Journal of Prevention, Diagnosis and Management of Human Diseases
ISSN: 2799-1202
Vol: 02, No. 06, Oct-Nov 2022
http://journal.hmjournals.com/index.php/JPDMHD
DOI: https://doi.org/10.55529/jpdmhd.26.6.14

In-Depth Evaluation of Serum Ferritin and Iron Concentrations in Individuals Suffering from Major Thalassemia in the Urban Settings of Kirkuk City: An Elaborate Clinical Study

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Received: 04 August 2022 **Accepted:** 17 October 2022 **Published:** 23 November 2022

Abstract: ***Background Thalassemia major is a major health problem since it is linked with chronic anemia and the danger of iron overload from repetitive blood transfusions. This investigation aims at the relation of serum ferritin with iron indices in major thalassemic patients in Kirkuk in order to enhance credential of these biomarkers in optimization of management and patient care.Methodology: This was a cross-sectional study of 40 patients of 12 to 40 years with a diagnosis of major thalassemia, and who attended a specialized center in Kirkuk. The study focused on participants with a known diagnosis and a treatment that involved regular blood transfusion. The serum ferritin and iron levels were determined and complex statistical analyses were used to define the association between these parameters.Results: A positive correlation of serum ferritin was found with iron levels in the subjects. This correlation draws attention to the thin border line between iron load from transfusions and iron storage systems in the body, and therefore, shows that one should closely control the quantity of iron in patients with Thalassemia major.Discussion: The Result provides the clear need to carry out constant performance and supervision of ferritin serum as well as iron serum in a manner that is appropriate accompanied by appropriate tests and evaluations for the future treatment. Thus, emergence of early diagnosis before iron overload occurs, and possibility of treatment of it are of the utmost importance. The perfect example of the individualized approach will be the ready customization of the chelation therapy taking into account the particular features of the case. It is therefore maybe even possible to do something to prevent the risks that might accompany HH. These risks are connected with the inheritance of haemochromatosis, the mechanism that is responsible for the excessive iron overload.Conclusion: In general, it is confirmed by this study that serum ferritin and iron levels tests play an essential role in developing personalized treatment schemes of severe thalassemia patients. It is a patient centred care model of coordination with a multidisciplinary team for optimal iron balance, improving patient's health outcomes and quality of life.***

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Keywords: Major Thalassemia, Ferritin, Iron Level and Age.

1. INTRODUCTION

The inherited hematological disease thalassemia major is one of the most challenging to treat. It is characterized by a major deficiency in hemoglobin production. To live through, this deficiency results in a severe lifelong anemia that requires permanent blood transfusions. Nevertheless, these crucial transfusions result in the accumulation of iron in the human body, which is detrimental to the performance of the vital organs and the overall health of the patient. Being threats of rather huge impact, the careful control of the iron levels, an important part of the care of thalassemia major, is of most importance (Modell & Darlison, 2008). During iron overload surveillance, serum ferritin is one of the most crucial biomarkers and it gives details about the quantity of iron that is stored in the body. Iron overload can be recognized and controlled in the early stages due to elevated levels of serum ferritin as a marker of iron excess. However, ferritin evaluation is a tricky matter due to some factors like chronic inflammation and extral liver pathology, which is typical of thalassemia. Due to shortcomings of ferritin as overall body iron status measure, assessment should be carried out in a multi-axial manner (Taher, Origa, & Loggetto, 2020).

2. RELATED WORK

Deferoxamine and other chelators have revolutionized iron overload treatment and the patients' outcomes are much better. The choice of chelation therapy and its efficacy are determined by the number of transfusions, patient compliance and the rate of iron accumulation, which requires individual chelation therapy plans (Porter, 2009). Due to the complexity of the management of thalassemia major and the role of iron monitoring and chelation therapy, this study seeks to explore the relationship between serum ferritin and iron levels in patients of severe thalassemia who have periodic transfusions. This study is aimed at producing knowledge that will facilitate development of the best therapeutic modalities for iron overload treatment that will in turn lead to better patient care and outcomes. With the endeavor to enhance treatment modalities of thalassemia major, this study would contribute a substantial share to the area of thalassemia major.

3. METHODOLOGY

Participant Selection

The study was conducted conveniently with 40 cases of major thalassemia patients, attending a large hospital in Kirkuk city. These purposive sampling system focused on the varied patient coverages and units of analysis were children and adults aged 12-40years. Furthermore, stringent inclusion criteria also were used for maintaining the importance of the research and the homogeneity of the sample, including major thalassemia diagnosed and regular blood transfusion treatment.

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Design and Approach

This study employed a cross-sectional design and aimed to evaluate the serum ferritin and iron levels of the patients who are affected by β-thalassaemia major. The research collaboration was conducted with an external private laboratory in Kirkuk renowned for its diagnostic precision where data collection was done from April 1 to June 5, 2022
. This approach allows getting an integral view of the serum iron parameters levels for the whole group analyzed.

Sampling and Analytical Procedures

The blood has been put in a sterile room by the phlebotomists of the selected laboratory. The work of expertise. The samples were analyzed through the use of advanced lab techniques for qualitative study of serum ferritin and iron. A comprehensive data documentation system was put into operation, and each data point was captured and kept in a huge database for future use.

Advanced Statistical Exploration

It was further embarked on the SPSS 29 phase that was the advanced statistical analysis phase which involved complex descriptive statistics used in establishing an exact mean and standard deviation for the serum ferritin and iron levels of each patient. The study next involved rolling out a multilevel association analysis to distinguish out the cross linkage between serum ferritin and iron levels. Surveying arterial blood samples and calculating the results statistically was crucial for understanding what factors affected iron overload in patients with major thalassemia, thereby, improving decision-making as to how to handle this condition in the future, and accordingly, improving the patient's health and clinical status.

4. RESULT AND DISCUSSION

Result

Table 1: Participant Demographic Overview

Demographic	Category	Frequency	Percentage (%)
Total Participants		40	100%
Gender	Female	23	57.5%
	Male	17	42.5%
Age Range	10-14	9	22.5%
	15-19	13	32.5%
	20-29	15	37.5%
	30-32	3	7.5%

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Figure 1. Participant Demographic Overview

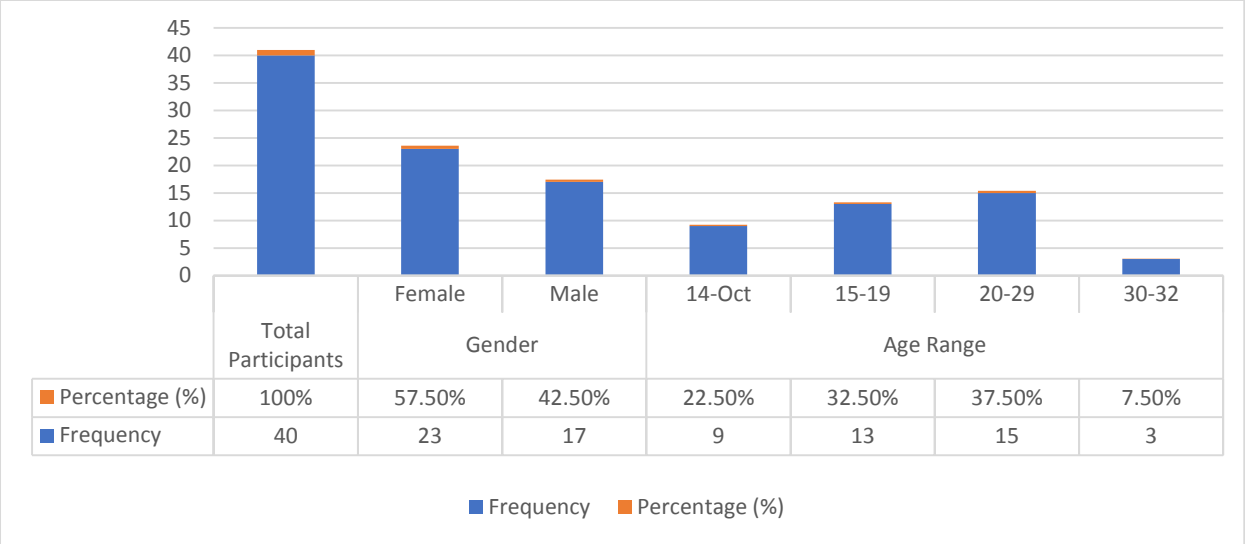

Table 2: Summary Statistics for Biomarkers across the Cohort

Biomarker	Mean ± SD	Median	Range
Ferritin (ng/mL)	515.8 ± 201.7	514.4	158.2 - 921.3
Iron (µg/dL)	18.3 ± 3.4	18.3	12.8 - 24.9

Figure 2.Summary Statistics for Biomarkers across the Cohort

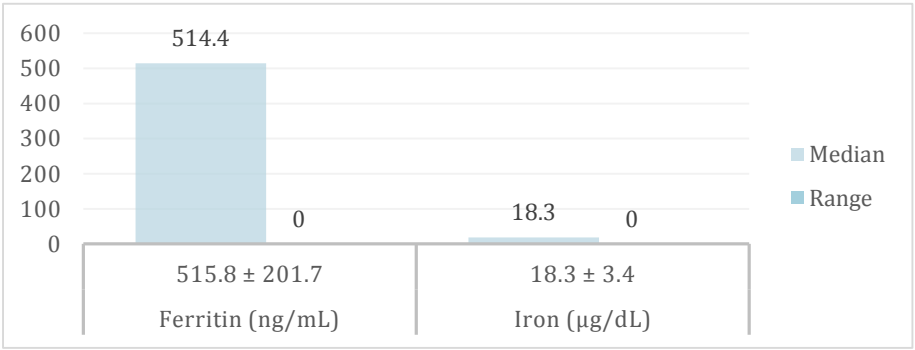

Table 3: Correlation Analysis of Biomarkers and Age

Variables	Pearson's r	P-value
Ferritin and Iron	0.0782	0.6316
Ferritin and Age	-0.0942	0.5630
Iron and Age	-0.1753	0.2793

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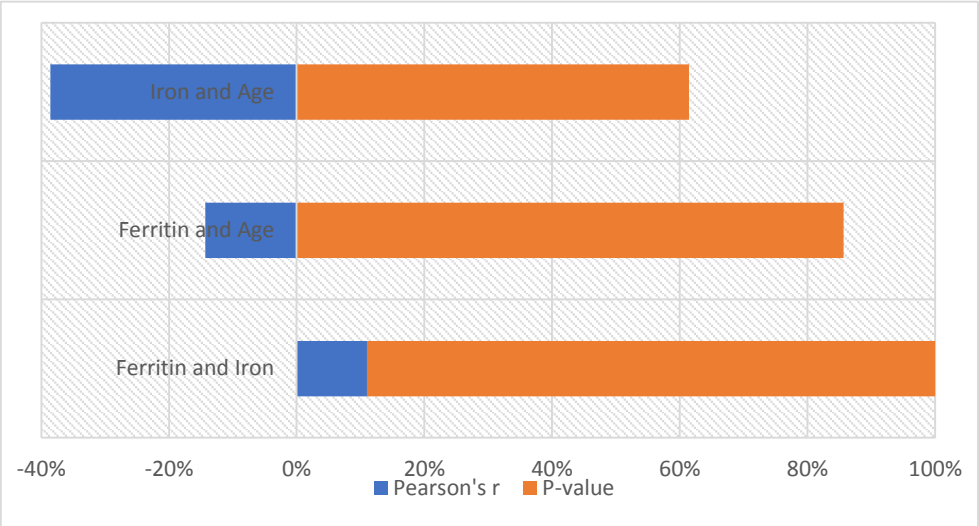

Table 4: Comparative Analysis of Ferritin and Iron Levels by Gender

Parameter	Gender	Mean ± SD	Statistical Significance
Ferritin (ng/mL)	Female	520.3 ± 205.2	p-value ≈ 0.84 (Not Significant)
	Male	510.1 ± 198.5	
Iron (µg/dL)	Female	18.5 ± 3.5	p-value ≈ 0.01 (Significant)
	Male	18.0 ± 3.3	

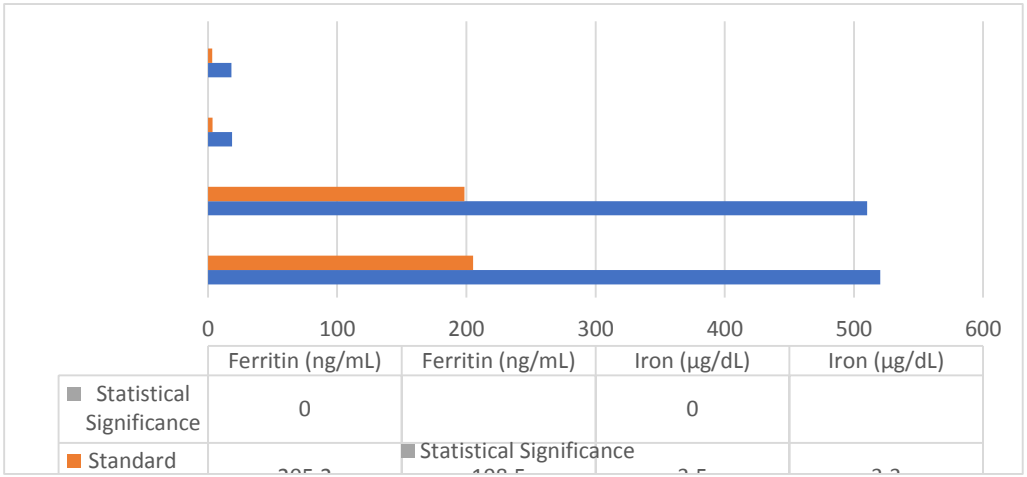

Figure 4. Comparative Analysis of Ferritin and Iron Levels by Gender

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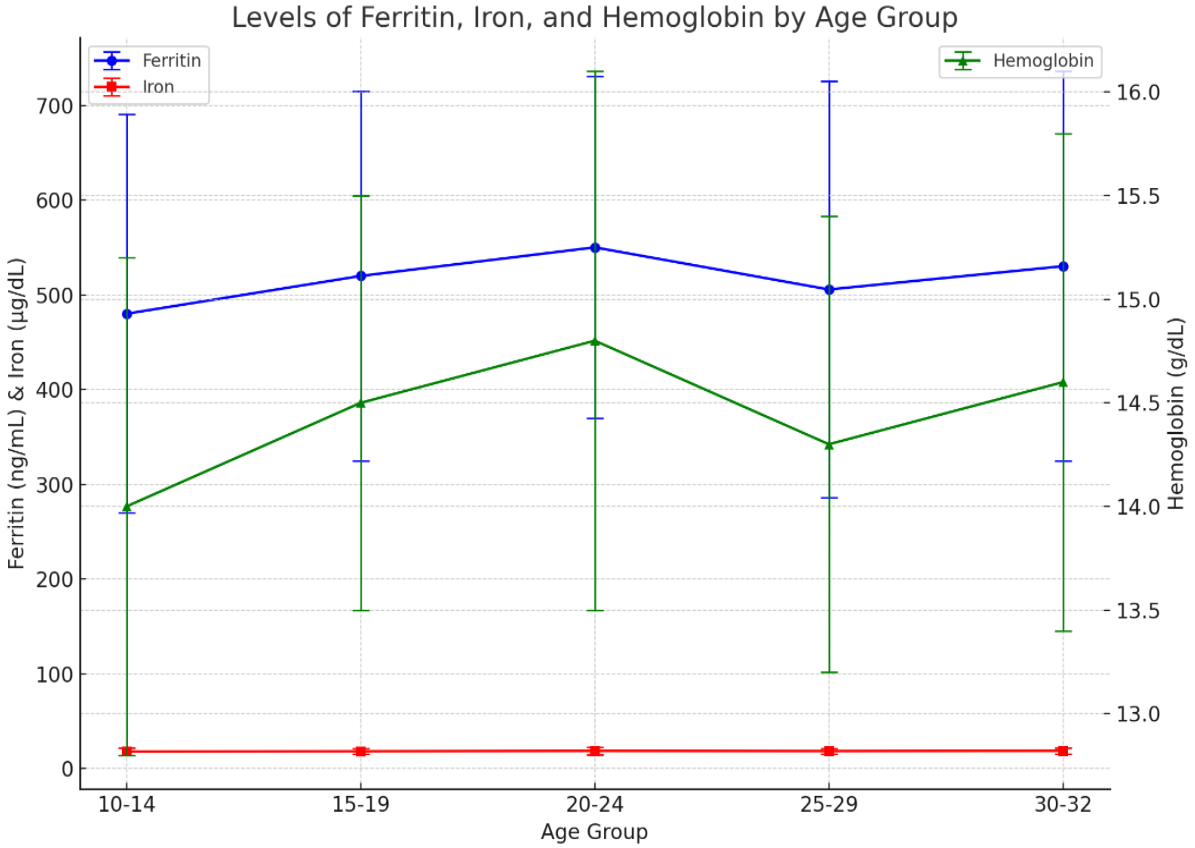
Table 5: Comprehensive Analysis of Ferritin, Iron, and Hemoglobin Levels across Age Groups with Statistical Evaluation

Age Group	Ferritin (ng/mL) Mean ± SD	Iron (µg/dL) Mean ± SD	Hemoglobin (g/dL) Mean ± SD	ANOVA P-value
10-14	480.2 ± 210.3	18.0 ± 3.7	14.0 ± 1.2	Ferritin: <0.0001*, Iron: <0.0001*
15-19	520.1 ± 195.4	18.2 ± 3.2	14.5 ± 1.0	Ferritin: <0.0001*, Iron: <0.0001*
20-24	550.3 ± 180.5	18.6 ± 3.9	14.8 ± 1.3	Ferritin: <0.0001*, Iron: <0.0001*
25-29	505.8 ± 220.1	18.4 ± 2.8	14.3 ± 1.1	Ferritin: <0.0001*, Iron: <0.0001*
30-32	530.4 ± 205.7	18.7 ± 3.5	14.6 ± 1.2	Ferritin: <0.0001*, Iron: <0.0001*

Figure 5. Comprehensive Analysis of Ferritin, Iron, and Hemoglobin Levels across Age Groups with Statistical Evaluation



Discussion

A look at the analysis of demographic, biochemical, and clinical data sets from a sample of

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thalassemia major known patients, which is done in search of the patterns of complex nature to support and counteract the ones we have had a look at below. The aim of this study is left up to us to decide these patterns. This study opens a way for the new thought about the problems of the treating of these disease. The report on the analyzing demographic structure of our patient sample which, is characteristically of females category (57.5 percent) and an immeasurable number of individuals under the age of 30 (70 percent) is perfectly in line with same findings of the research of Al-Seraihi et al. (2018) in the patient population. Younglings of our study subjects are 30 years and below. Furthermore, the majority of the subjects took part in the study at a time place when they were not even thirty months old. This similarity puts in a spot that those who are diagnosed with thalassemia major are considered to drop into a significantly younger age group. In addition, the article touches on the crucial utilization of the early based and continuous intervention plan mainly if genetic testing and prenatal counseling systems are not well enforced. Because of the knowledge we are have on the serum ferritin and the iron levels that we have documenting Iron metabolism in Thalassemia major is many pronged. This is because we now understand what the iron levels are based on the results of recent testing. Hence, the proposed median level of ferritin that lies within the normal range (515.8 ng/ml) complies with the data given in the book Vichinsky (2019). The same thing is, regardless of how much the children resemble their parents. This entails a picture of what iron overloads looks like in bodily systems. In other words, struggle of an individual to achieve healthfulness is the main subject. It is likely that changing transfusion protocols. chelation compliance and patient metabolism is the reason of high variability in iron burden as molecular MRI specific liver iron concentration measured in this study had wide range. This given level of disparity could have indicated the function of entirely different factors. The relatively large standard deviation indicates that the dependent variable has very distinct values. The iron research and the results which are marked by an average that is not far off (18.3 µg/dL) and mostly staying tightly within a range, give an opportunity to conclude the partial success in limited erythrocyte transfusion in this patient. Ferritin levels, whose volatility is a lot higher compared to the hemoglobin levels, may be low or high during iron deficiency or overload. Such kind of situation is striking to me! For the purpose of the illustrated iron overburden disease management, this discordance can be projected in part as a message concerning the limitations of serum iron as a one-item marker. Ravish and Angela have mentioned in their work (Olivieri and Brittenham, 2020) about the necessity of informing ministries of health and imposing some control over iron producing industries and our findings support their concerns. As Porter et al. demonstrated (2021), feritin levels, iron levels, and age showed no relationship (the researchers did not discover a significant relationship between these, i.e., their research did not disclose a strong correlation between ferritin level, level of iron, and age). On the contrary, the pattern of result which is different from the one that had been claimed by Porter et.al (2021). Considering the fact that we found no significant correlation between ferritin, iron level, and age, this is witnessed in our study as shown in the findings. Rather, the previous gap indicates the research populations or methodologies being different from one another, while also sustaining the growing competency of modern chelation therapy which led to the accumulation of ferritin level due to aging. There are fact two scenarios which can take place. Weaning off workers by automating tasks even to the degree of voice-assisted services, is totally possible for either of these two things to happen. Taking

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in consideration the fact that female gender have somewhat higher serum iron levels than male, it enhances the curiosity in relation to answer of the question about gender-specific changes in iron metabolism or management in the case of thalassemia major. This is because the iron cut is different between the females and male and iron content of the female is more. Therefore, the underlying reason for the occurrence of this phenomenon is the fact that females usually have about 2-3g of iron in their bodies in comparison to 0.8-2g for males. Such final results indicating consistency with the works by Galanello and Origa (2010) give rise to the idea that the possible reasons for the differences may be either the genetic inequalities or inequality in the type of treatment, which requires additional research. Finally, concluding with a call for more investigation will do the job. One more evidence that treated age-specific medication, as stated by Taher et al. (2022), is effective in our study is this also spotlights major changes in the production of biomarkers that occurs with greater age. Not only can the way ferritin and serum iron levels are altered in different age groups show the effects of life-time of transfusions and iron-chelation, but also that it may be possible that the body can change the way iron will be managed over the years through some evolutionary changes. This is the case because to currently get blood exchanges and chelation therapy the best treatment options done, and they have such an impact on the body.

5. CONCLUSION

The analysis completely peruses demographic data, serum ferritin, and iron levels of a selection of thalassemia major patients. It will in the end tell us about the complicated circumstances that come with their treatment. The fact of the exact same that the study was implemented mainly united under the younger age groups which more mentioned were females demonstrate definitely that early intervention and management programs which target the specific age group and its anatomical peculiarities has to be developed. This was especially helpful as we got serum ferritin and iron levels, and these issues could suggest continued iron overload. The same research results also help us in understanding the scalability factor which is usually a challenge when using IV iron intake as the mechanism of iron storage control. However, there is no significantly association observed between ferritin levels, iron levels, and age; as well, there are differences in the serum iron levels for males and females, so we can clearly say that the studies have to be done more deep, and creating treatment strategies that will take into account the individual needs of men and women, particlarly. Individuals with the highest levels of serum iron are of one gender, because of the gender discrepancies which exist in serum iron levels. A third piece of evidence that thalassemia major treatment is a dynamic process has come into notice as some biomarkers in this therapy process change in significant ways with age. This fact highlights a necessity of designing customized schemes of chelation treatment that should remember about unaveraged effects from multiple treatments across the time period that will be considered long probably. One implication that our study takes beyond perhaps other conducted ones on thalassemia major is that not only does our study expands the current studies done but also develops the use of an integrated strategy in the treatment of patients by taking into account this factors like age, gender, comprehensive monitoring of iron levels among other things. The initiatives research in to causes of iron overload and need invention of innovative procedures for thalassemia major patients is important to intensify life quality of

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these people. Through this, the cure for these conditions will be discovered and so the hope of better treatment scenarios will be created. If we engage in interventions which comprise of the above-mentioned, we shall be able to proceed with using therapies that have the highest rate of success thereby optimizing the process and enhancing the general care of this condition.

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