**Republic of Yemen**

**Ministry of Higher Education & Research**

**Emirates International University**

**Faculty of Medicine & Health Sciences**

**Community Medicine Department**

# Prevalence of Hepatitis B and C viruses among Thalassemia Patients in Yemen, 2023.

A Research submitted to the department of community Medicine, faculty of Medicine and Health Sciences, Emirates University, in partial fulfilment for the degree of MBBH in General Medicine and Surgery.

## Researchers

Shatha Abdulmuneem Al-Dhaheri Al-Shadadi

Sarah Hefdh Allah Mohamed Al-Sarari

Salwa Ahmed Ahmed Alsharabi

Thurya Majed Nomaan Murshed

Omaima Nadher Saeed AL Shwafi

Asalah Muaamar Abdullah Al-Selwi

Ahlam Abdulrahman Abdullah Al-Taheri

Malak Bakil Ali Alhomani

Suhair Saleh Ahmed Al-Qudari

Norah Adel Mohammed Shamsan

## Supervisor

**Dr. Nora Ahmed Al Awadhy**

Faculty of medicine and health sciences

Sanaa University

2023 - 2024$^{AD}$

# DEDICATION

Every challenging work need self-effort as well as guidance of elders especially those who were very close to our heart.

Our humble effort we dedicate this research to our loving Fathers and mothers.

To our brothers and sisters who have been our source of inspiration and gave us strength to continue.

To our relative, mentors, friends, and colleagues who have always been there for us whenever we need them.

# ACKNOWLEDGEMENT

First and foremost, all praise and glory belong to **Allah** for the abundance of blessings and support granted to us. It is impossible to adequately convey our gratitude to the many people who have helped us learn and whose cooperation made this work possible.

We would like to express our sincere gratitude to our **supervisor, Dr. Nora Al-Awadhy**, for initiating and planning this work, as well as for her valuable scientific advice, continuous support, patience, inspiration, encouragement, and many great ideas.

We would also like to thank ***Prof. Saleh Al-Dhaheri,*** the Dean of the College of Medicine, ***Prof. Sadeq Abdulmoghani,*** the Head of the Department of Medicine, ***Dr.Abdulbaset Al-Ghoury*** head of laboratory department in the Emirates international university, **Dr.Moamer *Badi*** for their continuous support and recommendations during our study. And special thanks extends to the medical department coordinator, ***Dr. Maha Al-Montasser***

Our deepest thanks go to the university president, ***Dr. Nasser Al-Mofary*** and the vice president of the university, ***Dr. Ahmed Al-Badaany*** for their visionary leadership, and their support.

Additionally, we extend our thanks ***to Yemeni Society for Thalassemia and Genetic Blood Disorders(YSTGBD).*** Especially ***Dr. Mokhtar Esmail*** Without their cooperation, this research would not have been possible

# Abstract

**Introduction:** Thalassemia is a common genetic disorder that requires regular blood transfusions, which can increase the risk of transfusion-transmitted infections (TTIs) like Hepatitis B (HBV) and Hepatitis C (HCV). Current screening methods for blood donors may not be sufficient to detect all TTIs, and stricter protocols are needed to minimize these risks. Improved screening methods and blood bank practices are crucial to protect β-thalassemia patients from TTIs.

**Objective:** To determine the prevalence of hepatitis C and B virus among thalassemic patients in Yemen.

**Methods:** This was a retrospective descriptive cross-sectional study conducted at the Yemen Society for Thalassemia and Genetic Blood Disorder (YSTH), Sana'a, Yemen 2023. The study involved All patients who fulfilling inclusion criteria (490 patients). The data collected by checklist, then organized and entered to Excell sheet. The data was analyzed by IBM SPSS version 29, Both descriptive and inferential statistics was done a $P \leq 0.05$ is considered significant in all tests.

**Results:** In total, 490 patients participated in this study, with a mean age 12.3 ±7.34 years, more than half of the patients were male, the highest frequency of patient diagnosis occurred in 2015. In addition, more than half of the patients (53.5%) were from urban areas, more than one fifth of patients from Hajjah (22.9%), followed by Sana'a (13.9%) and Amran (13.5%). This study revealed that most patients had beta-thalassemia, (45.5%) and 40% with beta-thalassemia major. The prevalence of HCV was (3.5%) and HBV (1%), unfortunately majority of patients (84.3%) haven't received HBV vaccine. Furthermore, there was no statistically significant association between HBV or HCV status and demographic data.

**Conclusion and recommendations:** The prevalence of thalassemia is notably higher in Hajjah, followed by Sana'a and Amran. The prevalence of HCV was 3.5% and HBV was 1%. It is imperative to educate the population about premarital tests and the importance of vaccination. Additionally, comprehensive training courses on blood transfusion and infection control are necessary for healthcare providers to ensure safe and effective care while minimizing the risk of infection transmission.



**Key words** : Thalassemia , HBV , HCV , Yemen

# Table of content

# List of Tables

# List of Figures

# Abbreviation

| Abbreviation | Meaning |
|---|---|
| CDC | Centers for disease control and prevention |
| CRP | C- reactive protein |
| ESR | Erythrocyte sedimentation rate |
| Hb | Hemoglobin |
| HBsAg | Hepatitis B surface antigen |
| HBV | Hepatitis B Virus |
| HCV | Hepatitis C Virus |
| HLA | Human leukocyte antigen |
| ICP | Infection control and prevention |
| IFN | Interferon |
| MCH | Mean corpuscular hemoglobin |
| MCV | Mean corpuscular volume |
| NAT | Nucleic acid amplification technology |
| RBCs | Red blood cells |
| SPSS | Statistical Package for Social Science |
| TTI | Transfusion Transmissible Infection |
| WHO | World Health Organization |
| YSTGBD | Yemeni Society for Thalassemia and Genetic Blood Disorders |

# Chapter 1: Introduction

## 1.1 Introduction:

Thalassemia is one of the most common genetic abnormalities worldwide, affecting approximately 3% (1.5 million) of the population and resulting in serious health problems such as increased morbidity, premature death, and emotional strain on affected families. Thalassemia is a group of hereditary hemolytic anemias defined by the defective synthesis of one or more globin chains of hemoglobin. Thalassemia is classified into two main types: alpha (α) and beta (β). Beta thalassemia is caused by a mutation in the beta-globin gene, and alpha thalassemia is caused by a mutation in the alpha-globin gene [(1)]. The breakdown of RBCs characterizes β-thalassemia because of defective synthesis of the β-globin chain, leading to the complete absence of βo or reduced synthesis of β+ in β-globin chains. Clinically, β-thalassemia is classified into three major subtypes depending on disease severity. These subtypes are transfusion-dependent β-thalassemia major (BTM), moderate β-thalassemia intermedia (BTI), and asymptomatic β-thalassemia trait (BTT) [(2)]. Approximately 1.5% (1–20%) of the world population is known to be carriers of β-thalassemia. A high prevalence of β-thalassemia carriers was reported in the Mediterranean region, Africa, Southeast Asia, and the Middle East [(1, 3, 4)]. Management of thalassemia patients depends on regular blood transfusions; however, complications include iron overload and transfusion-transmitted infections, which may increase the rate of morbidity and mortality [(1)].

B-thalassemia patients are at high risk of acquiring viral infections such as HBV and HCV. Also, the incidence of hepatitis among thalassemia patients has been reduced following the implementation of the HBV vaccine and the screening of transfused blood components for HBV and HCV; a significant prevalence of HBV and HCV among thalassemia patients is still reported [(5)].

HBV is one of the most widespread viral infections and is considered the 10th most common cause of death. The most frequent symptoms of hepatitis B are nausea and jaundice; however, the clinical picture varies among individuals [(6, 7)]. when the patient dies after 30–45 s due to an HBV infection. According to the CDC USA, HBV is 10 times more contagious than HCV [(8)]. Studies reported that large numbers of individuals have asymptomatic, chronic, and occult hepatitis B infection [(9)].

Thalassemia patients are at risk of infection due to frequent blood transfusions along with their constituents [10]. To minimize the spread of HBV infection, most blood transfusion services use an ELISA test for HBsAg detection during donor screening. However, cases of post-transfusion hepatitis have been reported, indicating that the ELISA technique is not entirely effective. The HBsAg test is a rapid test routinely used for screening blood donors. It is a simple qualitative test, and the result is read visually within minutes. The test is not reliable because of its lower sensitivity, specificity, and subjective evaluation of its result. The nucleic acid amplification technology (NAT) test is an advanced molecular test that detects specific target DNA or RNA segments of the virus amplified in vitro, enabling the detection of low levels of virus in the blood sample by increasing the specific target RNA or DNA present at a detectable level. NAT testing is the most highly recommended and reliable method of donor screening in developed countries [11].

HCV is an RNA virus from the hepacivirus genus and belongs to the Flaviviridae family. It is a hepatotropic virus. Nearly 180 million people are infected with chronic hepatitis, with a prevalence of around 2%, and about 3–4 million individuals are being infected every year globally. Six genotypes have been recognized among the hepatitis C viruses identified worldwide [12, 13]. The prevalence of HCV in β-thalassemia patients has been reported in published studies conducted on multi-transfused thalassemia patients [11, 14]. The higher risk of HCV infection in β-thalassemia patients is mainly linked with the mean age of the patients, the mean duration, and the extent of blood transfusion.

HBV and HCV infections among thalassemia patients are one of the major health problems in Yemen. Screening for HBsAg and HCV antibodies in blood donors using high-quality techniques should be performed to avoid such problems. In Yemen, where more than 70% of blood donors are family, replacement, and paid donors [15], There is a higher risk of getting hepatitis viruses. In studies conducted among thalassemia patients in Sana'a City, the HBV was positive in 3.5% of the patients [16], while among sickle cell anemic patients in Bait Al-Faqeeh, Al-Hodeidah Governorate, the hepatitis B surface antigen was found in 35 patients (35%) [17]. Also, previous studies mentioned that thalassemia is a serious problem, where the prevalence of the thalassemia trait in outpatient clinics in Sana'a City is 13.3% (beta thalassemia trait 4.4%, alpha thalassemia trait 8.9%) [18]. Multi-transfused thalassemia patients are a population at high risk for

blood-borne viral infections, especially HBV and HCV, which can cause post-transfusion hepatitis. The reported frequency of infection varies significantly for different countries due to the different prevalence and sensitivity of the diagnostic methods [19]. So, the aim of this study is to determine the prevalence of hepatitis B and hepatitis C viruses among thalassemic patients and their relationship with blood transfusion.

## 1.2 Problem Statement:

Thalassemia is a genetic blood disorder that requires regular blood transfusions, making thalassemia patients particularly vulnerable to infectious diseases such as hepatitis B and C. Subsequently examine the prevalence Hepatitis B &C Virus among thalassemia patients is essential to address the increasing prevalence of Hepatitis B and C virus among thalassemia patients in order to prevent further transmission and improve the health outcomes of affected individuals.

## 1.3 Research Question

- What is the prevalence of hepatitis C and B virus among thalassemic patients in attending YSTGBD?

## 1.4 Study justifications

1. The lack of previous studies on prevalence of HBV, HCV among thalassemia patient despite the increasing infection rate.
2. Several risk factors are associated with the acquisition of Hepatitis C and hepatitis B infection in thalassemic patients. These include increased age duration of transfusion and HBSAG Seropositivity. A recently published study identified at least ten transfusions per year and age more than 10 years in addition to co-infection with Hepatitis B to be significantly associated with the risk of acquiring Hepatitis C infection.
3. To reduce the risk of transmission of infections associated with transfusions, the donor blood is screened for common pathogens such as Hepatitis B, Hepatitis C, and HIV. We decided to determine the prevalence of viral hepatitis B and C and the risk factors associated with the transmission of Hepatitis C in thalassemic patients registered with our department. We thought that the resulting information could be used to revise the current management strategies in place.

4. Raise awareness regarding the need for urgent action including the hepatitis vaccines among thalassemic patients to prevent the transmission of HBV and HCV.

## 1.5 Objectives:

### 1.5.1 General objective:

- To determine the prevalence of hepatitis C and B virus among thalassemic patients attending Yemen

### 1.5.2 Specific objectives:

- To determine the prevalence of hepatitis C virus.
- To determine the prevalence of hepatitis B virus.
- To identify the geographic distribution of thalassemia patients.
- To identify the associated diseases (complications) among thalassemic patients.
- To identify the surgical operations that were carried out.
- To find a relationship between the seroprevalence status of HCV / HBV and demographic data of the patients.
- To find a relationship between the seroprevalence status of HCV / HBV and frequency of blood transfusion and serum ferritin.

## 1.6 Research hypothesis:

**1.5.1 Null Hypothesis:** There is no significant difference in the prevalence of hepatitis C and B virus and demographic data among thalassemic patients in Yemen.

**1.5.2 Alternative Hypothesis:** There is a significant difference in the prevalence of hepatitis C and B virus and demographic data among thalassemic patients in Yemen.

# Chapter 2: Literature review



## 2.1 Background

## 2.1 Definition of Thalassemia:

Thalassemia is derived from the Greek word "Thalassa" meaning sea. This is a congenital autosomal recessive infirmity of hemoglobin (Hb) with a predominant incidence in the Indian subcontinent, Mediterranean and Middle Eastern nations, and Southeast Asia [20].

Thalassemia is an inherited disorder of Hb. There is a reduction or absence of production of one or more globin chains of Hb tetramers, thereby leading to uncontrolled destruction of RBC directed toward grievous anemia. There are two types of thalassemia, α, and β, which are frequently found. This is based on the involvement of the globin chain Alpha thalassemia and Beta thalassemia [21] .

Thalassemia minor (carrier, heterozygous): is caused by one mutated gene. The patients usually have no clinical manifestations and only sometimes they have mild anemia [22,23], Often asymptomatic and only discovered in routine blood tests, where the MCV and MCH are found to be low. The blood film may be normal [24].

Thalassemia intermedia (patient, homozygous): patients whose anemia does not require regular transfusion [25]. Huge number of genotypes giving rise to one phenotype , varying degree of anaemia so may require transfusion , Have hypochromic microcytic indices and may require splenectomy if recurrent haemolytic episodes [24]

Thalassemia major (patient, homozygous): due to deficiency in both alleles of beta genes, the patients manifest with severe anemia that necessitate blood transfusion. This disease starts to manifest after 6 months of life when fetal hemoglobin (Hb-gamma) disappears and is replaced by adult HbA [25]. Without treatment they get: extramedullary haemopoiesis, with frontal bossing, left ventricular failure secondary to anaemia , hepatosplenomegaly and short stature [24].

Hemoglobin (Hb) is the protein contained in red blood cells that is responsible for delivery of oxygen to the tissues. The amount of hemoglobin in whole blood is expressed in grams per deciliter (g/dl). The normal Hb level for males is 14 to 18 g/dl; that for females is 12 to 16 g/dl [26,27].

Hepatitis B virus (HBV), a partially double-stranded hepatotropic DNA virus, is the etiological agent of acute and chronic hepatitis B in humans [6].

Hepatitis C: is an infectious disease caused by the hepatitis C virus (HCV), which is an RNA virus of the family Flaviviridae. HCV infection can cause acute hepatitis C; following acute infection, 50–80% of patients develop chronic hepatitis C. Chronic HCV infection triggers a chronic inflammatory disease process, which might lead to liver fibrosis, cirrhosis, hepatocellular carcinoma and death [28].

**2.2 Pathophysiology of Thalassemia:**

Thalassemia is autosomal recessive, which means both the parents must be affected with or carriers for the disease to transfer it to the next generation[21] .

Hemoglobin consists of an iron-containing heme ring and four globin chains: two alpha and two non-alphas. The composition of the four globin chains determines the hemoglobin type. Fetal hemoglobin (HbF) has two alpha and two gamma chains (alpha2 gamma2). Adult hemoglobin A (HbA) has two alpha and two beta chains (alpha2 beta2), whereas hemoglobin A2 (HbA2) has two alpha and two delta chains (alpha2 delta2). At birth, HbF accounts for approximately 80 percent of hemoglobin and HbA accounts for 20 percent. the transition from gamma globin synthesis (HbF) to beta globin synthesis (HbA) begins before birth. By approximately six months of age, healthy infants will have transitioned to mostly HbA, a small amount of HbA2, and negligible HbF [29].

Thalassemia caused by mutations or deletions of the Hb genes, resulting in underproduction or absence of alpha or beta chains. Alpha thalassemia is caused by deletions of alpha-globin genes, and beta thalassemia are caused by a point mutation in splice site and promoter regions of the beta-globin gene on chromosome 11 [21].

**2.3 Epidemiology of Thalassemia:**

Thalassemia is a widespread disorder with a high prevalence in the Mediterranean region, parts of North and West Africa, the Middle East, the Indian subcontinent, Southeast Asia, and South China. The global prevalence of thalassemia is estimated to affect about 5% of the world population, with approximately 200 million people worldwide having some form of haemoglobinopathy. The highest prevalence of thalassemia is found in the thalassemia belt, which includes the Mediterranean region, parts of Africa, the Middle East, and Southeast Asia. A systematic review and meta-analysis in Gulf area the prevalence of thalassemia among children below five years of age ranged from 0.25% to 33%, while it was 0.9% in children above five years and from

0.035% to 43.3% among adult thalassemia patients. The prevalence of thalassemia varies among different ethnic groups and castes, with consanguinity playing a major role in its prevalence in certain populations [30–32].

## 2.4 History and Physical examination :

Thalassemia presentation varies widely depending on the type and severity. A complete history and physical examination can give several clues that are sometimes not obvious to the patient themselves. The following findings can be noted [21,33]

**Fatigue**:

Patients usually report fatigue due to anemia as the first presenting symptom**.**

**Skin**

Skin can show pallor due to anemia and jaundice due to hyperbilirubinemia resulting from intravascular hemolysis. Extremities examination can show ulcerations. Chronic iron deposition due to multiple transfusions can result in bronze skin.

**Musculoskeletal**

Extramedullary expansion of hematopoiesis results in deformed facial and other skeletal bones and an appearance known as chipmunk face.

**Cardiac**

Iron deposition in cardiac myocytes due to chronic transfusions can disrupt the cardiac rhythm, and the result is various arrhythmias. Due to chronic anemia, overt heart failure can also result.

**Abdominal**

Chronic hyperbilirubinemia can lead to precipitation of bilirubin gall stones and manifest as typical colicky pain of cholelithiasis. Hepatosplenomegaly can result from chronic iron deposition and also from extramedullary hematopoiesis in these organs. Splenic infarcts or autophagy result from chronic hemolysis due to poorly regulated hematopoiesis.

**Hepatic**:

Hepatic involvement is a common finding in thalassemias, particularly due to the chronic need for transfusions. Chronic liver failure or cirrhosis can result from chronic iron deposition or transfusion-related viral hepatitis.

**Slow Growth Rates**: Anemia can inhibit a child's growth rate, and thalassemia can cause a delay in puberty. Particular attention should focus on the child's growth and development according to age.

**Endocrinopathies**: Iron overload can lead to its deposition in various organ systems of the body and resultant decreased functioning of the respective systems. The deposition of iron in the pancreas can lead to diabetes mellitus; in the thyroid or parathyroid glands can lead to hypothyroidism and hypoparathyroidism, respectively. The deposition in joints leads to chronic arthropathies. In the brain, iron prefers to accumulate in the substantia nigra and manifests as early-onset Parkinson's disease and various other physiatry problems.

## 2.5 Laboratory diagnosis of thalassemia:

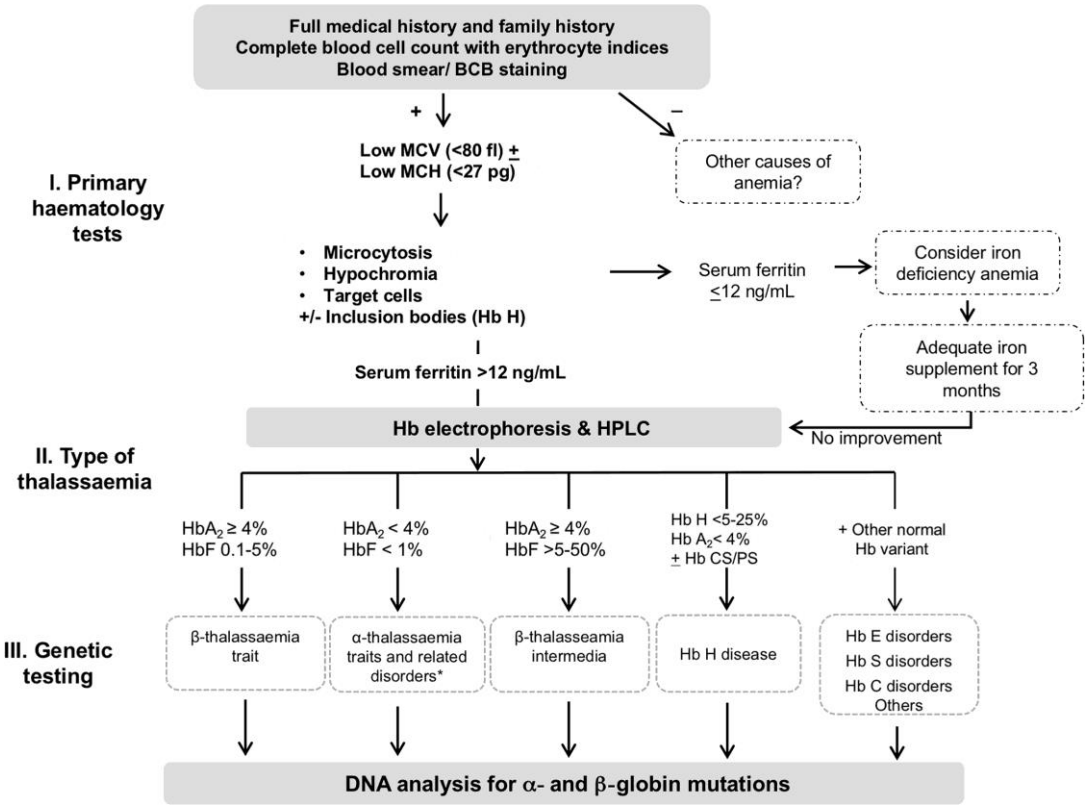


**Figure 1: Diagnostic flowchart for identification of thalassemia** [34]

**Hematologic finding:**

Red blood cells indices microcytic hypochromic anemia, nucleated red blood cells on peripheral blood smear, and hemoglobin analysis that reveals decreased amounts of HbA and increased amounts of hemoglobin F [35].

**Peripheral blood smear**

The peripheral blood smear is an important diagnostic tool for thalassemia. It can reveal characteristic RBC morphology such as microcytosis, hypochromia, anisocytosis, and poikilocytosis. However, it is not possible to define a specific type of thalassemia based solely on RBC morphology [36].

**Qualitative and quantitative hemoglobin analysis**

hemoglobin A (HbA) which has two globin alpha and two globin beta chains (α2 β2), hemoglobin F (HbF) which has two globin alpha and two globin gamma chains (α2 γ2), hemoglobin A2 (HbA2) which has two globin alpha chains and two globin delta chains (α2 δ2) .These methods provide both qualitative and quantitative analysis of hemoglobin components, allowing for the detection of specific hemoglobin variants and thalassemia mutations [37]

**Molecular Genetic Analysis**

Molecular studies are necessary to identify mutations in globin genes, which are responsible for thalassemia and hemoglobinopathies. These studies help in making a definitive diagnosis of thalassemia [38].

**Iron studies:** (serum iron, ferritin, unsaturated iron-binding capacity (UIBC), total iron-binding capacity (TIBC), and percent saturation of transferrin) are also done to rule out iron deficiency anemia as the underlying cause.

**2.6 Differential Diagnosis of Thalassemia [21] :**

- **Iron deficiency anemia:** This is ruled out by iron studies and Mentzer index.
- **Anemia of chronic disease and renal failure:** Elevated markers of inflammation (CRP, ESR) point in this direction.
- **Sideroblastic anemias:** These are ruled out by iron studies and peripheral blood smear.
- **Lead poisoning:** This is ruled out by measuring serum protoporphyrin level.

**2.7 Treatment / Management of Thalassemia:**

Thalassemia treatment depends on the type and severity of the disease.

**Mild thalassemia (Hb: 6 to 10g/dl):**

Signs and symptoms are generally mild with thalassemia minor and little if any, treatment is needed. Occasionally, patients may need a blood transfusion, particularly after surgery, following childbirth, or to help manage thalassemia complications [21].

**Moderate to severe thalassemia (Hb less than 5 to 6g/dl):**

**Blood transfusions:**

The patients with beta-thalassemia major require periodic and lifelong blood transfusions regularly washed RBCs or leukocyte-depleted RBCs, according to a standardized protocol to maintain a hemoglobin level greater than 10 g / dL (100 g per L) [39].

**Iron Chelation therapy**:

Iron chelation is important to avoid complications of iron overload and could prove survival in patients with beta-thalassemia major [40] .Iron chelation therapy should be started when the serum ferritin level is greater than 1000 ng/ml, so there are three main chelators that can remove the excess iron overload from the body such as deferoxamine in a dosage of (30-50 mg/kg) is administered subcutaneously over a period of 8–12 hours on five nights each week, oral deferiprone (75-80 mg/kg/day divided into three doses) and oral deferasirox (20-40 mg/kg/day once a day) [39-40] . Deferiprone and deferasirox are oral chelators that have come into the clinic in recent years, but they are different in

molecular weight and leading to differences in intestinal absorption, so deferoxamine was the only available iron chelator for several decades [41].

**Bone marrow transplant**:

Stem cell transplantation is the only cure for thalassemia. It has witnessed major developments that have made it less toxic, more successful, and feasible for a larger number of patients with diverse comorbidities and from a wider range of donors, also advances in human leukocyte antigen (HLA) typing have greatly refined alternate donor selection with results of matched unrelated donors similar to matched sibling donors [42].

**Splenectomy:** Patients with thalassemia major often undergo splenectomy to limit the number of required transfusions. Splenectomy is the usual recommendation when the annual transfusion requirement increases to or more than 200 to 220 mL RBCs/kg/year with a hematocrit value of 70%. Splenectomy not only limits the number of required transfusions but also controls the spread of extramedullary hematopoiesis. Post splenectomy immunizations are necessary to prevent bacterial infections, including *Pneumococcus*, *Meningococcus*, and *Hemophilus influenzae*. Post splenectomy sepsis is possible in children, so this procedure is deferred until 6 to 7 years of age, and then penicillin is given for prophylaxis until they reach a certain age [21].

**2.8 Hepatitis C virus (HCV):**

Hepatitis C virus (HCV) infection is a major concern for the public health worldwide in both developing and developed countries. Transmission of HCV infection is mainly by exposure to infected devices and tools despite rigid hygienic control, infected blood or blood products, hemodialysis, intravenous (IV) drug abuse, and organ transplantation [43]

Infections with the hepatitis C virus (HCV) are pandemic, and the World Health Organization (WHO) estimates a world-wide prevalence of 3%. In Middle Europe, approximately 1% of the population is infected [44].

A systematic review and met analysis study revealed that pooled HCV prevalence in the general population was 1.8% and among blood donors the prevalence ranged from 0.2 to 3.0% depending on governorate of origin. The highest prevalence within the general population groups was reported among pregnant women in one study (8.5%) followed by a study of African migrant community living in a Shanty town in Sana'a

(5.2%). Among high-risk populations, HCV prevalence among hemodialysis patients was 40.0% in 1999 and 62.7% in 2007. Among patients with acute and chronic liver disease it was 74.1% [45].

**2.9 Epidemiology of Hepatitis C Virus among thalassemia patients:**

The prevalence of Hepatitis C Virus (HCV) among thalassemia patients varies across different regions. In South Iran, the prevalence of HCV infection among β-thalassemia patients was found to be 17.6%, with genotype 3a being the most common genotype [14]. In Peshawar, Pakistan, the frequency of HCV in beta-thalassemia patients was 18.5% [46] . Another study in Iraq states that the prevalence rate of HBV was 2.5% (l male and 1 Female) which was significantly associated with family history of hepatitis[47].

Pervious study in Yemen reported that 15.4% (30/195) of children were seropositive for the antibodies against HCV, 13.3% (26/195) were infected with hepatitis B as confirmed by HBsAg seropositivity, and 4.1% (8/195) were concomitantly seropositive for HBsAg and anti-HCV [48]. These findings highlight the high risk of HCV infection among thalassemia patients, particularly those who receive multiple blood transfusions. It is important to implement effective screening and prevention strategies to reduce the transmission of HCV in this vulnerable population.

**2.10 hepatitis B virus (HBV):**

HBV, or hepatitis B virus, is a hepatotropic virus that can cause chronic hepatitis and hepatocellular carcinoma. It is a major global public health concern, with approximately 3.5% of the world's population currently chronically infected [49]. The clinical outcome of HBV infection depends on the interplay between viral replication and the host immune response, with adaptive immunity playing a crucial role in controlling and clearing the infection [50]. Acute HBV infection can range from mild hepatitis to fulminant hepatitis, with a more severe course often observed in HBV/HDV co-infection [51]. Interferons (IFNs) are cytokines with antiviral properties that are used for the treatment of HBV infection, and they induce the expression of IFN-stimulated genes (ISGs) responsible for inhibiting HBV replication [52].

**2.11 Epidemiology of HBV inn thalassemia patients**

The prevalence of hepatitis B virus (HBV) in thalassemia patients varies across different studies: study conducted in India, the seroprevalence of HBsAg (HBV surface

antigen) was found to be 0.5% among multi-transfused thalassemic patients [53]. However, in Pakistan, the seroprevalence of HBV in thalassemia major patients ranged from 0.66% to 7.4% (54). IN Yamen literature showed that 13.3% (26/195) were infected with hepatitis B as confirmed by HBsAg seropositivity, and 4.1% (8/195) were concomitantly seropositive for HBsAg and anti-HCV [48].

These variations in prevalence may be attributed to factors such as geographic location, screening programs, and the implementation of preventive measures. It is important to note that the prevalence of HBV in thalassemia patients should be regularly monitored, and appropriate measures should be taken to prevent transmission, such as vaccination and screening of blood products.

### 2.12 Patient Education [21]

Patients should be educated to keep a check on their disease by following an appropriate treatment plan and adopting healthy living habits.

- **Avoid excess iron.** Unless the doctor recommends otherwise, patients should avoid multivitamins or other supplements that contain iron.
- **Eat a healthy diet.** Eating a balanced diet that contains plenty of nutritious foods can help the patient feel better and boost energy. Doctors sometimes also recommend taking a folic acid supplement to help make new red blood cells.
- **Avoid infections.** Patients should try maximally to protect themselves from infections, especially following a splenectomy. An annual flu shot, meningitis, pneumococcal, and hepatitis B vaccines are recommended to prevent infections.
- Patients should also receive education about the hereditary nature of the disease. If both parents have thalassemia minor, there is a 1/4th chance that they will have a child with thalassemia major. If one parent has beta-thalassemia minor and the other parent has some form of beta-globin gene defect, i.e., sickle cell defect, they should also be counseled about the possibility of disease transfer to their children.
- Patients with thalassemia should understand that their disease is not due to iron deficiency and that iron supplements will not cure the anemia; in fact, it will lead to more iron buildup if they are already receiving blood transfusions.

## 2.13 Previous studies

1. **Al-Shawia et al**. (Yemen ,2021) conducted a descriptive cross-sectional study to determine incidence of hepatitis B virus and risk factors among Multi-Transfused Beta Thalassemia Patients attending at The Yemeni Society for Thalassemia and Genetic Blood Disorder (YSTGBD) Sana'a –Yemen. There were 200 Blood samples were collected from beta thalassemia patients attending at (YSTGBD). All samples were examined using the ECLIA technique, during which the basic information was collected through special questionnaires for this purpose. The rate of incidence by HBsAg in all study samples was determined to be 7(3.5%). The study showed that there was a statistically significant relationship between infection with the hepatitis B virus and the age group of more than 10 years age (P = 0.042), in addition to that number of blood transfusions received by HBsAg positive was significantly higher than that of HBsAg negative thalassemia patients (P = 0.022) [(16)].
2. **Jallab et al.** (Iraq, 2020) carried out a retrospective cross-sectional study to estimate the prevalence of HBV and HCV in beta thalassemic major patients in Ad-Diwayah governorate. The study had been collected from patients, their guardians and from the records. The prevalence rate of HBV was 2.5% (l male and 1 Female) which was significantly associated with family history of hepatitis; while the prevalence rate of HCV was 3.8% (1male and 2 female) which was significantly associated with age and family history of hepatitis [(47)].
3. **Akhtar et al.** (Pakistan, 2020) conducted a systematic review and meta-analysis study to summarize the prevalence of HCV infection in β-thalassemia patients in Pakistan. They identified a total of 229 potential studies, of which 27 studies were finally considered in the meta-analysis. The pooled prevalence of HCV in *β*-thalassemia patients in Pakistan was 36.21% (95% CI: 28.98–43.75%) based on 5789 *β*-thalassemia patients, but there was considerable heterogeneity. Meta-analysis estimated the HCV prevalence among the *β*-thalassemia patients at 45.98% (95% CI: 38.15–53.90%) in Punjab, 31.81% (95% CI: 20.27–44.59%) in Sindh, and 28.04% (95% CI: 13.58–45.26%) in Khyber Pakhtunkhwa. Meta–regression analysis showed that geographical location was a key source of heterogeneity. Rhey concluded that the pooled prevalence of HCV in *β*-thalassemia patients in Pakistan was more than one in three, and higher than in neighbouring countries. It varies regionally within the country. With the use of standard prevention procedures during blood transfusion, the

risk of HCV transmission in $\beta$-thalassemia patients could be controlled and the prevalence of HCV in $\beta$-thalassemia patients reduced [55].

4. **Al-Sharifi et al**. (Iraq ,2019) carried out a cross-sectional study on 100 Mult transfused thalassaemic patients for 2 months to assess the prevalence of hepatitis B and C viruses in thalassaemic patients and its relationship with type of thalassemia, blood transfusion, and spleen status. Twelve (12%) patients had a positive HBcAb, while 3 (3%) had HBsAg positivity, higher percentage of HCV-infected patients (91%) received regular every 1-month blood transfusion, 50% of hepatitis C patients had splenomegaly, and 20.7%had splenectomy. They concluded that the good and sensitive screening tests and stringent donor selection processes are required for the better control of this transfusion-transmitted infection among thalassaemic patients [56].
5. **Murtaza et al**. (2023, Pakistan) carried out the descriptive cross-sectional study to determine the prevalence of hepatitis B and C among beta-thalassemia major patients at a tertiary care Hospital: A total of 87 patients with beta thalassemia major were studied; their mean age was 10.0+3.68 years. Males were 55.8% and females were 44.8%. Out of all 35.6% patients were infected by HCV, while only one patient found with HCV and HBV co-infection. As per the stratification, HCV infection was significantly linked to age more than 10 years (p-0.001), while statistically insignificant according to gender (p-0.344). As per the study conclusion, HCV infection was observed to be highly prevalent among patients with beta-thalassemia major. It was positively related to the blood transfusions. Unfortunately, due to the high incidence of these viruses in individuals with beta thalassemia, it would appear that the precautions used in blood preparation and testing to prevent infections that are transferred by blood transfusion are still insufficient [22].

# Chapter 3: Research Methodology

### 3.1. Study design:

A retrospective cross-sectional study was conducted at the Yemen Society for Thalassemia and Genetic Blood Disorder (YSTGBD).

### 3.2. Study period:

The study was carried out during the period 2023 to 2024.

### 3.3. Study area:

Sana'a is the capital of Yemen and the largest city of Yemen, located in the north of Yemen, involve 10 districts, the weather is cold most of the year and population in Sanaa's (2023) estimated at 3,292,497 [57,58].

The Yemeni Society for Thalassemia and Genetic Blood Disorders (YSTH) was founded on 15th Apr. 2000, it is a non-profit humanitarian society that fights against chronic diseases and cares for infected patients. It carries out its activities by its statutes and the principles of the constitution and the law of the Republic of Yemen, it is the only society for genetic blood disorder in Sana'a and it received more than 2531cases of genetic blood disorder. The Association has seen the opening of a branch in the city of Hodeidah to provide health and social care services to patients living in Hodeidah and neighboring governorates (Riymha, Hajjah, Al Mahweet and Dhamar) [59].

### 3.4. Study population:

The study population included all patients attending The YSTGBD in Sana'a City during the study period and fulfilling inclusion criteria.

#### 3.4.1. Inclusion Criteria:

- Known cases of thalassemia and had full registered data at the YSTH.
- Patients who undergo hepatitis viral screening.

#### 3.4.2. Exclusion Criteria:

- Patients who have other diagnosis
- Patients who have missed data or not of the inclusion criteria.

### 3.5. Samples size and technique:

From the 1st of January 2023 to the last day of December 2023 490 patient were reported in this study who fulfilling inclusion criteria.

### 3.6. Data collection tool:

A checklist was filled including the subject's personal and clinical information includes; age, gender, diagnosis, time of thalassemia diagnosis, origin, residency, blood transfusion, complication, undergoes splenectomy and laboratory diagnosis (HBS-Ag and HCV-Ab) (Appendix III).

### 3.7. Research variables:

- **Independent variables**: age, gender, diagnosis, time of thalassemia diagnosis, origin, residency, blood transfusion, complication and undergoes splenectomy.
- **Dependent variables:** HCV and HBV prevalence (HBS-Ag and HCV-Ab) status.

### 3.8. Data Analysis and data management

The data entered were ordered, cleaned, and analyzed by using SPSS version 29. Both descriptive and inferential statistics were performed.

The category variables are presented as frequency and percentage, whereas the continuous variables are presented as means and standard deviation.

The Pearson $X^2$ Test at a 95% confidence interval. The data is presented as tables and figures.

Independent T-Test and ANOVA test were used to find the relationship between continuous data and dependent variables.

A p-value of $\leq 0.05$ was considered statistically significant in all tests.

### 3.9. Ethical considerations:

- Permission letter was taken from Community Medical Department of Emirates International University (Appendix 2).
- The agreement form YSTGBD was obtained.
- The obtained data do not contain any personal information such as name and telephone number.

# Chapter 4: Results

## 4.1 Results

Table 1 showed that the study included 490 patients, more than one fifth of them (22.4%) aged between 9-12 years, followed by the 5 - 8 years (20.6%). The mean age was 12.3 years, with a standard deviation of 7.34 years.

**Table 1: Distribution of patients by age (n=490).**

| Age group (year) Mean± SD= (12.3±7.34) | Frequency | Percentage |
|---|---|---|
| Less than 5 | 73 | 14.9 |
| 5 – 8 | 101 | 20.6 |
| 9 – 12 | 110 | 22.4 |
| 13 – 16 | 94 | 19.2 |
| 17 – 21 | 67 | 13.7 |
| 22 – 25 | 19 | 3.9 |
| More than 25 | 26 | 5.3 |

Table 2 revealed that more than half of the patients were male (55.1%) while (44.9%) were female.

**Table 2: Distribution of patients by gender (n=490).**

| Gender | Frequency | Percentage |
|---|---|---|
| Male | 270 | 55.1 |
| Female | 220 | 44.9 |

Table 3 and figure 1 showed that the highest frequency of patient diagnosis occurred in 2015, with 47 patients diagnosed, representing 9.6% of the total patients while the lowest frequency of patient diagnosis was 2004, 2005, and 2006, each with only 1 ,8 and 6 patients diagnosed respectively, representing 0.2%, 1.6%, and 1.2% of the total patients, respectively.

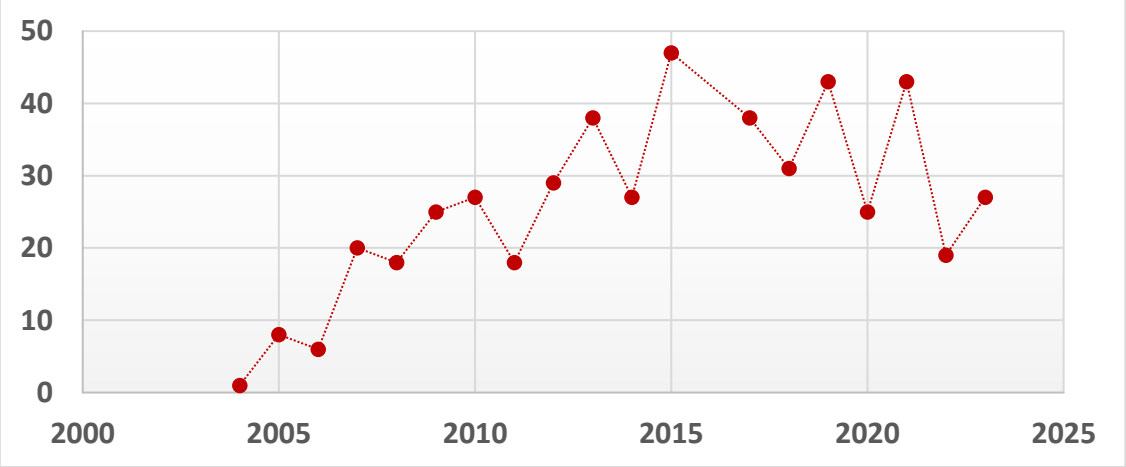


**Figure 1: distribution of patients by date of diagnosis (n=490).**

Table 3 showed that the more than one fifth of patients from Hajjah (22.9%), followed by Sana'a (13.9%) and Amran (13.5%), while other regions with significant patient representation included Al-Mahweet (8.6%), Dhamar (10.0%), and Taiz (6.7%). There were very few non-Yemeni patients (0.4%).

**Table 3: Distribution of patient by Governorate (n=490).**

| Origin | Frequency | Percent |
|---|---|---|
| Non-Yemeni | 2 | 0.4 % |
| Ibb | 39 | 8.0 % |
| Abyan | 2 | 0.4 % |
| Amanat Al Asimaha | 3 | 0.6 % |
| Al-Baydha | 11 | 2.2 % |
| Al-Hodeidah | 21 | 4.3 % |
| Al-Dhalea | 9 | 1.8 % |
| Al-Mahweet | 42 | 8.6 % |
| Taiz | 33 | 6.7 % |
| Hajjah | 112 | 22.9 % |
| Dhamar | 49 | 10.0 % |
| Raymah | 26 | 5.3 % |
| Sa'adah | 6 | 1.2 % |
| Sana'a | 68 | 13.9 % |
| Aden | 1 | 0.2 % |
| Amran | 66 | 13.5 % |

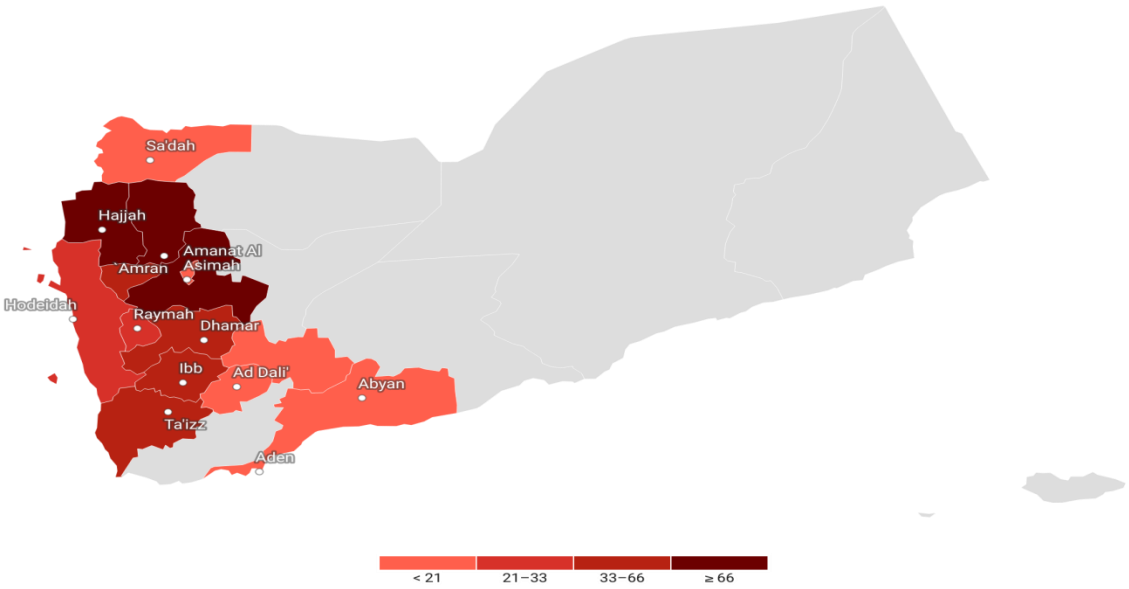


Table 4 revealed that more than half of the patients (53.5%) were from urban areas, while 46.5% were from rural areas.

**Table 4: Distribution of patients by residency (n=490).**

| Residency | Frequency | Percent |
|---|---|---|
| Rural | 228 | 46.5 % |
| Urban | 262 | 53.5 % |

Table 5 showed that the most common blood group was O+ (57.6%), followed by A+ (26.3%), and the least common blood groups were B- (0.8%) and A- (1.8%), with other blood groups represented including O- (5.5%), B+ (5.1%), and AB+ (2.9%).

**Table 5: Distribution of patients by blood grouping (n=490).**

| Blood grouping | Frequency | Percentage |
|---|---|---|
| A- | 9 | 1.8 % |
| A+ | 129 | 26.3 % |
| AB+ | 14 | 2.9 % |
| B+ | 25 | 5.1 % |
| O- | 27 | 5.5 % |
| O+ | 282 | 57.6 % |
| B- | 4 | 0.8 % |

Table 6 revealed that the majority of patients had beta-thalassemia, including 45.5% with beta-thalassemia, 40% with beta-thalassemia major and6.7% with thalassemia intermedia. There were also 7.8% with alpha-thalassemia.

**Table 6: Distribution of patient by diagnosis (n=490).**

| Diagnosis | Frequency | Percentage |
|---|---|---|
| Alpha-Thalassemia | 38 | 7.8 % |
| B- Thalassemia | 223 | 45.5 % |
| Thalassemia intermedia | 33 | 6.7 % |
| B-Thalassemia major | 196 | 40.0 % |

Table 7 described that less than half of the patients were diagnosed during the first 6 months (40.6%) or between 7-12 months (35.7%), with smaller percentages diagnosed later.

**Table 7: Distribution of patient by time of diagnosis (n=490).**

| Time of diagnosis | Frequency | Percentage |
|---|---|---|
| During first 6 months | 199 | 40.6 % |
| 7-12 months | 175 | 35.7 % |
| 13-24 months | 48 | 9.8 % |
| 3-5 years | 56 | 11.4 % |
| More than 5 years | 12 | 2.4 % |

Table 8 showed that about three quarter of the patients (74.5%) did not have 0consanguinity between their parents, and most had 2-4 family members (46.9%), with 35.9% having a positive sibling history and 10.4% a history of sibling death.

**Table 8: Family history of thalassemia (n=490).**

| Variables | | Frequency | Percentage |
|---|---|---|---|
| Consanguinity between parents | Yes | 125 | 25.5 % |
| | No | 365 | 74.5 % |
| Number of Family members | 0 | 29 | 5.9 % |
| | 1 | 41 | 8.4 % |
| | 2 | 103 | 21.0 % |
| | 3 | 93 | 19.0 % |
| | 4 | 83 | 16.9 % |
| | 5 | 45 | 9.2 % |
| | 6 | 44 | 9.0 % |
| | 7 | 23 | 4.7 % |
| | 7 | 18 | 3.7 % |
| | 9 | 7 | 1.4 % |
| | 10 | 3 | 0.6 % |
| | 11 | 1 | 0.2 % |
| Sibling history | No | 314 | 64.1 % |
| | Yes | 176 | 35.9 % |
| history of sibling's death | No | 439 | 89.6 % |
| | Yes | 51 | 10.4 % |

Table 9 revealed that the prevalence of Hepatitis B infection among patients was (1%), with the vast majority being negative (99%).

**Table 9: Distribution of patients by status of HBS Ag investigation (n=490).**

| HBS Ag | Frequency | Percentage |
|---|---|---|
| Negative | 485 | 99.0 % |
| Positive | 5 | 1.0 % |

Table 10 revealed that the prevalence of Hepatitis C infection was among patients was (3.5%), with the majority being negative (96.5%).

**Table 10: Distribution of patients by status of HCV Ab investigation (n=490).**

| HCV Ab | Frequency | Percentage |
|---|---|---|
| Negative | 473 | 96.5 % |
| Positive | 17 | 3.5 % |

Table 11 reported that the majority of patients (84.5%) had no associated diseases, with the most common associated conditions being splenomegaly (5.9%) and splenomegaly with hepatomegaly (1.4%), along with a few other conditions like diabetes, heart disease, and respiratory infections.

**Table 11: presences of associated diseases**

| system | Associated diseases | Frequency | Percent |
|---|---|---|---|
| No comorbidity | | 414 | 84.4 % |
| Central nervous system | Blindness | 1 | 0.2 % |
| | CVA | 1 | 0.2 % |
| | Mental retardation | 1 | 0.2 % |
| | Migraine | 1 | 0.2 % |
| | Paralysis | 2 | 0.4 % |
| Endocrine system | Diabetes mellitus | 2 | 0.4 % |
| Cardiovascular system | Heart disease | 3 | 0.6 % |
| Respiratory system | Respiratory infection | 3 | 0.6 % |
| Gastrointestinal tract | Splenomegaly | 29 | 5.9 % |
| | splenomegaly & hepatomegaly | 7 | 1.4 % |
| | splenomegaly & hepatitis | 2 | 0.4 % |
| | splenomegaly - osteoporosis | 2 | 0.4 % |
| | liver disease | 1 | 0.2 % |
| | liver failure | 1 | 0.2 % |
| | Gall bladder stone | 2 | 0.4 % |
| | HCV | 3 | 0.6% |
| | Hepatitis* | 3 | 0.6 % |
| | Hepatomegaly | 3 | 0.6 % |
| | Hernia | 3 | 0.6 % |
| | Hydatid cyst | 1 | 0.6 % |
| | Renal stone | 1 | 0.2 % |
| | Growth delayed | 1 | 0.2 % |
| Urinary tract | Osteoarthritis | 1 | 0.2 % |
| Musculoskeletal | Osteoporosis | 2 | 0.4 % |

***Total (HBV & HCV)**

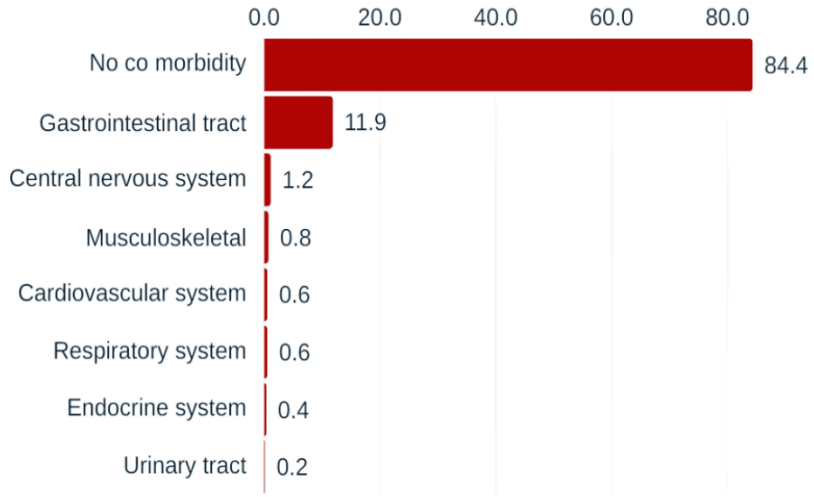


**Figure 2: Presences of associated diseases**

Table 12 reported that splenectomy is the most common operations (30.4%), followed by splenectomy & cholecystectomy (0.6%).

**Table 12: Distribution of patients by operations (n=490).**

| Operations | Frequency | Percentage |
|---|---|---|
| No operations | 334 | 68.2% |
| Cholecystectomy | 1 | 0.2% |
| Splenectomy | 149 | 30.4% |
| splenectomy & appendectomy | 1 | 0.2% |
| splenectomy & cholecystectomy | 3 | 0.6% |
| splenectomy & tonsillectomy | 1 | 0.2% |
| Tonsillectomy | 1 | 0.2% |

Table 13 revealed that majority of patients (84.3%) haven't received HBV vaccine, while 10.4%% received three doses followed by one dose (2.9%) and two doses (2.4%).

**Table 13: Distribution of patient by vaccination status (n=490).**

| HBV Vaccine | Frequency | Percentage |
|---|---|---|
| Not vaccinated | 413 | 84.3% |
| One dose | 14 | 2.9% |
| Two doses | 12 | 2.4% |
| Three doses | 51 | 10.4% |

Table 14 revealed that the majority of patients (89.6%) required blood transfusions every month, while a smaller percentage needed transfusions every 3 weeks (4.3%), with a few patients needing them, when necessary (2.4%), every 2 months (2.0%), or every 3 months (0.6%), and only 1 patient (0.2%) never requiring a blood transfusion

**Table 14: Distribution of patient by times of blood transfusion (n=490).**

| Blood transfusion | Frequency | Percentage |
|---|---|---|
| never transfuse | 1 | 0.2% |
| Every 3 weeks | 21 | 4.3% |
| Every month | 439 | 89.6% |
| When necessary | 12 | 2.4% |
| Every 2 month | 10 | 2.0% |
| Every 3 months | 3 | 0.6% |
| once a year | 4 | 0.8% |

Table 15 revealed there was a statistically significant association between patient origin and diagnosis (p=0.024). Non-Yemeni patients and those from Abyan had 100% beta-thalassemia, while other regions showed varying distributions across the different thalassemia types.

**Table 15: Relationship between diagnosis and origin by chi square test.**

| Origin | Alpha-Thalassemia | B-Thalassemia | Thalassemia intermedia | B-Thalassemia major | Chi-s | P .value |
|---|---|---|---|---|---|---|
| | Row % | Row % | Row % | Row % | | |
| Non-Yemeni | 0.0% | 100% | 0.0% | 0.0% | | |
| Ibb | 12.8% | 41.0% | 5.1% | 41.0% | | |
| Abyan | 0.0% | 100% | 0.0% | 0.0% | | |
| Amanat Al Asimaha | 0.0% | 33.3% | 0.0% | 66.7% | | |
| Al-Baydha | 0.0% | 63.6% | 18.2% | 18.2% | | |
| Al-Hodeidah | 0.0% | 76.2% | 4.8% | 19.0% | | |
| Al-Dhalea | 33.3% | 33.3% | 0.0% | 33.3% | | |
| Al-Mahweet | 14.3% | 35.7% | 9.5% | 40.5% | | |
| Taiz | 3.0% | 51.5% | 6.1% | 39.4% | 65.625 | 0.024 |
| Hajjah | 7.1% | 39.3% | 6.3% | 47.3% | | |
| Dhamar | 10.2% | 38.8% | 6.1% | 44.9% | | |
| Raymah | 3.8% | 53.8% | 3.8% | 38.5% | | |
| Sa'adah | 0.0% | 50.0% | 33.3% | 16.7% | | |
| Sana'a | 5.9% | 47.1% | 10.3% | 36.8% | | |
| Aden | 0.0% | 0.0% | 100% | 0.0% | | |
| Amran | 7.6% | 48.5% | 1.5% | 42.4% | | |
| Al-Jawf | 0.0% | 0.0% | 0.0% | 0.0% | | |

Table 16 reported that there was a significant association between age and diagnosis ($p<0.001$), with younger patients more likely to have beta-thalassemia major. However, no significant relationships were found between diagnosis and residency, gender, blood group, consanguinity, sibling history, or history of sibling death.

**Table 16: Relationship between diagnosis and demographic characteristics by chi square test.**

| Demographic characteristics | | Diagnosis | | | | chi s | P .value |
|---|---|---|---|---|---|---|---|
| | | Alpha-Thalassemia | B-Thalassemia | Thalassemia intermedia | B-Thalassemia major | | |
| | | Row % | Row % | Row % | Row % | | |
| **Residency** | Rural | 8.8% | 46.9% | 6.1% | 38.2% | 1.343 | 0.719 |
| | Urban | 6.9% | 44.3% | 7.3% | 41.6% | | |
| **Gender** | Male | 8.9% | 48.5% | 6.3% | 36.3% | 4.427 | 0.219 |
| | Female | 6.4% | 41.8% | 7.3% | 44.5% | | |
| **Age (years)** | < 5 | 2.7% | 45.2% | 0.0% | 52.1% | 116.396 | <0.01 |
| | 05-8 | 3.0% | 21.8% | 5.9% | 69.3% | | |
| | 09-12 | 3.6% | 42.7% | 8.2% | 45.5% | | |
| | 13 - 16 | 12.8% | 62.8% | 1.1% | 23.4% | | |
| | 17- 21 | 20.9% | 58.2% | 10.4% | 10.4% | | |
| | 22 - 25 | 5.3% | 63.2% | 10.5% | 21.1% | | |
| | >25 | 7.7% | 42.3% | 31% | 19.2% | | |
| **Blood group** | A- | 11.1% | 55.6% | 11.1% | 22.2% | 10.933 | 0.897 |
| | A+ | 10.1% | 45.7% | 5.4% | 38.8% | | |
| | AB+ | 14.3% | 35.7% | 7.1% | 42.9% | | |
| | B+ | 4.0% | 36.0% | 16.0% | 44.0% | | |
| | O- | 7.4% | 48.1% | 3.7% | 40.7% | | |
| | O+ | 6.7% | 46.5% | 6.7% | 40.1% | | |
| | B- | 0.0% | 25.0% | 0.0% | 75.0% | | |
| **Consanguinity between parents** | No | 8.0% | 41.6% | 6.4% | 44.0% | 1.276 | 0.735 |
| | Yes | 7.7% | 46.8% | 6.8% | 38.6% | | |
| **Siblings' history** | No | 8.0% | 44.6% | 6.7% | 40.8% | 0.343 | 0.952 |
| | Yes | 7.4% | 47.2% | 6.8% | 38.6% | | |
| **History of sibling's death** | No | 8.0% | 44.4% | 7.1% | 40.5% | 2.345 | 0.504 |
| | Yes | 5.9% | 54.9% | 3.9% | 35.3% | | |

Table 17 revealed a statistically significant association with diagnosis (p=0.031). Patients with beta-thalassemia and Beta-thalassemia major were more likely to require monthly or more frequent transfusions compared to other thalassemia types.

**Table 17: Relationship between diagnosis and blood transfusion**

| Blood transfusion | Diagnosis | | | | Chi-s | P .value |
|---|---|---|---|---|---|---|
| | Alpha-Thalassemia | B-Thalassemia | Thalassemia intermedia | B-Thalassemia major | | |
| | Row % | Row % | Row % | Row % | | |
| Never transfuse | 0% | 100% | 0% | 0% | 30.782 | 0.031 |
| Every 3 weeks | 4.8% | 66.7% | 0% | 28.6% | | |
| Every month | 8.2% | 46.5% | 6.8% | 38.5% | | |
| When necessary | 8.3% | 16.7% | 0% | 75.0% | | |
| Every 2 month | 0% | 0% | 20.0% | 80.0% | | |
| Every 3 months | 0% | 66.7% | 0% | 33.3% | | |
| once a year | 0% | 0% | 25.0% | 75.0% | | |

Regarding the age of diagnosis, there were significant differences across the thalassemia types (p=0.010). Patients with alpha-thalassemia and beta-thalassemia major were diagnosed earlier (11.1 and 15.7 months, respectively) compared to those with thalassemia intermedia (31.9 months). (Table 18).

**Table 18: Relationship between diagnosis and mean age of diagnosis (months)**

| Diagnosis | N | Mean Age of diagnosis 17±28.2 (months) | SD | F | P .value |
|---|---|---|---|---|---|
| Alpha-Thalassemia | 38 | 11.1 | 11.9 | 3.856 | 0.010 |
| B- Thalassemia | 223 | 17.0 | 30.3 | | |
| Thalassemia intermedia | 33 | 31.9 | 40.1 | | |
| B-Thalassemia major | 196 | 15.7 | 24.7 | | |

Table 19 found there was significant differences in mean serum ferritin levels based on diagnosis ($p<0.001$). Patients with alpha-thalassemia had the highest mean ferritin (6,286.6 ng/mL), followed by beta-thalassemia (5,038.9 ng/mL) and beta-thalassemia major (4,024.4 ng/mL), with thalassemia intermedia having the lowest levels (2,517.2 ng/mL).

**Table 19: Relationship between diagnosis and mean serum Ferritin.**

| Diagnosis | N | Mean of serum Ferritin 4571.2±2772.6 | SD | F | P .value |
|---|---|---|---|---|---|
| Alpha-Thalassemia | 29 | 6286.6 | 2494.6 | 13.064 | <0.001 |
| B- Thalassemia | 180 | 5038.9 | 2876.8 | | |
| Thalassemia intermedia | 25 | 2517.2 | 1928.5 | | |
| B-Thalassemia major | 151 | 4024.4 | 2492.2 | | |

Table 20 showed that there was no statistically significant association between HBV status (HBsAg positive) and patient residency, gender, age, blood group, consanguinity, sibling history, or history of sibling death.

**Table 20: Relationship between HBS Ag and demographic characteristics**

| Demographic characteristics | | HBS Ag | | Chi-s | P .value |
|---|---|---|---|---|---|
| | | Negative | Positive | | |
| | | Row % | Row % | | |
| Residency | Rural | 98.70% | 1.30% | 0.368 | 0.544 |
| | Urban | 99.20% | 0.80% | | |
| Gender | Male | 99.30% | 0.70% | 0.466 | 0.495 |
| | Female | 98.60% | 1.40% | | |
| Age | Less than 5 years | 100% | 0% | 6.963 | 0.324 |
| | 5 - 8 years | 99% | 1% | | |
| | 9 - 12 years | 98.20% | 1.80% | | |
| | 13 - 16 years | 100% | 0% | | |
| | 17- 21 years | 97.00% | 3.00% | | |
| | 22 - 25 years | 100% | 0% | | |
| | More than 25 years | 100% | 0% | | |
| Blood group | A- | 100% | 0% | 1.334 | 0.97 |
| | A+ | 99.20% | 0.80% | | |
| | AB+ | 100% | 0% | | |
| | B+ | 100% | 0% | | |
| | O- | 100% | 0% | | |
| | O+ | 98.60% | 1.40% | | |
| | B- | 100% | 0% | | |
| Consanguinity between parents | No | 98.40% | 1.60% | 0.558 | 0.455 |
| | Yes | 99.20% | 0.80% | | |
| Siblings' history | No | 99.40% | 0.60% | 1.273 | 0.259 |
| | Yes | 98.30% | 1.70% | | |
| History of sibling's death | No | 98.90% | 1.10% | 0.587 | 0.444 |
| | Yes | 100% | 0% | | |

Table 21 showed that there was no statistically significant association between HBV status (HBsAg positive) and diagnosis.

**Table 21: Relationship between HBS Ag and diagnosis**

| Diagnosis | HBS Ag | | Chi-s | P .value |
|---|---|---|---|---|
| | Negative | Positive | | |
| | Row % | Row % | | |
| Alpha-Thalassemia | 100% | 0% | 6.048 | 0.109 |
| B- Thalassemia | 97.8% | 2.2% | | |
| Thalassemia intermedia | 100% | 0% | | |
| B-Thalassemia major | 100% | 0% | | |

Table 21 showed that there was no statistically significant association between HBV status (HBsAg positive) and blood transfusion.

**Table 22: Relationship between HBS Ag and blood transfusion.**

| blood transfusion | HBS Ag | | Chi-s | P .value |
|---|---|---|---|---|
| | Negative | Positive | | |
| | Row % | Row % | | |
| Never transfuse | 100% | 0% | 3.272 | 0.774 |
| Every 3 weeks | 95.2% | 4.8% | | |
| Every month | 99.1% | 0.9% | | |
| When necessary | 100% | 0% | | |
| Every 2 month | 100% | 0% | | |
| Every 3 months | 100% | 0% | | |
| Once a year | 100% | 0% | | |

Table 23 showed that there was a significant association between HBV status and the presence of associated diseases (p<0.001). Patients who had HBV positivity suffered from splenomegaly and hepatomegaly (28.6%).

**Table 23: Relationship between HBS Ag and diagnosis**

| Operation and associated diseases | | HBS Ag | | Chi-s | P .value |
|---|---|---|---|---|---|
| | | -ve | +ve | | |
| | | Row % | Row % | | |
| Operations | No operations | 99.1% | 0.9% | 0.274 | 0.900 |
| | Cholecystectomy | 100% | 0.0% | | |
| | Splenectomy | 98.7% | 1.3% | | |
| | splenectomy – appendectomy | 100% | 0.0% | | |
| | splenectomy - cholecystectomy | 100% | 0.0% | | |
| | splenectomy – tonsillectomy | 100% | 0.0% | | |
| | Tonsillectomy | 100% | 0.0% | | |
| Associated diseases | No comorbidity | 99.3% | 0.7% | 53.678 | <0.001 |
| | Blindness | 100% | 0.0% | | |
| | diabetes mellitus | 100% | 0.0% | | |
| | gall bladder stone | 100% | 0.0% | | |
| | HCV | 100% | 0.0% | | |
| | heart disease | 100% | 0.0% | | |
| | Hepatitis* | 100% | 0.0% | | |
| | Hepatomegaly | 100% | 0.0% | | |
| | Hernia | 100% | 0.0% | | |
| | Splenomegaly | 100% | 0.0% | | |
| | splenomegaly & hepatomegaly | 71.4% | 28.6% | | |
| | splenomegaly & hepatitis | 100% | 0.0% | | |
| | splenomegaly – osteoporosis | 100% | 0.0% | | |
| | respiratory infection | 100% | 0.0% | | |
| | Paralysis | 100% | 0.0% | | |
| | hydatid cysts | 100% | 0.0% | | |
| | Osteoarthritis | 100% | 0.0% | | |
| | CVA | 100% | 0.0% | | |
| | growth delayed | 100% | 0.0% | | |
| | liver disease | 100% | 0.0% | | |
| | liver failure | 100% | 0.0% | | |
| | mental retardation | 100% | 0.0% | | |
| | Migraine | 100% | 0.0% | | |

***Total (HBV & HCV)**

No significant differences were found in mean serum ferritin levels or age at diagnosis of thalassemia and prevalence of HBV infection (Table 23).

**Table 24: Relationship between HBS Ag and mean of serum ferritin and age of diagnosis.**

| HBV Ag | | N | Mean | SD | F | P .value |
|---|---|---|---|---|---|---|
| Serum Ferritin 4571.2±2772.6 | Negative | 380 | 4575.49 | 2775.9 | 0.070 | 0.792 |
| | Positive | 5 | 4246.00 | 2781.0 | | |
| age diagnosis 17±28.2 (month) | Negative | 485 | 17.04 | 28.3 | 0.004 | 0.947 |
| | Positive | 5 | 16.20 | 13.3 | | |

Table 24 reported that like HBV, there were no statistically significant associations between HCV positivity and patient residency, gender, age, blood group, consanguinity, sibling history, or history of sibling death.

**Table 25: Relationship between HCV Ab and demographic characteristics**

| Variables | | HCV Ab | | Chi-s | P .value |
|---|---|---|---|---|---|
| | | Negative | Positive | | |
| | | Row % | Row % | | |
| Residency | Rural | 95.60% | 4.40% | 1.070 | 0.301 |
| | Urban | 97.30% | 2.70% | | |
| Gender | Male | 96.30% | 3.70% | 0.099 | 0.754 |
| | Female | 96.80% | 3.20% | | |
| Age | Less than 5 years | 100% | 0.00% | 12.193 | 0.058 |
| | 5 - 8 years | 99.00% | 1.00% | | |
| | 9 - 12 years | 96.40% | 3.60% | | |
| | 13 - 16 years | 90.40% | 9.60% | | |
| | 17- 21 years | 98.50% | 1.50% | | |
| | 22 - 25 years | 90% | 10.50% | | |
| | More than 25 years | 100% | 0.00% | | |
| Blood group | A- | 100% | 0.00% | 4.500 | 0.609 |
| | A+ | 97.70% | 2.30% | | |
| | AB+ | 92.90% | 7.10% | | |
| | B+ | 100% | 0.00% | | |
| | O- | 100% | 0.00% | | |
| | O+ | 95.40% | 4.60% | | |
| | B- | 100% | 0.00% | | |
| Consanguinity between parents | No | 96.80% | 3.20% | 0.036 | 0.849 |
| | Yes | 96.40% | 3.60% | | |
| Siblings' history | No | 97.50% | 2.50% | 2.217 | 0.136 |
| | Yes | 94.90% | 5.10% | | |
| History of sibling's death | No | 96.10% | 3.90% | 2.046 | 0.153 |
| | Yes | 100% | 0.00% | | |

Table 25 reported that like HBV, there were no statistically significant associations between HCV Ab status and diagnosis.

**Table 26: Relationship between HCV Ab and diagnosis**

| Diagnosis | HCV Ab | | Chi-s | P .value |
|---|---|---|---|---|
| | Negative | Positive | | |
| | Row % | Row % | | |
| Alpha-Thalassemia | 97.4% | 2.6% | 0.410 | 0.938 |
| B- Thalassemia | 96.0% | 4.0% | | |
| Thalassemia intermedia | 97.0% | 3.0% | | |
| B-Thalassemia major | 96.9% | 3.1% | | |

Table 26 reported that like HBV, there were no statistically significant associations between HCV Ab status and blood transfusion.

**Table 27: Relationship between HCV Ab and blood transfusion**

| Blood transfusion | HCV Ab | | Chi-s | P .value |
|---|---|---|---|---|
| | Negative | Positive | | |
| | Row % | Row % | | |
| Never transfuse | 100% | 0.0% | 2.101 | 0.910 |
| Every 3 weeks | 95.2% | 4.8% | | |
| Every month | 96.6% | 3.4% | | |
| When necessary | 100% | 0.0% | | |
| Every 2 month | 90.0% | 10.0% | | |
| Every 3 months | 100% | 0.0% | | |
| Once a year | 100% | 0.0% | | |

Table 27 there was a significant association was found between HCV status and the presence of associated diseases (p<0.001). Patients with HCV infection Had splenomegaly.

**Table 28: Relationship between HCV Ab and Operations and associated diseases**

| Operations and associated diseases | HCV Ab | | Chi-s | P .value |
|---|---|---|---|---|
| | Negative | Positive | | |
| | Row % | Row % | | |
| No operations | 96.7% | 3.3% | 0.421 | 0.999 |
| Cholecystectomy | 100% | 0.0% | | |
| Splenectomy | 96.0% | 4.0% | | |
| splenectomy – appendectomy | 100% | 0.0% | | |
| splenectomy – cholecystectomy | 100% | 0.0% | | |
| splenectomy – tonsillectomy | 100% | 0.0% | | |
| Tonsillectomy | 100% | 0.0% | | |
| No comorbidity | 97.1% | 2.9% | 73.430 | <0.001 |
| Blindness | 100% | 0.0% | | |
| diabetes mellitus | 100% | 0.0% | | |
| gall bladder stone | 100% | 0.0% | | |
| heart disease | 100% | 0.0% | | |
| Hepatitis | 100% | 0.0% | | |
| Hepatomegaly | 100% | 0.0% | | |
| Hernia | 66.7% | 33.3% | | |
| Splenomegaly | 96.6% | 3.4% | | |
| splenomegaly & hepatomegaly | 100% | 0.0% | | |
| splenomegaly & hepatitis | 0.0% | 100% | | |
| splenomegaly – osteoporosis | 100% | 0.0% | | |
| Respiratory infection | 100% | 0.0% | | |
| Paralysis | 100% | 0.0% | | |
| Renal stone | 100% | 0.0% | | |
| Osteoporosis | 100% | 0.0% | | |
| Hydatid cysts | 100% | 0.0% | | |
| Osteoarthritis | 100% | 0.0% | | |
| CVA | 100% | 0.0% | | |
| Growth delayed | 100% | 0.0% | | |
| Liver disease | 100% | 0.0% | | |
| Liver failure | 100% | 0.0% | | |
| Mental retardation | 100% | 0.0% | | |
| Migraine | 100% | 0.0% | | |

No significant differences were observed in mean serum ferritin levels or age at diagnosis of thalassemia with prevalence of HCV infection (Table 28).

**Table 29: Relationship between HCV AB and mean of serum ferritin and age of diagnosis.**

| HCV AB | | N | Mean | SD | F | P .value |
|---|---|---|---|---|---|---|
| Serum Ferritin 4571.2±2772.6 | Negative | 374 | 4542.9 | 2792.4 | 1.366 | 0.243 |
| | Positive | 11 | 5533.6 | 1813.7 | | |
| age diagnosis 17±28.2 (month) | Negative | 473 | 17.3 | 28.6 | 0.920 | 0.338 |
| | Positive | 17 | 10.6 | 13.3 | | |

# Chapter 5: Discussion

## 5.1 Discussion

Beta thalassemia is the most common genetic blood disease, affecting millions of people in both developing and developed countries including Yemen. The current study examined the prevalence and clinical characteristics of 490 thalassemia patients.

The present study showed that the mean age was 12.3 with a standard deviation of 7.34 years, and patients between 9-12 years old were the most represented age group. As well as more than half of the patients were male. These results are similar to previous study in Yemen, which reported that he majority of thalassemic children attending the YSTGBD were males (58.5%), aged 8 years or older (81.0%) [48] and in Iraq the mean age of all patients was 13.38 ±8.26 years with a range of 2 to 39 years, and the majority of them were between 10 to 19 years and < 10 years of age [47].

The current study demonstrated that the highest frequency of patient diagnosis occurred in 2015, with 47 patients diagnosed, representing 9.6% of the total patients while the lowest frequency of patient diagnosis was 2004, 2005, and 2006, each with only 1 ,8 and 6 patients diagnosed respectively, representing 0.2%, 1.6%, and 1.2% of the total patients, respectively. In addition, more than half of the patients (53.5%) were from urban areas, while 46.5% were from rural areas, more than one fifth of patients from Hajjah (22.9%), followed by Sana'a (13.9%) and Amran (13.5%), while other regions with significant patient representation included Al-Mahweet (8.6%), Dhamar (10.0%), and Taiz (6.7%). These results are in the same line with pervious study by Al-Shawia1 et al reported that the most patients origin from Hajjah (20%), Amran (16%) , Al-Mahweet (13.5%) , Sana'a (12.5%) and Ibb (11%)(16). Our results differ from a study in Iraq which reported that the patients from urban areas accounted for 27 out of 80 (33.8 %) and patients from rural areas accounted for 53 out of 80 (66.2 %) [47].

This study revealed that most patients had beta-thalassemia, including 45.5% with beta-thalassemia, 40% with beta-thalassemia major and 6.7% with thalassemia intermedia. There were also 7.8% with alpha-thalassemia. Furthermore, less than half of the patients were diagnosed during the first 6 months (40.6%) or between 7-12 months (35.7%), with smaller percentages diagnosed later. There was a statistically significant association between patient origin and diagnosis (p=0.024). Non-Yemeni patients and those from Abyan had 100% beta-thalassemia, while other regions showed varying distributions across the different thalassemia types. Patients with beta-thalassemia and

Beta-thalassemia major were more likely to require monthly or more frequent transfusions compared to other thalassemia types. Regarding the age of diagnosis, there were significant differences across the thalassemia types (p=0.010). Patients with alpha-thalassemia and beta-thalassemia major were diagnosed earlier (11.1 and 15.7 months, respectively) compared to those with thalassemia intermedia (31.9 months). However, no significant relationships were found between diagnosis and residency, gender, blood group, consanguinity, sibling history, or history of sibling death. These results agree with pervious study in Saudia Arabia showed that the prevalence of β- thalassemia trait is higher than that of sickle cell trait in the adult population of Al Majma'ah [60] , In addition , meta-analaysis study in gulf area reported that the prevalence of thalassemia among children below five years of age ranged from 0.25% to 33%, while it was 0.9% in children above five years and from 0.035% to 43.3% among adult thalassemia patients [31] . Patients with beta-thalassemia major (TM) present between 6 and 24 months of age when hemoglobin production transitions from fetal (HbF) to adult (HbA) [61] . Intermedia can present in children as young as two years of age with growth and developmental delay. Milder forms of beta-thalassemia intermedia may first be present in adults as fatigue and pallor. Beta-thalassemia intermedia can have variable degrees of physical exam findings suggestive of erythroid hyperplasia and extramedullary hematopoiesis as described for the beta-thalassemia major; however, this reactive hematopoiesis is sufficient to compensate for the anemia without requiring transfusion [62].

Our study reported that that the most common blood group among thalassemic patients was O+ (57.6%), followed by A+ (26.3%), and the least common blood groups were B- (0.8%) and A- (1.8%). Pervious study carried out by Hussein revealed that there was a significant difference in the frequency of ABO blood groups, presence of Rh factor and thalassemia that was O>B>A>AB [63] .

Regrading family history about three quarter of the patients (74.5%) did not have consanguinity between their parents, and most had 2-4 family members (46.9%), with 35.9% having a positive sibling history and 10.4% a history of sibling death. These results agreed with pervious study in Pakistan which reported that the 262 (couples) parents of β-thalassemic patients revealed 96% consanguineous marriages with 72% were first cousins, 10% were near/distant blood relatives, 14% were intra-caste [64]. In addition pervious a study in Bangladesh that demonstrated that the consanguineous marriage is

an influential factor for thalassemia disease confirmed by (15%) of the patients had the history of consanguineous marriage of their parents [65].

The majority of patients (89.6%) required blood transfusions every month, while a smaller percentage needed transfusions every 3 weeks (4.3%), with a few patients needing them, when necessary (2.4%), every 2 months (2.0%), or every 3 months (0.6%), and only 1 patient (0.2%) never requiring a blood transfusion. Serum ferritin levels ranged from 270 to 15,990 ng/mL, with a mean of 4,571.2 ng/mL and a median of 3,950 ng/mL. The study found there was significant differences in mean serum ferritin levels based on diagnosis ($p<0.001$). Patients with alpha-thalassemia had the highest mean ferritin (6,286.6 ng/mL), followed by beta-thalassemia (5,038.9 ng/mL) and beta-thalassemia major (4,024.4 ng/mL), with thalassemia intermedia having the lowest levels (2,517.2 ng/mL). In Pakistan The mean number of blood transfusion per year was 21.65 + 6.59 SD [66]. As well as in Iran the average ferritin blood level was 3179.54 ± 1621.72 (161 to 8345), The difference of average ferritin level in patients was evaluated by positive and negative hepatitis tests that showed there were no statistically significant difference [67]. The main reason for increased serum ferritin in thalassemia patients is the accumulation of iron due to repeated blood transfusions. Regular transfusions can provide a normal red blood cell count, but the transfused blood contains a substantial amount of iron, which the body cannot excrete. Over time, the excess iron accumulates in tissues, leading to organ damage and complications. Chelation therapy is an effective way to manage iron overload in these patients and reduce the risk of organ damage[68].

In the present study the prevalence of HCV was (17, 3.5%) of patients and (5 ,1%) of patients were positive for hepatitis B virus, unfortunately majority of patients (84.3%) haven't received HBV vaccine, while 10.4%% received three doses followed by one dose (2.9%) and two doses (2.4%). Furthermore, in this study there was no statistically significant association between HBV or HCV status and patient residency, gender, age, blood group, consanguinity, sibling history, or history of sibling death. Also, no significant differences were found in mean serum ferritin levels or age at diagnosis of thalassemia and prevalence of HBV or HCV infection. However, there was a significant association between HBV and HCV status and the presence of associated diseases ($p<0.001$). Patients who had HBV or HCV positive suffered from splenomegaly and hepatomegaly. Our results are consistent with previous studies in Yemen and other countries. For instance pervious study in Iraq reported that two patients out of 80 were

infected with HBV accounting for 2.5 %, while 3 patients out of 80 were infected with HCV accounting for 3.8 % [47]. In Pakistan out of total 80 patients 4(5%) patients turned out to be HBs antigen positive. Out of total 80 patients 68 patients (85%) were vaccinated against hepatitis B and 12 (15%) patients were unvaccinated. About 31(38.7%) patients were hepatitis C positive and among these 19(61.2%) patients were male and 12(38.8%) patients were female (66). In south of Iran-B andar Abbas there was 3 patients, (2.5%) positive by PCR for HBV, while HCV were positive in 18 (15.0%) patients .there were no statistically significant differences between average age difference in patients with positive and negative hepatitis tests [67]. Out of 116 beta-thalassemia major patients of East Azerbaijan province, four patients (3.4%) were HCV-Ab positive. Out of 116 patients with beta-thalassemia major, 101 patients (87.1%) were vaccinated against the hepatitis B virus [69]. These variations in the prevalence of HBV and HCV infection could be due to differences in the prevalence of these viruses in the general population, differences in vaccination rates against HBV, varying blood transfusion practices, and different methods used for screening and diagnosis of viral infections. In conclusion, the prevalence of HBV and HCV infection in thalassemia patients varies across different populations and geographic locations, and regular screening and appropriate interventions are necessary to manage the risk of viral infections in thalassemia patients.

# Chapter 6: Conclusion and Recommendations

## 6.1 Conclusion:

- In Yemen, thalassemia is more prominent in some provinces such as Hajjah followed by Sana'a, Amran and Al-Mahweet.
- Thalassaemic patients are at increased risk of developing complications such as iron overload and viral infections, including hepatitis B and C
- . The prevalence of HCV was (3.5%) and HBV (1%) among the patients.
- Furthermore, the present study found that most thalassemia patients in Yemen had not received the HBV vaccine,
- Additionally, patients with positive HBV or HCV status were observed to suffer more frequently from specific associated diseases such as splenomegaly and hepatomegaly.

## 6.2 Recommendations:

**For the General Public:**

- Attending health education campaigns to raise awareness about thalassemia,
- Doing premarital testing.

**For Healthcare Providers:**

- Attending training programs focused on safe blood transfusion practices and infection control measures.
- Attending training programs regarding the unique needs of thalassemia patients, including the prevention and management of complications.
- Periodic virus investigation for thalassemia patients.

**For Health Policy Makers:**

- Integrate thalassemia education and premarital testing awareness into broader public health initiatives to reach a wider audience.
- The national obligatory premarital examination screening program for thalassemia.
- Allocate resources and support the implementation of specialized centres for thalassemia.

- Providing hepatitis B vaccines to thalassemia patients
- Providing equipment's and devices for virus investigation, rather than rapid tests.

**For universities**

- Promotion of Premarital Testing Awareness
- Collaborative Research Initiatives: Encourage collaborative research initiatives between medical and public health faculties to study the prevalence and impact of thalassemia, iron overload, and viral infections. This can contribute to a deeper understanding of the condition and inform evidence-based healthcare practices.

## 6.3 Limitations:

- Many data were obtained but the majority were excluded due to incomplete data, in addition to missing important variables, such as vaccination and type of thalassemia.
- Lack of national related studies which were limited to one serotype of hepatitis.
- The presence of only one centre for thalassaemic patients in Sana'a (YSTGBD) for that, the study has been conducted in a small number of patients.

## References:


1. Surani C, Shah R, Sinha M. A study of prevalence of hepatitis-B and hepatitis-C infection in thalassemic patients in a tertiary care hospital, Jamnagar, Gujarat, India. Int J Curr Microbiol App Sci. 2018;7:3142–6.

2. Dumaidi K, Al-Jawabreh A, Samarah F, Rabayaa M. Prevalence of sero-molecular markers of hepatitis C and B viruses among patients with β-thalassemia major in Northern West Bank, Palestine. Can J Infect Dis Med Microbiol. 2018;2018.

3. Ladis V, Karagiorga-Lagana M, Tsatra I, Chouliaras G. Thirty-year experience in preventing haemoglobinopathies in G reece: achievements and potentials for optimisation. Eur J Haematol. 2013;90(4):313–22.

4. Kountouris P, Lederer CW, Fanis P, Feleki X, Old J, Kleanthous M. IthaGenes: an interactive database for haemoglobin variations and epidemiology. PloS One. 2014;9(7):e103020.

5. De Sanctis V, Kattamis C, Canatan D, Soliman AT, Elsedfy H, Karimi M, et al. β-thalassemia distribution in the old world: an ancient disease seen from a historical standpoint. Mediterr J Hematol Infect Dis. 2017;9(1).

6. Li H, Yan L, Shi Y, Lv D, Shang J, Bai L, et al. Hepatitis B virus infection: overview. Hepat B Virus Infect Mol Virol Antivir Drugs. 2020;1–16.

7. Liu Z, Shi O, Zhang T, Jin L, Chen X. Disease burden of viral hepatitis A, B, C and E: a systematic analysis. J Viral Hepat. 2020;27(12):1284–96.

8. Guvenir M, Arikan A. Hepatitis B virus: from diagnosis to treatment. Pol J Microbiol. 2020;69(4):391–9.

9. de Almeida NAA, de Paula VS. Occult Hepatitis B virus (HBV) infection and challenges for hepatitis elimination: A literature review. J Appl Microbiol. 2022;132(3):1616–35.

10. Tayyab M, Shahzad AH, Khan AA, Hanif F, Afzal I, Sajed AN, et al. Transfusion Associated Diseases and Complications of Blood Transfusion in Thalassaemia Patients. Eur J Med Sci. 2020;2(2):104–13.

11. Riaz M, Abbas M, Rasool G, Baig IS, Mahmood Z, Munir N, et al. Prevalence of transfusion-transmitted infections in multiple blood transfusion-dependent thalassemic patients in Asia: A systemic review. Int J Immunopathol Pharmacol. 2022;36:03946320221096909.

12. Medina C, Garcia AH, Crespo FI, Toro FI, Mayora SJ, De Sanctis JB. A Synopsis of Hepatitis C Virus Treatments and Future Perspectives (preprint). 2023;

13. El-Serag HB. Epidemiology of viral hepatitis and hepatocellular carcinoma. Gastroenterology. 2012;142(6):1264–73.

14. Farshadpour F, Taherkhani R. Prevalence and molecular evaluation of hepatitis C virus infection among multi-transfused thalassemia patients in south of Iran. Oman Med J. 2022;37(5):e427.

15. Ghaleb YA, Al-Somainy AA, Alamad MA, Al Serouri AA, Khader YS. Evaluation of blood transfusion services in public and private blood bank centers, Sana'a capital, Yemen. Inq J Health Care Organ Provis Financ. 2019;56:0046958019870943.

16. Al-Shawia Maa, Abdullah Qym. seroprevalence of hepatitis b virus among multi-transfused beta thalassemia patients attending at the yemeni society for thalassemia-Sana'a, Yemen. electron j univ aden basic appl sci. 2022;3(3):158–62.

17. Kudhari AYH, Al-Jaufy AY. Prevalence of Hepatitis B Virus among Sickle Cell Anemic Patients in Bait Al-Faqeeh, Al-Hodeidah Governorate, Yemen. Abhath J Basic Appl Sci. 2022;1(1):57–71.

18. Al-Nood H. Thalassemia trait in outpatient clinics of Sana'a City, Yemen. Hemoglobin. 2009;33(3–4):242–6.

19. Amatullah J. Frequency of Hepatitis B, C and HIV infections among transfusion-dependent Thalassemia patients in Bangladesh. 2018;

20. Hossain MS, Hasan MM, Raheem E, Islam MS, Al Mosabbir A, Petrou M, et al. Lack of knowledge and misperceptions about thalassaemia among college students in Bangladesh: a cross-sectional baseline study. Orphanet J Rare Dis. 2020;15:1–10.

21. Bajwa H, Basit H. Thalassemia. 2019; Available from: https://www.ncbi.nlm.nih.gov/books/NBK545151/

22. Murtaza M, Ahmed KA, Abbasi M, Farooq A, Shafique M, Ahmed N. Prevalence of hepatis b and c among beta thalassemia major patients at a tertiary care hospital: http://doi. org/10.46536/jpumhs/2023/13.01. 405. J Peoples Univ Med Health Sci NawabshahJPUMHS. 2023;13(1):194–9.

23. Shafique F, Ali S, Almansouri T, Van Eeden F, Shafi N, Khalid M, et al. Thalassemia, a human blood disorder. Braz J Biol. 2021;83.

24. Crisp S, Rainbow J, editors. Emergencies in Paediatrics and Neonatology [Internet]. Oxford University Press; 2013 [cited 2024 Nov 5]. Available from: https://doi.org/10.1093/med/9780199605538.001.0001

25. Tarım HŞ, Öz F. Thalassemia major and associated psychosocial problems: a narrative review. Iran J Public Health. 2022;51(1):12.

26. Billett HH. Hemoglobin and hematocrit. Clin Methods Hist Phys Lab Exam 3rd Ed. 1990;

27. Ahmed MH, Ghatge MS, Safo MK. Hemoglobin: structure, function and allostery. Vertebr Invertebr Respir Proteins Lipoproteins Body Fluid Proteins. 2020;345–82.

28. Rabaan AA, Al-Ahmed SH, Bazzi AM, Alfouzan WA, Alsuliman SA, Aldrazi FA, et al. Overview of hepatitis C infection, molecular biology, and new treatment. J Infect Public Health. 2020;13(5):773–83.

29. Zakaria M, Hassan T, Sherief L, Erhabor O. Thalassemia Syndromes: New Insights and Transfusion Modalities. BoD–Books on Demand; 2023.

30. Musallam KM, Lombard L, Kistler KD, Arregui M, Gilroy KS, Chamberlain C, et al. Epidemiology of clinically significant forms of alpha-and beta-thalassemia: A global map of evidence and gaps. Am J Hematol. 2023;98(9):1436–51.

31. Abu-Shaheen A, Heena H, Nofal A, Abdelmoety DA, Almatary A, Alsheef M, et al. Epidemiology of thalassemia in Gulf Cooperation Council countries: a systematic review. BioMed Res Int. 2020;2020.

32. Bellis G, Parant A. Beta-thalassemia in Mediterranean countries. Findings and outlook. Investig Geográficas. 2021;(in press):1–10.

33. Iqbal AM, Sajjad M. Review article on thalassemia. Medico Res Chron. 2021;8(1):42–6.

34. Brancaleoni V, Di Pierro E, Motta I, Cappellini M. Laboratory diagnosis of thalassemia. Int J Lab Hematol. 2016;38:32–40.

35. Guidi GC. Hematological Diagnostics. In: Clinical and Laboratory Medicine Textbook. Springer; 2024. p. 163–93.

36. Prasad V, Sharma D, Verma SL. Peripheral Blood Smear Examination: An Overview. Webology. 2022;19(2).

37. Munkongdee T, Chen P, Winichagoon P, Fucharoen S, Paiboonsukwong K. Update in laboratory diagnosis of thalassemia. Front Mol Biosci. 2020;7:74.

38. Sabath DE. The role of molecular diagnostic testing for hemoglobinopathies and thalassemias. Int J Lab Hematol. 2023;45:71–8.

39. Khoriaty RN, Jones M, Worden FP. Hematology Board Review: Blueprint Study Guide and Q&A. Springer Publishing Company; 2023.

40. Yadav PK, Singh AK. A review of iron overload in beta-thalassemia major, and a discussion on alternative potent iron chelation targets. Plasmatology. 2022;16:26348535221103560.

41. Kwiatkowski JL. Clinical challenges with iron chelation in beta thalassemia. Hematol Clin. 2023;37(2):379–91.

42. Mulas O, Mola B, Caocci G, La Nasa G. Conditioning regimens in patients with β-thalassemia who underwent hematopoietic stem cell transplantation: a scoping review. J Clin Med. 2022;11(4):907.

43. Abutaleb A, Kottilil S, Rosenthal E. Hepatitis C Virus. In: Viral Infections of Humans: Epidemiology and Control. Springer; 2023. p. 1–28.

44. Guntipalli P, Pakala R, Kumari Gara S, Ahmed F, Bhatnagar A, Endaya Coronel M. Worldwide prevalence, genotype distribution and management of hepatitis C. Acta Gastroenterol Belg. 2021;84(4):637–56.

45. Chaabna K, Raddad LA. The Epidemiology Of Hepatitis C Virus In Yemen: A Systematic Review And Meta-analysis. In Hamad bin Khalifa University Press (HBKU Press); 2014. p. HBPP0139.

46. Syed FN, Kashif N, Khan MR, Memon FA, Jabbar MZ, Palleti SK. Hepatitis C Virus Infection in Patients with Beta Thalassemia after Multiple Transfusions at a Tertiary Care Hospital. Pak J Med Health Sci. 2023;17(01):363–363.

47. Jallab HR, Easa Z. Prevalence of Hepatitis B and Hepatitis C Viruses in β-thalassemia Major Patient in AD-Diwanya Province, Iraq. Indian J Forensic Med Toxicol. 2020;14(1):1245–9.

48. Hudna AS, Salah AA, Almaqrami AA, Senan AF, Berman FA, Ali IM, et al. Hepatitis B and C among Multi-Transfused Pediatric Thalassemic Patients in Sana'a City, Yemen: A Single-Center Retrospective Study. Yemeni J Med Sci. 2022;16(1):7–13.

49. El Battioui F, El Malki F, Barrijal S. Strategies for the development of hepatitis B virus vaccines. In: Oncogenic Viruses. Elsevier; 2023. p. 173–89.

50. Zheng P, Dou Y, Wang Q. Immune response and treatment targets of chronic hepatitis B virus infection: innate and adaptive immunity. Front Cell Infect Microbiol. 2023;13:1206720.

51. Yurdaydin C. Acute HBV/HDV Infection. Viral Hepat Acute Hepat. 2019;67–75.

52. Li Q, Sun B, Zhuo Y, Jiang Z, Li R, Lin C, et al. Interferon and interferon-stimulated genes in HBV treatment. Front Immunol. 2022;13:1034968.

53. Mishra K, Shah A, Patel K, Ghosh K, Bharadva S. Seroprevalence of HBV, HCV and HIV-1 and correlation with molecular markers among multi-transfused thalassemia patients in Western India. Mediterr J Hematol Infect Dis. 2020;12(1).

54. Ehsan H, Wahab A, Anwer F, Iftikhar R, Yousaf MN. Prevalence of transfusion transmissible infections in beta-thalassemia major patients in Pakistan: a systematic review. Cureus. 2020;12(8).

55. Akhtar S, Nasir JA, Hinde A. The prevalence of hepatitis C virus infection in β-thalassemia patients in Pakistan: a systematic review and meta-analysis. BMC Public Health. 2020;20(1):1–9.

56. Al-Sharifi LM, Murtadha J, Shahad A, Mohammed Y, Sura J, Waleed Z, et al. Prevalence of hepatitis B and C in thalassemic patients and its relation with type of thalassemia, frequency of blood transfusion, and spleen status. Med J Babylon. 2019;16(2):108.

57. Sanaa - Wikipedia [Internet]. [cited 2023 Nov 25]. Available from: https://en.wikipedia.org/wiki/Sanaa

58. Sanaa Population 2023 [Internet]. [cited 2023 Nov 25]. Available from: https://worldpopulationreview.com/world-cities/sanaa-population

59. YSTH. Yemen Society for Thalassemia And Genetic Blood Disorders. SEO TopMaxTech.Net; [cited 2023 Nov 25]. About the Society. Available from: https://ysth.org/en/about-us-2/

60. Mir SA, Alshehri BM, Alaidarous M, Banawas SS, Dukhyil AAAB, Alturki MK. Prevalence of hemoglobinopathies (β-thalassemia and sickle cell trait) in the adult population of Al Majma'ah, Saudi Arabia. Hemoglobin. 2020;44(1):47–50.

61. Origa R. Beta-thalassemia. 2021;

62. Matta BN, Musallam KM, Maakaron JE, Koussa S, Taher AT. A killer revealed: 10-year experience with beta-thalassemia intermedia. Hematology. 2014 Jun 1;19(4):196–8.

63. Hussein MT. Study of Blood Groups and Rhesus Factor in Beta Thalassemia Patients Undergoing Blood Transfusions. Sciences. 2022;8(1):1–5.

64. Aslamkhan M, Qadeer MI, Akhtar MS, Chudhary SA, Maryam M, Ali Z, et al. cultural consanguinity as cause of β-thalassemia prevalence in population. medRxiv. 2023;2023–06.

65. Mahzabin N, Islam IA, Dey M, Jahan N, Sajib MKH, Shah MS, et al. Frequency of consanguineous marriage among the thalassaemia major patients in Bangabandhu Sheikh Mujib Medical University. Age Mean±SD. 2022;15:9–34.

66. Khalil S, Khan HS, Akhtar P. Status of hepatitis B and C in beta thalassemia major patients. J Islamabad Med Dent Coll JIMDC. 2016;5(2):71–3.

67. Allamehzadeh Z, Hamadiyan H, Izadi Raeini M, Shams S, Koolivand M. Prevalence of hepatitis B and C in thalassemia major patients in south of Iran-Bandar Abbas. 2018;

68. Shah F, Huey K, Deshpande S, Turner M, Chitnis M, Schiller E, et al. Relationship between serum ferritin and outcomes in β-thalassemia: a systematic literature review. J Clin Med. 2022;11(15):4448.

69. Mirzaei G, Shamsasenjan K, Jafari B, Bagherizadeh Y, Sadafzadeh A, Bannazadeh-Baghi H, et al. Prevalence of HBV and HCV infection in beta-thalassemia major patients of Tabriz city, Iran. New Microbes New Infect. 2021;43:100912.

# Appendix

## **Appendix I** (Ethical consent):

Republic of Yemen
Emirates International University
College of Medicine & Health Sciences

الجمهورية اليمنية
كلية الطب والعلوم الصحية
الجامعة الإماراتية الدولية

الإخوة/ الجمعية اليمنية لمرضى الثلاسيميا والدم الوراثي المحترمون

تحية طيبة وبعد

الموضوع/ السماح لطلاب الطب البشري مستوى خامس الحصول على تقارير مرضى الثلاسيميا لاستكمال بحث التخرج

تهديكم الجامعة الإماراتية الدولية أطيب تحياتها متمنية لكم دوام التوفيق والنجاح في أعمالكم.

بالإشارة إلى الموضوع أعلاه فإننا نرجو من سيادتكم التكرم بالتوجيه بما يلزم للسماح لطلاب المستوى الخامس- طب بشري- الدفعة الخامسة الحصول على تقارير مرضى الثلاسيميا لخدمة بحث تخرجهم والذي سيحصل على عنوان:

**( prevalence of hepatitis B & C virus among thalassemia patient in Sana'a Yemen 2022-2023 )**

شاكرين تعاونكم سلفا

مع فائق التقدير والاحترام

عميد كلية الطب و العلوم الصحية
أ.د. صالح الظاهري

مدير المركز الخارجي

الأخ العزيز د/ مختار اسماعيل
تحية طيبة وبعد
الإطلاع وتسهيل مهمة الطلاب حسب النظام
ولكم خالص الشكر

- مرفق لكم أسماء الطلاب

Republic of Yemen
Emirates International University
College of Medicine & Health Sciences

الجمهورية اليمنية
كلية الطب والعلوم الصحية
الجامعة الإماراتية الدولية

EMIRATES INTERNATIONAL UNIVERSITY

كشف طلاب المستوى الخامس- طب بشري- الدفعة الخامسة (جروب F )

| م | اسم الطالب |
|---|---|
| ١ | شذى عبدالمنعم الظاهري احمد الشدادي |
| ٢ | اصالة معمر عبدالله سلطان الصلوي |
| ٣ | سارة حفظ الله محمد الصراري |
| ٤ | احلام عبد الرحمن عبدالله الطاهري |
| ٥ | سلوى احمد أحمد الشرعبي |
| ٦ | سهير صالح احمد القداري |
| ٧ | ثريا ماجد نعمان عبدالمرشد |
| ٨ | ملاك بكيل علي صالح الحماتي |
| ٩ | اميمة ناظر سعيد الشوافي |
| ١٠ | نورة عادل محمد شمسان |

## Appendix II (YSTHGBD Stipulation):

Republic of Yemen
Ministry of Social Affairs & Labor
Yemen Society for Thalassemia
& Genetic Blood Disorders
Permit No. (57)

YSTH
الجمعية اليمنية لمرضى الثلاسيميا والدم الوراثي
YEMEN SOCIETY FOR THALASSEMIA
AND GENETIC BLOOD DISORDERS

الجمهورية اليمنية
وزارة الشئون الاجتماعية والعمل
الجمعية اليمنية لمرضى الثلاسيميا
والدم الوراثي
تصريح رقم (٥٧)

عضو الاتحاد العالمي للثلاسيميا
عضو الرابطة الإقليمية للثلاسيميا
A Member of Thalassaemia International Federation
A Member of Regional Association of Thalassaemia

الرقم: .....
التاريخ: / / ١٤هـ
الموافق: / / ٢٠م

### ضوابط و شروط إجراء البحوث العلمية في المركز العلاجي لمرضى الثلاسيميا والدم الوراثي

١. الالتزام بتعليمات إدارة الجمعية والمركز العلاجي ورؤوسا الأقسام المعنيين ، واحترام الكادر في الجمعية والمركز.
٢. الالتزام الكامل بنظام ولوائح الجمعية و المركز وأخلاقيات البحث العلمي المتعارف عليها والاحترام المتبادل بين الزملاء الباحثين.
٣. ان يكون الطالب/ـة حاصل/ـة على بطاقة جامعية من الجامعات المعترف بها فقط.
٤. إحضار أصل مذكرة من الجامعة/الكلية/المعهد للتعاون مع الطالب/ـة /الطلاب في تقديم التسهيلات والبيانات المطلوبة يوضح فيها المهمة البحثية والهدف منها وأسماء الطلاب.
٥. إجراء الفحص الطبي قبل الزواج Hb electrophoresis وإحضار أصل النتيجة.
٦. إحضار البرنامج الخاص بالنشاط أو البحث العلمي مع الأنشطة والإجراءات التي سيتم تنفيذها مزمنة.
٧. أن يتعهد الطالب/ـة بعدم تنفيذ أي نشاط متعلق بمرضى الثلاسيميا والدم الوراثي المسجلين في المركز العلاجي إلا بموافقة خطية من الجمعية.
٨. عدم جمع أي تبرعات باسم المرضى أو الجمعية إلا بموافقة خطية من الجمعية معمدة من الإدارة.
٩. الا يتم إغفال اسم الجمعية في البحث العلمي.
١٠. عدم استخدام البيانات المقدمة او التصوير أو المونتاج لأغراض شخصية أو لأغراض أخرى غير البحث العلمي.
١١. أن يتعهد الطالب/ـة بإحضار نسخة من البحث العلمي أو المونتاج الذي قام به بعد استكماله.
١٢. يحق للطبيب أو مدير المركز العلاجي الاطلاع على البيانات الطبية التي تم جمعها للتعديل وتصحيح الأخطاء إن وجدت.
١٣. أن يتم دعوة الجمعية عند مناقشة البحث العلمي للحضور.
١٤. يحق للجمعية مقاضاة ومساءلة أي متدرب او باحث أو فريق بحث لم يلتزم بالشروط المبينة أعلاه وأخل بها او ببعض منها.
١٥. لا يحق للباحث تصوير أي استمارات أو بيانات خاصة بالمركز إلا بموافقة خطية من إدارة الجمعية أو إدارة المركز.
١٦. في حالة تطلب البحث استخدام اجهزه أو مستلزمات طبية خاصة بالمركز يتحمل الباحث تكاليف مالية مقابل ذلك تحدد من قبل القسم المختص.
١٧. تحديد أوقات تواجد الباحثين خلال ساعات العمل مع البحث على توزيعهم بعدد مناسب في الأقسام بحسب احتياج البحث وبما لا يتسبب بحدوث ازدحام في أي قسم بالمركز العلاجي.

نحن الطلاب الموضحة بياناتنا أدناه نؤكد التزامنا بالشروط المذكورة أعلاه.

## Appendix III (Questionnaire):

| Section one: Demographic data | |
|---|---|
| **Age** | |
| **Sex** | ☐ Male<br>☐ Female |
| **Date of diagnosis** | |
| **Age of diagnosis** | |
| **Origin (province)** | |
| **Blood group** | |
| **No. of family members** | |
| **Family history** | ☐ Yes<br>☐ No |
| **history of sibling's death** | |
| **consanguinity between parents** | ☐ Yes<br>☐ No |
| **Section two: details of diseases** | |
| **Diagnosis** | ☐ Alpha-Thalassemia<br>☐ B- Thalassemia<br>☐ B- Thalassemia major<br>☐ B- Thalassemia intermedia |
| **Vaccine (HBV)** | ☐ Yes<br>☐ No |
| **Dose of vaccine** | |
| **Associated diseases** | |
| **Surgical operation** | |
| **Blood transfusion per year** | ☐ Every 3 weeks<br>☐ Monthly<br>☐ Every 2 months<br>☐ Every 3 months<br>☐ Once yearly<br>☐ when necessary<br>☐ never transfuse 0 |
| **S. Ferritin** | |
| **HBS _ Ag** | ☐ Positive<br>☐ Negative |
| **HCV _ Ab** | ☐ Positive<br>☐ Negative |

# الملخص

**المقدمة**: داء الثلاسيميا هو اضطراب جيني شائع يتطلب عمليات نقل دم منتظمة، مما يزيد من خطر الإصابة بالعدوى المنقولة بالدم مثل التهاب الكبد الوبائيB والتهاب الكبد الوبائي C. قد لا تكون طرق الفحص الحالية للمتبرعين بالدم كافية للكشف عن جميع حالات العدوى المنقولة بالدم، وهناك حاجة إلى بروتوكولات أكثر صرامة لتقليل هذه المخاطر. تعتبر طرق الفحص المحسنة وممارسات بنوك الدم ضرورية لحماية مرضى بيتا ثلاسيميا وغيرهم من المرضى المعتمدين على نقل الدم..

**الهدف من الدراسة:** تقييم معدل انتشار فيروس التهاب الكبد الوبائي بي والتهاب الكبد الوبائي سي بين مرضى الثلاسيميا في اليمن.

**منهجية الدراسة:** أجريت دراسة وصفية مقطعية مستعرضة في الجمعية اليمنية للثلاسيميا والدم الوراثي (YSTH)، صنعاء، اليمن في عام ٢٠٢٣وشملت الدراسة عدد المرضى (٤٩٠ مريضًا) ممن استوفوا معايير الادراج. تم جمع البيانات بواسطة استبانة، ثم تمت معالجتها وإدخالها في برنامج الأكسل. تم تحليل البيانات بواسطة برنامج الحزم الإحصائية للعلوم الاجتماعية الإصدار ٢٩، وتم إجراء كل من الإحصاءات الوصفية والاستدلالية مع اعتبار قيمة P ≤٠,٠٥ ذات دلالة إحصائية في جميع الاختبارات.

**النتائج**: شارك في هذه الدراسة ٤٩٠ مريضًا، بمتوسط عمر ١٢,٣ ± ٧,٣٤ سنة، كان أكثر من نصف المرضى ذكورًا، وكان أعلى معدل لتشخيص المرضى في عام ٢٠١٥. بالإضافة إلى ذلك، كان أكثر من نصف المرضى (٥٣,٥٪) من المناطق الحضرية، وأكثر من خمس المرضى من محافظة حجة (٢٢,٩٪)، يليها صنعاء (١٣,٩٪) وعمران (١٣,٥٪). وأظهرت هذه الدراسة أن معظم المرضى ٤٥,٥٪ مصابون ببيتا ثلاسيميا، و ٤٠٪ مصابون ببيتا ثلاسيميا الرئيسية. وكان معدل انتشار فيروس التهاب الكبد الوبائي سي (٣,٥٪) وفيروس التهاب الكبد الوبائي بي (١٪) بين المرضى، وللأسف لم يتلق غالبية المرضى (٨٤,٣٪) لقاح التهاب الكبد الوبائي بي. علاوة على ذلك، لم يكن هناك ارتباط ذو دلالة إحصائية بين حالة فيروس التهاب الكبد الوبائي بي أو فيروس التهاب الكبد الوبائي سي والبيانات الديموغرافية.

**الخلاصة:** يزداد معدل انتشار الثلاسيميا بشكل ملحوظ في محافظة حجة، يليها صنعاء وعمران. بين المرضى، كان معدل انتشار فيروس التهاب الكبد الوبائي سي ٣,٥ ٪ وفيروس التهاب الكبد الوبائي بي ١ ٪. من الضروري تثقيف السكان حول فحوصات ما قبل الزواج وأهمية التطعيم. بالإضافة إلى ذلك، تعد الدورات التدريبية الشاملة حول نقل الدم ومكافحة العدوى ضرورية للعاملين في مجال الرعاية الصحية لضمان رعاية آمنة وفعالة مع تقليل خطر انتقال العدوى.

**الجمهورية اليمنية**

**وزارة التعليم العالي والبحث العلمي**

**الجامعة الإماراتية الدولية**

**كلية الطب والعلوم الصحية**

**قسم طب المجتمع**

# انتشار فيروسات التهاب الكبد بي وسي بين مرضى الثلاسيميا في اليمن ٢٠٢٣

بحث مقدم إلى قسم طب المجتمع كلية الطب والعلوم الصحية الجامعة الإماراتية الدولية كمتطلب للحصول على درجة البكالوريوس في الطب والجراحة العامة

**الباحثون**

شذى عبد المنعم الظاهري الشدادي

سارة حفظ الله محمد الصراري

سلوى أحمد أحمد الشرعبي

ثريا ماجد نعمان مرشد

أميمة ناظر سعيد الشوافي

أصالة معمر عبد الله الصلوي

أحلام عبد الرحمن عبد الله الطاهري

ملاك بكيل علي الحماني

سهير صالح احمد القداري

نورة عادل محمد شمسان

**اشراف**

د/ نورا أحمد العواضي

كلية الطب والعلوم الصحية

**جامعة صنعاء**

**١٤٤٤-١٤٤٥هـ**