard deviation of 8.53 and minimum age of 17 and maximum age of67, 41.17% were students, 16.7% had no job, 8.6% were academic professor, and8.14% were students in higher education.

Table 2 represents the educational degree of the participants. 59.6% were from Baghdad, 6.1% were from Al-Mosul, 5.7% were from Basrah, 4.8% were from Babil, 4.4% were from Anbar and same for Dyala, and 3.9% were from Al-Najaf. the remainder were from other provinces. 68.8% of the people have heard about thalassemia previously.

The mean score of the participants who heard about the disease is 3 with a standard deviation of 1.46. Table 3 represents the source from where the Participants have heard about the disease (only 202 participants).

A significant weak positive association was noticed between age and the score with r=0.22 and p-value of 0.04.

No significant association was found between the score and age, gender and if the couples are relatives using T-test with a Pvalue of 0.85, 0.068 and 0.198 respectively.

Results of medical sample (n=185)

The mean age is 22.3 years with standarddeviation of 3.3. Minimum age was 17 and maximum was 39 years. 84.9% were medical students, 5.9% dentists, 3.2% pharmacist, 2.7% physicians, and 3.3% for other medical fields' careers. 31.4% were from Baghdad, 20% were from Basrah, 15.7% from Al-Dewaniyah, the remaining of the sample was distributed in different other provinces. 94% of the sample have heard about the disease.

The mean score of medical sample was3.87 with standard deviation of 1. 22.

Table 4 represents other sociodemographic data of the non-medical and medical group.

Table 5 demonstrates the score-based questionnaire answers among medical and non-medical group.

Among non-medical sample, of those who said that thalassemia has relation to consanguineous marriage, 84.1% of them claimed that consanguineous marriage can increase the risk of thalassemia, 2.3% claimed that it decreases the risk meanwhile the others did not have information. Of those who said thalassemia is preventable, 46.7% claimed that consanguineous marriage prevention is the best way, 32.2% said that doing test before marriage is the way for prevention, 13.3% said avoidance of certain foods is the way of prevention, others suggested blood transfusion restriction and avoidance of marriage from the affected ones.

There is statistically significant difference between mean score of medical sample and non-medical sample using T test of P-value of 0.0001.

Table 2: The educational degree of the participants.

		Frequency	Valid percent
Valid	Primary	3	0.7
	Intermediate	2	0.5
	Preparatory	32	7.7
	College	123	29.6
	Higher education	71	17.1
	Medical fields	185	44.5
	Total	416	100.0
Missing	System	1	
Total	417		

Table 3: Source of knowledge about the disease.

Source of knowledge	Valid percent	Frequency
Friends and family	28.8	58
Internet	27.7	56
School and college	22.3	45
Hospital visit	8.9	18
Others	12.3	25

DISCUSSION

Thalassemia has a great economic burden in Iraq. It is the most common hereditary hemoglobinopathy in Iraq.1 Knowledge and awareness about thalassemia play a significant role in the success of the national program of thalassemia prevention; for thisreason, this study was conducted.4 This study aims to find awareness level among general population and among a particular group who are involved frequently with the subject who are the medical students.

Most of the participants in this study were in their twenties, and this can be confirmed by their mean of age was 26.25, which is a critical age group to be targeted for awareness about the disease as they are assessment and evaluation of their willing to get engaged or having their first child, and they should be aware about this common disease in the community and identify the best method for its prevention.

In this study (regarding non-medical sample), 68% of the participants identify the disease as a consanguineous marriage related disease, and 84% of them believed it increases the risk. Studies had shown that avoiding consanguineous marriage is a well-established and effective preventive measure which should be done by educating young couples who have a marriage desire to prevent many recessive diseases including but not limited to thalassemia.[8] When both parents are carriers of a particular gene for any disorder, each child ofthose parents has a 25% risk of that recessive disorder.

The chance that both parents will be carriers of the gene of the same disorder is influenced by the extent to which the problem is endemic in a community.[9] The study (regarding non-medical field) shows that participants believed that the best method of prevention is to have a premarital testing.

The premarital testing is an essential part in the prevention programs, and it is applied in several countries worldwide such as Cyprus,5 Lebanon,6 Saudi Arabia, Iran, and United Arab Emirates.7 In Iraq, the prevention program is now applied, and every couple is obliged to do premarital investigations including blood tests, but the couples are free to make their decision to proceed with their marriage or not. The WHO recommends that these tests are to be done on voluntary basis14 but the high economic burden of the blood diseases in Iraq was the rationale for making them mandatory, the situation is the same in many countries in the Mediterranean region. Some countries applied screening test among secondary school students in order to identify those at risk before they have a desire or arrangement for marriage.

A study done in Duhok, in north Iraq, showed that about 54,132 couples who were willing to get engaged were tested and 130 of them were found to be at risk; 98.1% of them decided to proceed with their marriage after they knew that.15 So it is necessary to educate couples and to spread awareness about the disease.

As the contagious diseases have many impacts including stigma, it is necessary to identify Thalasssemia as a non-contagious disease to protect patients from being stigmatized. 84.5% of the non-medical people field described the disease as a non-contiguous disease, and it is known that all genetic diseases are not infectious in nature.

Thalassemia is transmitted in an autosomal recessive fashion in majority of cases; in very rare cases it is associated with a dominant mutation.[10]

Essential for the awareness is to assess the source of information about the disease and its prevention. The most frequent source of information was from families or friends, followed by social media sites; this might give a good indicator of raising community awareness about thalassemia if more attention is given for social media.

Table 4.

	Non-medical sample			Medical sample		
Category	Frequency	Proportion	Mean score	Frequency	Proportion	Mean score
Age group <25	99	42.7%	3.1	19	10.3%	4.1
Age group >25	133	57.3%	2.9	166	89.7%	3.8
Male	67	28.9%	2.9	53	28.6%	4
Females	165	71.1%	3	132	71.4%	3.7
Married persons	72	31%	3.4	21	11.4%	4.1
Unmarried persons	160	69%	2.8	164	88.6%	3.8
Relative marriage	15	20.8%	3.6	15	71.4%	2.6
Non relative marriage	57	79.2%	3.3	6	28.5%	3.3
Family history*	32	20.1%	3.4	21	12.1%	3.9
No family* history	127	79.9%	3.1	153	87.9%	3.9

Table 5: Items' answers of awareness among medical and non-medical sample.

Question	Non-medical sample			Medical sample		
	Yes (%)	No (%)	I don't know (%)	Yes (%)	No (%)	I don't know (%)
Is thalassemia a chronic disease?	136 (58.7)	22 (9.6)	74 (31.7)	159 (85.9)	7 (4.1)	19 (10)
Is consanguineous marriage related thalassemia occurrence?	160 (68.8)	21 (8.9)	51 (22.3)	163 (88.3)	5 (2.3)	17 (9.4)
Is thalassemia a contagious disease?	8 (3.6)	195 (84)	29 (12.4)	3 (1.8)	169 (91.2)	13 (7.1)
Is thalassemia a preventable disease?	100 (43.1)	38 (16.2)	94 (40.7)	104 (56.2)	29 (15)	52 (28.4)

As a limitation, this study was conducted as an online survey and only those with internet access had the chance of participation in the study so an important part to be considered in next studies is to address those living in villages and those without internet access to involve them in the study in order to have a full clear image about the awareness of the disease in a more precise and clear way. And the authors encourage future researchers to use this questionnaire to assess thalassemia awareness in these areas as it was proved to be valid and reliable.[11,12]

Table 6

Patient number	Age	Sex	Hb	ferritin	Spleenectomy
1	25	Female	8.2	1841	No
2	26	Female	8.0	12000	No
3	27	Female	10.4	3038	No
4	27	Female	10.1	4783	No
5	27	Female	9.7	6156	No
6	27	Female	9.8	7281	No
7	29	Female	10.5	1816	No
8	29	Female	7.8	10069	No
9	32	Female	10.5	1427	No
10	27	Male	11.0	1101	No
11	31	Male	10.7	1327	No
12	28	Male	10.5	1692	No
13	26	Male	9.7	2688	No
14	27	Male	9.1	6161	No
15	25	Male	9.0	7475	No
16	25	Male	8.4	10023	No
17	24	Male	8.5	10315	No
18	25	Female	8.0	11567	No
19	26	Female	8.9	7348	Yes
20	26	Female	9.4	3902	Yes
21	27	Female	10.9	864	Yes
22	28	Female	9.1	2148	Yes
23	28	Female	10.7	2639	Yes
24	28	Female	10.4	1975	Yes
25	29	Female	9.5	3288	Yes
26	29	Female	9.2	9057	Yes
27	29	Female	11.4	395	Yes
28	30	Female	9.7	1135	Yes
29	30	Female	9.1	5199	Yes
30	31	Female	10.0	2209	Yes
31	33	Female	9.8	7176	Yes
32	36	Female	10.9	1393	Yes
33	27	Female	11.4	489	Yes
34	28	Male	10.8	3028	Yes
35	30	Male	11.2	638	Yes
36	28	Male	10.8	728	Yes
37	25	Male	10.1	1285	Yes
38	24	Male	10.0	1964	Yes
39	25	Male	9.8	2035	Yes

40	**25**	**Male**	**9.4**	**2132**	**Yes**
41	**31**	**Male**	**8.7**	**2209**	**Yes**
42	**25**	**Male**	**8.1**	**3007**	**Yes**
43	**31**	**Male**	**8.0**	**4551**	**Yes**
44	**29**	**Male**	**8.1**	**4563**	**Yes**
45	**29**	**Male**	**7.7**	**4931**	**Yes**
46	**26**	**Male**	**7.9**	**6304**	**Yes**
47	**29**	**Male**	**7.5**	**8872**	**Yes**
48	**29**	**Male**	**7.0**	**10130**	**Yes**
49	**29**	**Male**	**7.0**	**11360**	**Yes**
50	**30**	**Male**	**7.8**	**1666**	**Yes**

The coloration between Hemoglobin and ferritin

TEST	N.V
HB	**Male (130 -160) g/dl Female (125 -155) g/dl**
Ferritin	**Male (20 – 300) ng/ml Female (15 – 200) ng/ml**

CONCLUSIONS

People awareness about thalassemia was relatively good, the highest awareness was for the contiguity of the disease and the lowest awareness was for the preventability.

More awareness programs will be beneficial for prevention of the disease.

In table 6 We noticed that the patients who had splenectomy had an increase in ferritin and a decrease in the amount of hemoglobin. It also appeared that the patient's gender did not play a significant role in the infection, because thalassemia affects both males and females, and those who had a decrease in the amount of hemoglobin needed a blood transfusion More blood and frequently, which led to an increase in the percentage of iron, and thus the attending physician gives some medicines that remove the excess amount of iron because red blood cells, when broken, result in globin protein, which quickly gets absorbed by the body to be reused again, unlike iron, which is absorbed part of it And the rest must be disposed of, but the quantity exceeds the body's carrying capacity, and thus it is accumulated, generating great damage to the body, especially on the bones, especially the facial bones.

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