International Journal of Science and Research Archive

eISSN: 2582-8185

Cross Ref DOI: 10.30574/ijsra

Journal homepage: https://ijsra.net/

(RESEARCH ARTICLE)

Check for updates

Clinical pathology study of physiological serum ferritin and lipid profile in thalassemia patients

Abdul-Samad Uleiwi Hassan *

Department of Medical Laboratory Techniques, College of Health and Medical Techniques, Al-Furat Al-Awsat Technical University, Kufa, Iraq.

International Journal of Science and Research Archive, 2025, 15(03), 562-568

Publication history: Received on 29 April 2025; revised on 04 June 2025; accepted on 06 June 2025

Article DOI: https://doi.org/10.30574/ijsra.2025.15.3.1727

Abstract

Background: Beta-thalassemia is a genetic disorder that frequently necessitates regular blood transfusions, resulting in iron overload, typically evidenced by elevated serum ferritin levels. These lipid abnormalities may contribute to the pathogenesis of certain clinical manifestations associated with thalassemia.

Methods: The study reported 30 cases of thalassemia in Mesopotamia. Examinations were conducted at the College of Health and Medical Techniques in Kufa. The evaluation of samples involves quantifying serum triglycerides (TG) using a colorimetric technique for in vitro diagnostic assessment with a specialized kit, according to the manufacturer's specified standards.

Results: In the patient cohort, ferritin levels were significantly elevated compared to those in the control group, indicating notable iron accumulation. Furthermore, the data revealed statistically significant differences in age, weight, and sex. The experimental group exhibited a mean ferritin level of 180.47 ± 16.364, in contrast to 125.70 ± 15.257 in the control group. Additionally, cholesterol levels were lower in the patient group, with a mean of 81.37 ± 6.289, compared with 96.87 ± 3.071 in the control group. These findings suggest that total cholesterol and serum triglyceride levels may play a role in the pathogenesis of cardiac and renal diseases, potentially providing novel therapeutic targets for the management of cardiovascular conditions.

Conclusion: Summary of the main conclusions drawn from the study, including the potential risks for thalassemia patients and the need for further research. While these elements are present throughout the paper, they are not condensed into a single abstract section at the beginning of the document.

Keywords: Thalassemia; Ferritin; Triglycerides; Cholesterol

1. Introduction

Thalassemia is an association of hereditary hematological illnesses resulting from abnormalities in the production of one or more hemoglobin chains(1) . The Greek terms haima (blood) and thalassa (sea) are the origin of the name thalassemia. Faulty alpha and beta globins cause the widespread symptoms found in many hemoglobin diseases, along with issues like abnormal hemoglobin, misshapen red blood cells, and weak red blood cells(2). In addition to nations along the northern coast of Africa and South America, thalassemia is prevalent throughout the Mediterranean, Middle East, Central Asia, India, southern China, and the Far East. Cyprus (14%), Sardinia (10.3%), and Southeast Asia exhibit the highest prevalence rates of the condition. The elevated prevalence of the thalassemia gene in these regions is probably associated with selection pressure from Plasmodium falciparum malaria(3).

* Corresponding author: Abdul-Samad Uleiwi Hassan.

There are two forms of thalassemia. Alpha thalassemia is distinguished by a lack of hemoglobin's alpha globin chains. Beta thalassemia is a genetic form of anemia caused by problems in making beta-globin chains, leading to lower beta chain production in hemoglobin(4).

The alpha type is divided into three categories: "silent" alpha thalassemia, which happens when a mutation affects one gene on a single chromosome and leads to mild anemia; alpha thalassemia trait, which involves two genes; and HbH disease, found in individuals with two copies of the gene that causes moderate to severe hemolytic anemia because of the buildup of β-like globin chains that create non-working beta chain groups called HbH (β4 tetramers) in adults. The most severe form of alpha thalassemia in a fetus is HbBart's (γ4 tetramers), known as hydrops, where the alpha genes are not active. The fetus's HbBart's (γ4 tetramers) is the most severe kind of alpha thalassemia, known as hydrops, a disorder in which the alpha genes are not expressed(5).

There are three types of beta thalassemia: intermedia beta thalassemia, beta-thalassemia minor, and beta-thalassemia major, which happens because the body absorbs too much iron due to not making enough red blood cells. Ferritin facilitates the availability of iron for essential cellular functions while safeguarding lipids, DNA, and proteins from the potentially deleterious effects of iron. Ferritin is found in every type of cell (6).

To diagnose thalassemia, doctors check the patient's health and family history, perform a complete blood count (CBC) and hemoglobin level tests, examine a blood sample under a microscope, conduct hemoglobin electrophoresis or high-performance liquid chromatography (HPLC), carry out genetic testing with DNA analysis, and perform iron tests(7). The aim of this study is for the assessment of serum ferritin, cholesterol, and triglycerides in patients with thalassemia in Iraq.

Objective

The evaluation of lipid levels (cholesterol and triglyceride) in patients with β thalassemia major (TM) and their relationship with serum ferritin.

2. Materials and methods

The study included 30 Iraqi patients diagnosed with β-thalassemia major, with ages spanning from 2 to 24 years. These participants were enrolled at two healthcare facilities: the Thalassemia Center in Najaf and Al-Rumaitha General Hospital in Muthanna Governorate. The β-thalassemia major diagnosis for each patient was verified through multiple means, including documentation in medical records, assessment of clinical manifestations, evaluation of hematological data, and analysis using hemoglobin electrophoresis. As part of their ongoing treatment protocol, all patients in the study were undergoing routine blood transfusions.

Five milliliters of venous blood were collected from both the patients and the control group. The samples were drawn into gel tubes for serum separation. The blood was allowed to clot at room temperature for approximately 30 minutes, then centrifuged at 3000 rpm for 5 minutes. The resulting serum was transferred into sterile Eppendorf tubes and stored at −20 °C until analysis. Serum triglyceride (TG) levels were measured using a color test for lab analysis, following the instructions from the maker of the specific test kit(8). A further examination involves the quantification of total blood cholesterol by the colorimetric approach for in vitro diagnostic assessment utilizing a kit. We conducted the cholesterol measurement process according to the specifications provided by the manufacturer. We conducted the most recent ferritin (CLIA) process according to the manufacturer's specified criteria(9).

Statistical analysis was performed using the SPSS software program, which is commonly used in healthcare research for data analysis. SPSS enables users to conduct various statistical analyses, including descriptive statistics, regression analysis, and factor analysis, facilitating a deeper understanding of how social factors influence health outcomes. The following tutorial outlines the steps for creating a new dataset, defining variables, entering data, and saving it(10).

3. Results and discussion

Table 1 Cases statistical analysis and linked factors for ferritin in thalassemia patients

Group Statistics							
Ferritin	**patient and normal**	**N**	**Mean**	**Std. Deviation**	**Std. Error Mean**	**p-value**	**t-test**
	normal	30	57.13	30.487	5.566	0.000	16.901
	patient	30	1211.33	372.801	68.064		

The results indicate that ferritin overload in these patients is primarily due to frequent blood transfusions and rapid hemolysis. Chronic transfusion therapy leads to excessive ferritin accumulation, which can cause a wide range of complications, including damage to the heart, liver, and endocrine glands(11). Hyperferritinemia is defined by serum ferritin levels exceeding the upper reference limit, which varies based on age, gender, and laboratory methodology. Individuals of East Asian ancestry may exhibit ferritin levels 1.5 to 2 times higher than the established reference ranges. However, elevated ferritin levels alone do not necessarily indicate iron overload. Refer to Table 1 and Figure 1 for further details.

It's clear that ferritin levels were significantly higher in the patient group compared to the control group (p 0.000), and this indicates a significant accumulation of iron in their bodies. low ferritin levels in females may result from various factors, including iron-deficiency anemia, menstrual blood loss, pregnancy, gastrointestinal disorders, and a vegetarian or vegan diet. Less common causes include chronic inflammatory diseases, kidney disease, certain cancers, genetic disorders affecting iron metabolism, and frequent blood donations(12).

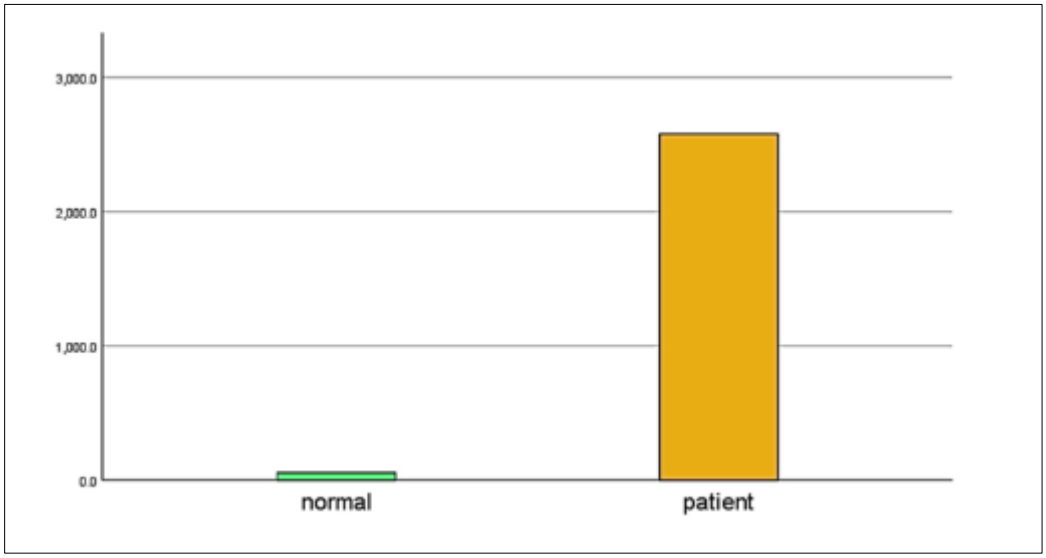

Figure 1 Ferritin levels in thalassemia patients, comparing normal and elevated values

Ferritin levels were also noticeably higher in older and overweight individuals. These findings suggest variations in iron levels among individuals with thalassemia, which may have implications for disease prognosis and treatment responsiveness(12).

Both Table 2 and Figure 2 demonstrate a significant disparity in lipid profiles between the patient and control groups. Triglyceride levels were notably higher in patients compared to controls. This alteration is likely due to reduced hepatic biosynthesis associated with anemia and iron overload, while impaired extrahepatic lipolytic activity may also contribute to the elevated circulating triglyceride levels(13).

Table 2 presents the findings of the statistical analysis and the factors associated with triglyceride levels in thalassemia patients

Group Statistics							
	Sex	**N**	**Mean**	**Std. Deviation**	**Std. Error Mean**	**p-value**	**t-test**
Ferritin	male	14	78.657	15.5056	4.1440	0.000	4.977
	female	16	38.294	27.8855	6.9714		

Lipid abnormalities have been observed in beta-thalassemia as well as in several other hematological disorders. The study revealed that the prevalence of HCV infection among children with thalassemia was significantly higher than in the control group, consistent with findings from several other studies(14). due to iron overload and the risk of hepatitis B and C infections, Blood transfusion is the primary risk factor for viral hepatitis transmission in individuals with hematological disorders(14).

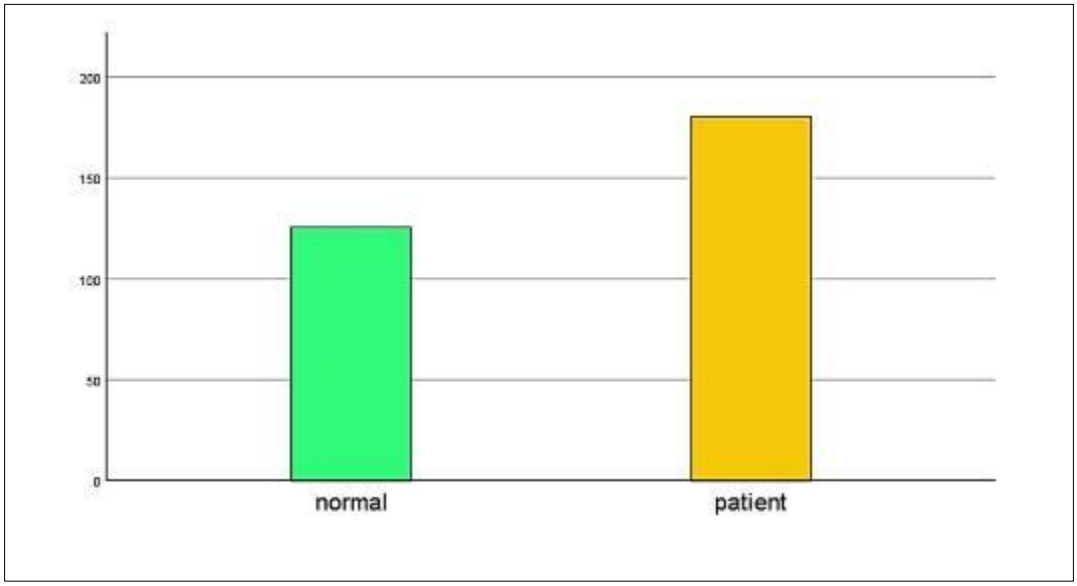

Figure 2 The triglyceride levels in thalassemia patients, comparing normal and abnormal samples

Several studies have yielded inconsistent findings regarding lipid profiles in children with thalassemia. Some investigations, such as those conducted by Tantawy et al. and Dwivedi and Kumar, have identified atherogenic profiles, whereas other studies have reported antiatherogenic profiles in thalassemic children studied(15).The present study's findings indicate that thalassemic children exhibit significantly lower levels of total serum cholesterol, LDL-C, and HDL-C, along with elevated serum triglycerides, compared to the control group. These results align with the findings reported by the aforementioned authors. The pathogenesis of these lipid abnormalities is attributed to multiple mechanisms, including plasma dilution due to anemia, accelerated erythropoiesis leading to increased cholesterol uptake by macrophages and histiocytosis of the reticuloendothelial system, impaired liver function resulting from iron overload, activation of the macrophage system with cytokine release, and hormonal disturbances(15).

The atherogenic ratio, specifically the LDL-C/HDL-C ratio, was significantly lower in both thalassemia groups than in the control group, corroborating the findings of a previous study 17. Previous studies have established that low HDL-C levels are associated with an increased risk of myocardial infarction. Patients with thalassemia exhibit a substantially higher coronary risk than their matched controls due to reduced HDL-C production, despite normal total cholesterol levels. Our findings indicated that serum triglyceride levels were significantly elevated in children with thalassemia intermedia (TI) compared to those with thalassemia major (TM). This result contrasts with the findings of a previous study (16). which reported no significant difference in lipid profiles between TM and TI. Rosnah et al(17) identified lower levels of total cholesterol (TC) and LDL-C in TI compared to TM.

The present study demonstrated a significant positive correlation between serum total cholesterol and both serum triglyceride and LDL-C levels. Rund and Rachmilewitz (18)fidentified a strong positive correlation between serum LDL-

C and total cholesterol levels in children with thalassemia. This finding suggests that anemia in patients with thalassemia may predispose them to reduced extrahepatic lipolysis activity, leading to elevated serum triglyceride levels.

The findings of the present study are consistent with those of previous studies regarding the altered serum lipid profile observed in patients with β-thalassemia major(19). Refer to Table 3 and Figure 3 provide further details.

Table 3 Illustrates the statistical analysis results and its correlates variables for cholesterol in thalassemia cases

Group Statistics							
Ferritin	**Wight group**	**N**	**Mean**	**Std. Deviation**	**Std. Error Mean**	**P-value**	**T -test**
	<=35kg	15	996.40	263.030	67.914	0.001	3.831
	>35kg	15	1426.27	345.993	89.335		

Children diagnosed with beta-thalassemia major may exhibit an elevated risk of cardiovascular thrombotic disease and thrombotic complications affecting other organs. Patients with beta-thalassemia major often present with hypertriglyceridemia and hypolipidemia. Early identification of patients with abnormal lipid profiles is essential to prevent thrombotic and atherogenic complications(20).

Hypolipidemia, when not linked to a genetic disease affecting cholesterol metabolism, is a persistent clinical characteristic in patients with significant thalassemia. The pathogenesis of hypolipidemia in severe thalassemia requires further elucidation through research on cholesterol metabolism and balance. Hypolipidemia, likely

associated with heightened erythropoietic activity, is most common in individuals with thalassemia intermedia, where it may indicate disease severity. However, it did not correlate with age, sex, hepatic damage, hemoglobin concentrations, or iron overload. Significantly, these reduced cholesterol levels do not safeguard patients with thalassemia against atherosclerosis, owing to the documented role of iron buildup in facilitating atherogenesis. In this scenario, iron chelation treatment may be an effective approach for mitigating the risk of atherosclerosis(21).

In thalassemia patients, low cholesterol levels appear to indicate an organism's inability to meet the heightened cholesterol demands for red cell membrane formation. Consequently, the availability of cholesterol, typically utilized in steroid hormone synthesis for infection control and hypercoagulability management, may be partially diminished(22).

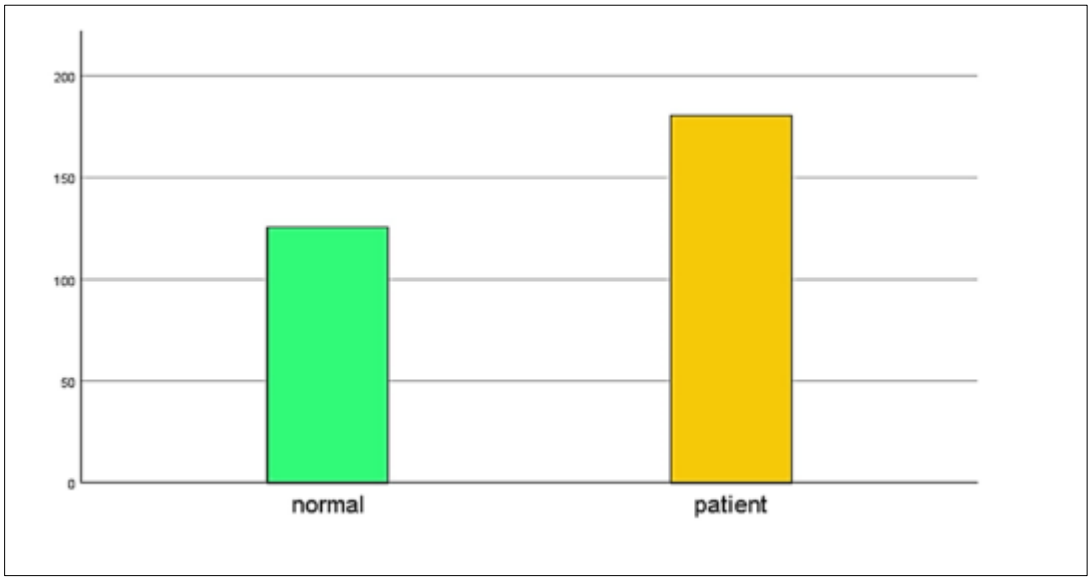

Figure 3 The cholesterol levels in thalassemia patients, comparing normal and abnormal samples

4. Conclusion

The study suggests that thalassemia major patients may be at a higher risk for iron overload, toxic effects, and deferoxamine complications. However, hypolipidemia in thalassemia remains unclear. Two main pathogenic mechanisms are the increased cholesterol consumption required for cell membrane formation and the hyperplastic and overactive reticuloendothelial system, which may increase LDL uptake. We need to conduct further research to ascertain whether hypolipidemia exacerbates thalassemia complications and whether we can recommend cholesterol supplementation for managing thalassemia intermedia.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

References

[1] Alidoost F, Gharagozloo M, Bagherpour B, Jafarian A, Sajjadi SE, Hourfar H, et al. Effects of silymarin on the proliferation and glutathione levels of peripheral blood mononuclear cells from β-thalassemia major patients. Int Immunopharmacol. 2006;6(8):1305–10.

[2] Al-Quobaili FA, Abou Asali IE. Serum levels of lipids and lipoproteins in Syrian patients with beta-thalassemia major. Saudi Med J. 2004;25(7):871–5.

[3] Andrews PA. Disorders of iron metabolism. N Engl J Med. 2000;342(17):1293–4.

[4] Sodia TZ, David AA, Chesney AP, Perri JN, Gutierrez GE, Nepple CM, et al. Nanoparticle-based liquid–liquid extraction for the determination of metal ions. ACS sensors. 2021;6(12):4408–16.

[5] Basu D, Adhya DG, Sinha R, Chakravorty N. Role of malonaldehyde as a surrogate biomarker for iron overload in the β-thalassemia patient: A systematic meta-analysis. Adv Redox Res. 2021;3:100017.

[6] Kocienski PJ. Protecting Groups, 2005. Georg Thieme Verlag; 2014.

[7] Bruzzese A, Martino EA, Mendicino F, Lucia E, Olivito V, Bova C, et al. Iron chelation therapy. Eur J Haematol. 2023;110(5):490–7.

[8] England JM, Fraser P. Differentiation of iron deficiency from thalassaemia trait by routine blood-count. Lancet. 1973;301(7801):449–52.

[9] Ganz T, Nemeth E. Pathogenic mechanisms in thalassemia II: iron overload. Hematol Clin. 2023;37(2):353–63.

[10] Jobanputra M, Paramore C, Laird SG, McGahan M, Telfer P. Co-morbidities and mortality associated with transfusion-dependent beta-thalassaemia in patients in England: a 10-year retrospective cohort analysis. Br J Haematol. 2020;191(5):897–905.

[11] Koohi F, Kazemi T, Miri-Moghaddam E. Cardiac complications and iron overload in beta thalassemia major patients—a systematic review and meta-analysis. Ann Hematol. 2019;98:1323–31.

[12] McDougall KE, Stewart AJ, Argiriou AM, Huggins CE, New PW. Comparison of three methods for measuring height in rehabilitation inpatients and the impact on body mass index classification: An open prospective study. Nutr Diet. 2018;75(1):123–8.

[13] Mettananda S, Fisher CA, Hay D, Badat M, Quek L, Clark K, et al. Editing an α-globin enhancer in primary human hematopoietic stem cells as a treatment for β-thalassemia. Nat Commun. 2017;8(1):424.

[14] Olivieri NF, Koren G, Harris J, Khattak S, Freedman MH, Templeton DM, et al. Growth failure and bony changes induced by deferoxamine. J Pediatr Hematol Oncol. 1992;14(1):48–56.

[15] Paul A, Thomson VS, Refaat M, Al-Rawahi B, Taher A, Nadar SK. Cardiac involvement in beta-thalassaemia: current treatment strategies. Postgrad Med. 2019;131(4):261–7.

[16] How I. treat thalassemia. Rachmilewitz EA, Giardina PJ. Blood. 2011; 118:3479–88.

[17] Rosnah B, Rosline H, Zaidah AW, Noor Haslina MN, Marini R, Shafini MY, et al. Detection of Common Deletional Alpha-Thalassemia Spectrum by Molecular Technique in Kelantan, Northeastern Malaysia. Int Sch Res Not. 2012;2012(1):462969.

[18] Rund D, Rachmilewitz E. β-Thalassemia. N Engl J Med. 2005;353(11):1135–46.

[19] Salih KM, Al-Mosawy WF. Evaluation some consequences of thalassemia major in splenectomized and non-splenectomized Iraqi patients. Int J Pharm Pharm Sci. 2013;5(Suppl 4):358–85.

[20] Stephens AD, Colah R, Fucharoen S, Hoyer J, Keren D, McFarlane A, et al. ICSH recommendations for assessing automated high-performance liquid chromatography and capillary electrophoresis equipment for the quantitation of HbA2. Int J Lab Hematol. 2015;37(5):577–82.

[21] Taher A, Vichinsky E, Musallam K, Cappellini M-D, Viprakasit V. Guidelines for the management of non transfusion dependent thalassaemia (NTDT). 2014;

[22] Mohamed SOO, Mohamed AEA, Salih MSK, Salih KSK, Abdelrahman ASEE, Abdelgadir AGA, et al. Serum lipid profile abnormalities among beta-thalassemia patients: a systematic review and meta-analysis. Lipids Health Dis. 2024;23(1):388.