# Prevalence of Thalassemia Traits and Medications Used for Treatment


Research Group:

**Zainab Nawfal Khairy**

**Zahraa Alaa Khalid**

**Karrar Abdulhakeem Abdullah**

**Fatima Wajid Raauf**

**Yousif Haitham Jameel**

Supervised by:

**Assistant Prof. Dr.Shatha Ramdhan**

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# Abstract

**Background:** Thalassemia is an inherited (i.e., passed from parents to children through genes) blood disorder caused when the body doesn't make enough of a protein called hemoglobin, an important part of red blood cells. When there isn't enough hemoglobin, the body's red blood cells don't function properly and they last shorter periods of time, so there are fewer healthy red blood cells traveling in the bloodstream.

**Objective:** The main objective of this research is to study the prevalence of thalassemia and its subtypes, and to showcase the efficacy of the most common medications that are used for treatment of thalassemia.

**Methods:** In this study, an independent questionnaire was collected from the Ibn Al-Balady hospital to collect responses targeting the population of Iraq, specifically Baghdad. The collection of cysts of a 100 thalassemia patients lasted from December 21$^{st}$ 2022 to January 5$^{th}$ 2023. All symptoms, medication and its side effects were collected, and the results were sorted in excel sheets and analyzed using SPSS.

**Results:** The sample for this study consisted of patients who were diagnosed with thalassemia, and who were currently taking treatment in Ibn Al-Balady hospital. The only thing in common between the participants in this sample was that they were all at some point diagnosed with thalassemia, otherwise the sample had patients of all ages, genders, levels of education, occupations, etc.

**Conclusion:** The results showed a higher prevalence rate of the beta thalassemia trait in Baghdad which is also the case for other countries in this region of the world.

# Introduction

## General Information:

Thalassemia (thal-uh-SEE-me-uh) is an inherited blood disorder that causes your body to have less hemoglobin than normal [1]. Hemoglobin enables red blood cells to carry oxygen. Thalassemia can cause anemia, leaving you fatigued [2]. The term thalassemia is derived from the Greek, thalassa (sea) and haima (blood). Beta-thalassemia includes three main forms: Thalassemia Major, variably referred to as "Cooley's Anemia" and "Mediterranean Anemia", Thalassemia Intermedia and Thalassemia Minor also called "beta-thalassemia carrier", "beta-thalassemia trait" or "heterozygous beta-thalassemia".

If you have mild thalassemia (Hb level is between 6-10 g/dl), you don't necessarily need treatment. But more severe forms might require regular blood transfusions [3]. You can take steps to cope with fatigue, such as choosing a healthy diet and exercising regularly [4].

## Types of Thalassemia:

1) **Alpha thalassemia** is caused by alpha-globin gene deletion which results in reduced or absent production of alpha-globin chains. Alpha globin gene has 4 alleles and disease severity ranges from mild to severe depending on the number of deletions of the alleles. Four allele deletion is the most severe form in which no alpha globins are produced and the excess gamma chains (present during the fetal period) form tetramers. It is incompatible with life and results in hydrops fetalis. One allele deletion is the mildest form and is mostly clinically silent.
2) **Beta thalassemia** results from point mutations in the beta-globin gene. It is divided into three categories based on the zygosity of the beta-gene mutation. A heterozygous mutation (beta-plus thalassemia) results in beta-thalassemia minor in which beta chains are underproduced. It is mild and usually asymptomatic. Beta thalassemia major is caused by a homozygous mutation (beta-zero thalassemia) of the beta-globin gene, resulting in the

total absence of beta chains. It manifests clinically as jaundice, growth retardation, hepatosplenomegaly, endocrine abnormalities, and severe anemia requiring life-long blood transfusions. The condition in between these two types is called beta-thalassemia intermedia with mild to moderate clinical symptoms [5].

## Symptoms and Early Signs of Thalassemia:

The signs and symptoms you have depend on the type of thalassemia and the severity of the patient's condition.

Thalassemia signs and symptoms can include:

- Fatigue
- Weakness
- Pale or yellowish skin
- Facial bone deformities
- Slow growth
- Abdominal swelling
- Dark urine [6]

Some newborns show signs and symptoms of thalassemia at birth; others develop them during the first two years of life. Some people who have only one affected hemoglobin gene don't have thalassemia symptoms [7]. Thalassemia affects approximately 4.4 out of every 10,000 live births throughout the world. This condition causes both males and females to inherit the relevant gene mutations equally because it follows an autosomal pattern of inheritance with no preference for gender [1]. Clinical presentation of thalassemia major occurs between 6 and 24 months. Affected infants fail to thrive and become progressively pale. Feeding problems, diarrhea, irritability, recurrent bouts of fever, and progressive enlargement of the abdomen caused by spleen and liver enlargement may occur. In some developing countries, where due to the lack of resources patients are

untreated or poorly transfused, the clinical picture of thalassemia major is characterized by growth retardation, pallor, jaundice, poor musculature, genu valgum, hepatosplenomegaly, leg ulcers, development of masses from extramedullary hematopoiesis, and skeletal changes resulting from expansion of the bone marrow.

## Prevalence of Thalassemia around the World:

Approximately 5% of the worldwide population has a variation in the alpha or beta part of the hemoglobin molecule, although not all of these are symptomatic and some are known as silent carriers. Carriers of thalassemia minor are usually clinically asymptomatic but sometimes have a mild anemia. When both parents are carriers there is a 25% risk at each pregnancy of having children with homozygous thalassemia. In fact, only 1.7% of the global population has signs as a result of the gene mutations, which is known as a thalassemia trait [8].

However, particular ethnic groups are more likely to be affected, with between 5% and 30% of these populations experiencing symptoms of thalassemia [9]. Alpha-thalassemia is particularly common among certain populations of Southeast Asian descent. There is also a high number of carriers in Sub-Saharan Africa and Western Pacific regions. Beta-thalassemia is the most common form of thalassemia among populations of Mediterranean, African, and South Asian ancestry [9].

Both alpha- and beta-thalassemia are more prevalent in tropical and subtropical regions of the world, particularly where malaria is or has been endemic. Although the reason for this is not clearly established, this association is thought to be due to carriers of the genetic mutation having a higher degree of protection against malaria [10].

All types of thalassemia can be fatal in some cases, particularly when there are multiple gene mutations that affect the production of the globin chains. In 2013, 25,000 deaths were attributable to thalassemia, which was an improvement upon the 36,000 deaths recorded in 1990 [11].

## Diagnostic Methods for Thalassemia:

Blood tests can reveal the number of red blood cells and abnormalities in size, shape or color. Blood tests can also be used for DNA analysis to look for mutated genes. 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 [12].

## Transfusion-Dependent Classification of Thalassemia:

Currently, thalassemia diseases are classified into transfusion-dependent thalassemia and non-transfusion-dependent thalassemia. This classification is based on the clinical severity of patients determining whether they do require regular blood transfusions to survive (transfusion-dependent thalassemia) or not (non-transfusion-dependent thalassemia). In addition to the previous terminology of "thalassemia major" or "thalassemia intermedia," this classification has embraced all other forms of thalassemia syndromes such as α-thalassemia, hemoglobin E/β-thalassemia and combined α- and β-thalassemia. Definitive diagnosis of thalassemia and hemoglobinopathies requires a comprehensive workup from complete blood count, hemoglobin analysis, and molecular studies to identify mutations of globin genes [13].

## General Medications Used for Thalassemia:

- **Orally:**
  - deferasirox (Exjade, Jadenu)
  - deferiprone (Ferriprox)
- **Intravenously:**
  - deferoxamine (Desferal)

# Aim of This Study

The aim of this study is to understand the prevalence of both subtypes of thalassemia (major and minor) among the population of Iraq and mainly in Baghdad. It also studies the usage of the medications used to treat thalassemia, and to put in perspective the availability and efficacy of these treatments and if weather or not it is possible to use better performing drugs with less side effects but at the cost of being less readily available.

# Patients and Methods

## Demographic and medical information:

- This is a cross sectional study of a sample of 100 participants who are currently living in Iraq, with most of them having residence in Baghdad.
- The sample was collected through direct conversation with the patients in Ibn Al-Balady hospital in the time period from
- The sample included patients who were diagnosed with any type of thalassemia.

## Analytic strategy:

- The data that was collected included the participants' personal history (gender, age, marital state, address, level of education, and occupation), it also includes the type of thalassemia, at what age the patient was diagnosed, the drugs that were prescribed by the hospital, and the frequency of taking those drugs, along with how often the patients have systemic checkups.

# Results

**Figure (1):** Classification of gender.

In the study of the 100 participants, figure (1) shows that (45) of them are male (45%), and that (55) of them are female (55%).

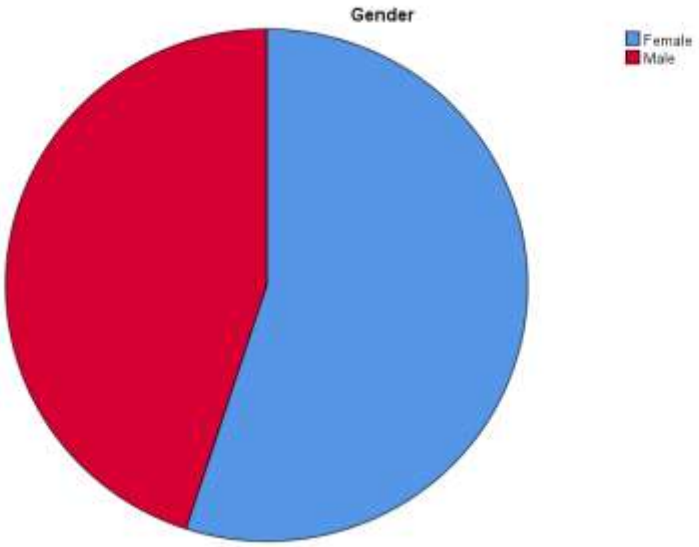


**Figure (2):** Age distribution.

Figure (2) showing the age of the 100 participants and showing that most of them are between the ages of 10-25 years.

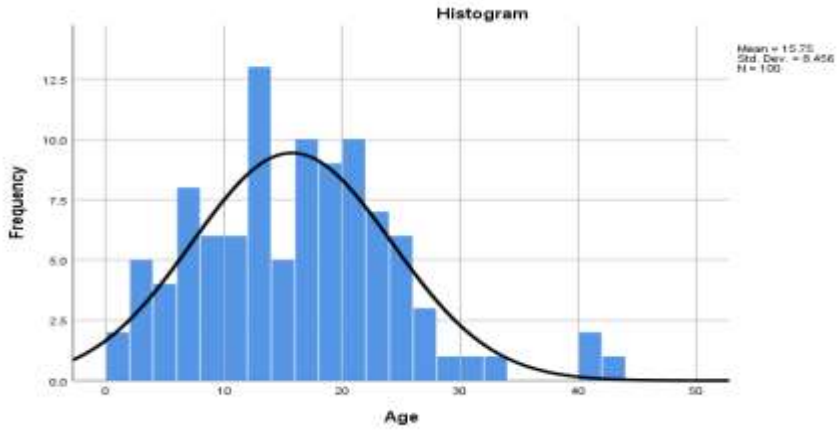

**Table (1):** Level of education.

**Table (2): Level of education**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | Elementary | 28 | 28.0 | 28.0 | 28.0 |
| | High school | 31 | 31.0 | 31.0 | 59.0 |
| | Other | 15 | 15.0 | 15.0 | 74.0 |
| | Postgraduate | 6 | 6.0 | 6.0 | 80.0 |
| | Primary | 3 | 3.0 | 3.0 | 83.0 |
| | University | 17 | 17.0 | 17.0 | 100.0 |
| | Total | 100 | 100.0 | 100.0 | |

In this study. Table (1) shows the difference of the level of education, where (31) of participants are in high school (31%), (28) of them are in elementary school (28%), (17) of them are in university (17%), (15) of them are in other (uneducated or too young) making (15%), (6) of them are in postgraduate (6%), and finally, only (3) of the participants are in primary school (3%).

**Figure (3):** Diagnosis of patients with thalassemia beta major and thalassemia minor.

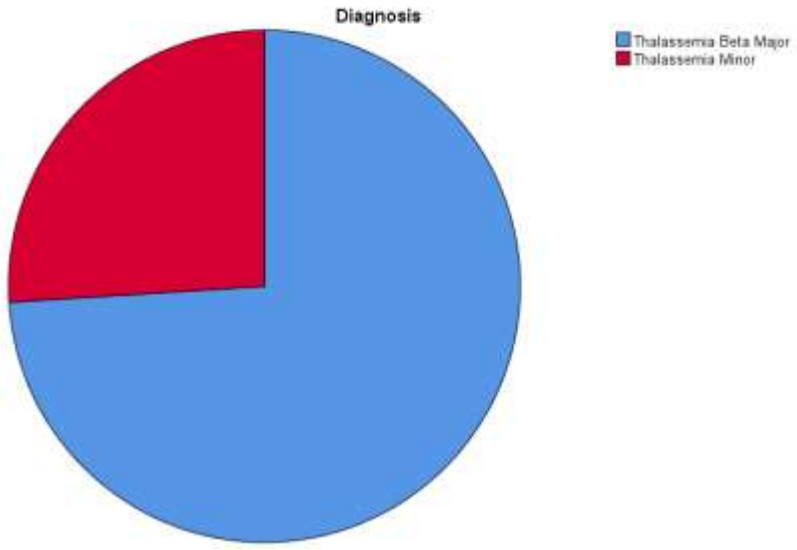


Figure (3) shows the prevalence of each type of thalassemia among the patients who are diagnosed with this disease. It shows that in this sample, there were (74) participants who had thalassemia beta minor (74%), while only (26) of them had thalassemia major (26%).

**Table (2):** The age in which the patients started taking medication for thalassemia.

**Table (4): When did you start taking medication for thalassemia?**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | Years 1-4 | 63 | 63.0 | 63.0 | 63.0 |
| | Years 4-6 | 19 | 19.0 | 19.0 | 82.0 |
| | Years 6-8 | 11 | 11.0 | 11.0 | 93.0 |
| | Years 8-10 | 7 | 7.0 | 7.0 | 100.0 |
| | Total | 100 | 100.0 | 100.0 | |

Table (2) showing that (63) participants started taking their medication around 1-4 years of age (63%), (19) of them started between 4-6 years of age (19%), (11) of them started between 6-8 years of age (11%), and only (7) of them began taking medication between 8-10 years of age (7%).

**Figure (4):** The two most commonly used drugs for treatment.

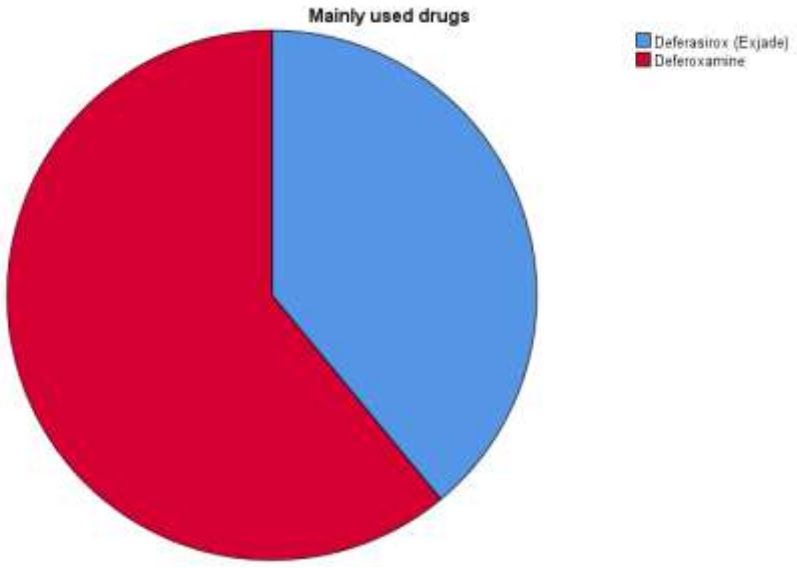


Figure (4) shows that (61) participants are taking deferoxamine as their main medication (61%), while (39) of them are taking deferasirox (exjade) as their main medication (39%). This makes these two drugs the most common and wildly available drugs for treatment. And nearly all patients who were asked about the availability of their medications said that their medications were always available.

# Discussion

To discuss the findings of this study we will need to look into the results of this research and what they tell us about the thalassemia disease.

To start with, we will look at the gender classification of our participants. The results show that (55%) of these participants were female and (45%) of them were male. This could indicate that females are more likely to acquire thalassemia from a genetic defect at birth. However, due to the limited sample size of a hundred participants, this difference in percentages between the genders could simply be a deviation from the median curve. In the introduction above, it is noted that the thalassemia trait follows an autosomal pattern of inheritance, which essentially means that it has no preference for either gender. This means that the small differentiation between the genders result, is simply a deviation from the norm due to the small sample size of the study.

Secondly, we will discuss the difference in prevalence between the two types of thalassemia (major and minor). In this result, it is shown that the vast majority of cases of thalassemia are of the thalassemia beta major subtype, this prevalence of the beta thalassemia trait is also seen in other research studies conducted in nearby countries. However, the same degree of prevalence of the beta thalassemia trait is not seen in other regions of the world [14].

And finally, we will discuss the results for the years in which the patients first started taking their treatment for thalassemia, along with the most commonly used drugs for treatment of thalassemia. Most of the participants are shown to have been diagnosed from an early age (1-4 years) and therefore have taking their medication for thalassemia for most of their life. The two main medications that were traced during this study were deferoxamine and deferasirox (exjade). Only these two medications were noted for the sake of simplicity and due to the fact that other drugs that are used for thalassemia treatment largely depend on the patients systemic needs, which are mostly unrelated to the thalassemia disease [15].

These results are important because they show the prevalence of the types of thalassemia in this particular region in the world, which aid in the research of future studies surrounding this topic.

Unfortunately however, there were many limitation and shortcomings to this research, such as the sample size of the study, and the fact that the sample consisted of only participants with thalassemia, which makes us unable to evaluate the prevalence of thalassemia in the normal and healthy population in Baghdad.

# Conclusion

The results showed a higher prevalence rate of the beta thalassemia trait in Baghdad which is also the case for other countries in this region of the world.

The results also show that the drugs used for the treatment of patients have a high efficacy in this region of Iraq.

# Recommendation

For future reference, it would be recommended for other studies and research teams to conducted the study on a bigger scale with a more diverse sample to get a more accurate evaluation on the subject matter, which will have to mean an increase in the efficiency of the information gathering process from the participants, and this can be solved by increasing the cooperation between the research team and the local hospitals.

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