



## The Mentzer Index and Pregnancy: Differentiating Between Iron Deficiency and Thalassemia

Emmanuel Ifeanyi Obeagu \*

Department of Biomedical and Laboratory Science, Africa University, Zimbabwe

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### Abstract

Anemia during pregnancy is a common condition with significant risks for both maternal and fetal health. The two primary causes of anemia in pregnancy—iron deficiency anemia (IDA) and thalassemia trait (TT)—require distinct treatment strategies. The Mentzer Index, a simple and cost-effective diagnostic tool, helps differentiate between these two types of anemia by calculating the ratio of mean corpuscular volume (MCV) to red blood cell (RBC) count. This review explores the role of the Mentzer Index in improving anemia diagnosis and management in pregnancy, highlighting its benefits and limitations. The Mentzer Index is calculated by dividing the MCV by the RBC count, with values greater than 13 typically indicating IDA and values less than 13 suggesting TT. The index offers a quick and accessible method for distinguishing between these two conditions, enabling healthcare providers to administer appropriate treatments, such as iron supplementation for IDA or genetic counseling for TT. Early and accurate diagnosis through the Mentzer Index can reduce the risk of complications such as preterm birth and low birth weight, while ensuring appropriate anemia management for pregnant women.

**Keywords:** Mentzer Index, Pregnancy, Iron Deficiency, Thalassemia, Anemia Diagnosis

### \*Address for Correspondence:

Emmanuel Ifeanyi Obeagu, Department of Biomedical and Laboratory Science, Africa University, Zimbabwe

## Introduction

Anemia is a widespread condition during pregnancy, with studies estimating its global prevalence at around 40-50%, posing significant risks to both maternal and fetal health. Pregnant women are at increased risk for anemia due to higher iron requirements for fetal development, increased blood volume, and the strain of pregnancy itself. The two most common causes of anemia during pregnancy are iron deficiency anemia (IDA) and thalassemia trait (TT). Though both result in low hemoglobin levels, their causes are fundamentally different and require distinct approaches to diagnosis and management. Accurate differentiation between IDA and TT is essential for effective treatment, as iron supplementation, the main treatment for IDA, is ineffective and potentially harmful in the case of TT.<sup>1-2</sup> The Mentzer Index, a simple calculation based on the mean corpuscular volume (MCV) and red blood cell (RBC) count, has gained recognition as an effective screening tool for distinguishing between these two types of anemia. By providing a quick, cost-effective, and accessible means to differentiate IDA from TT, the Mentzer Index allows healthcare providers to initiate appropriate management strategies early in pregnancy. A value greater than 13 typically suggests IDA, whereas a value less than 13 points towards TT. However, the index, while useful, has limitations that must be

considered in its application.<sup>3-4</sup> The importance of accurately diagnosing the cause of anemia during pregnancy cannot be overstated. Anemia in pregnancy is associated with adverse outcomes such as preterm birth, low birth weight, and maternal fatigue, which can severely affect quality of life. Inadequate or inappropriate treatment can exacerbate these risks. Therefore, healthcare providers must not only diagnose anemia but also identify its underlying cause to ensure that appropriate and effective treatments are provided. The Mentzer Index offers a valuable tool for this purpose, enabling clinicians to quickly rule out iron deficiency as the sole cause and investigate further for thalassemia traits, which may not require iron supplementation.<sup>5</sup>

Iron deficiency anemia (IDA) is the most common form of anemia during pregnancy, resulting from insufficient iron to meet the increased demand of both the mother and fetus. IDA can lead to significant complications such as maternal fatigue, impaired immune function, and, in severe cases, cardiovascular problems. The condition can also lead to adverse outcomes for the fetus, including intrauterine growth restriction and preterm birth. Early identification of IDA allows for timely iron supplementation, which is essential in preventing these complications. However, in some pregnant women, particularly those from regions where thalassemia is

prevalent, thalassemia trait (TT) may be the underlying cause of anemia, which does not respond to iron supplementation and may require different management strategies.<sup>6-7</sup> Thalassemia trait is a genetic blood disorder that leads to mild anemia but is often misdiagnosed as IDA due to overlapping clinical features, such as low hemoglobin and low MCV. However, unlike IDA, thalassemia trait is not caused by iron deficiency and does not require iron supplementation. Misidentifying TT as IDA can lead to unnecessary iron treatments, which may cause iron overload in the body and lead to complications. The Mentzer Index helps address this issue by offering a simple method for differentiating between the two types of anemia based on RBC count and MCV values. This distinction is critical because the management of TT requires genetic counseling and monitoring, rather than iron supplementation.<sup>8-9</sup> Despite the value of the Mentzer Index in diagnosing anemia, it is important to recognize its limitations. While the index is a useful screening tool, it cannot definitively diagnose mixed anemia, where IDA and TT coexist, or other forms of anemia, such as folate or vitamin B12 deficiency. Additionally, the index can be influenced by factors such as inflammation or concurrent medical conditions that affect RBC count and MCV, leading to false or ambiguous results. Therefore, while the Mentzer Index can guide initial diagnosis and management, it must be used alongside other diagnostic tests, such as serum ferritin levels, hemoglobin electrophoresis, or genetic testing, to confirm the cause of anemia and guide appropriate treatment.<sup>10-11</sup>

### Interpretation of the Mentzer Index

The Mentzer Index is a simple, cost-effective tool used to help differentiate between iron deficiency anemia (IDA) and thalassemia trait (TT), particularly in cases where anemia is suspected during pregnancy. It is based on the relationship between two key laboratory parameters: the mean corpuscular volume (MCV) and the red blood cell (RBC) count.

The interpretation of the Mentzer Index depends on the value obtained from the calculation:

1. **Mentzer Index > 13:** A value greater than 13 is typically suggestive of **iron deficiency anemia (IDA)**. This is because iron deficiency leads to microcytic anemia, where red blood cells are smaller than normal (low MCV), and the RBC count is usually reduced. Since iron is crucial for hemoglobin production, low iron levels lead to fewer and smaller red blood cells. A higher index value indicates that the reduction in RBC count is more pronounced than the reduction in MCV, a hallmark of IDA.<sup>12</sup>
2. **Mentzer Index < 13:** A value less than 13 generally points to **thalassemia trait (TT)**. Thalassemia is a genetic disorder that results in abnormal hemoglobin production, leading to microcytic anemia. However, unlike IDA, thalassemia trait is not due to iron deficiency, and RBC count may be normal or even slightly elevated. In TT, the reduction in MCV

is greater than the reduction in RBC count, which is reflected in a lower Mentzer Index.<sup>13</sup>

3. **Mentzer Index between 13 and 16:** Values within this range can be more ambiguous and may indicate a need for further testing. In cases of mixed anemia (such as coexisting IDA and thalassemia trait), the result might fall between these two thresholds. Additionally, certain conditions like chronic inflammation or anemia of chronic disease can complicate the interpretation of the Mentzer Index.<sup>14</sup>

### Clinical Use of the Mentzer Index

The Mentzer Index is typically used as a screening tool to help clinicians distinguish between IDA and TT before ordering more expensive or invasive diagnostic tests. It is particularly useful in resource-limited settings where access to sophisticated diagnostic techniques like hemoglobin electrophoresis or genetic testing may be restricted. However, the Mentzer Index should not be used in isolation. It serves as an initial step in the diagnostic process, which should be followed by confirmatory tests to ensure accurate diagnosis. In the context of pregnancy, the Mentzer Index can help avoid the unnecessary administration of iron supplements to women with thalassemia trait, as they do not benefit from such treatments and iron supplementation may lead to iron overload. Early and accurate differentiation between IDA and TT is essential.<sup>15</sup>

### Application of the Mentzer Index in Pregnancy

Pregnancy is a critical period during which anemia, particularly iron deficiency anemia (IDA) and thalassemia trait (TT), can have significant consequences for both maternal and fetal health. The Mentzer Index plays an essential role in helping clinicians differentiate between these two common causes of anemia, thereby guiding appropriate treatment strategies. By calculating the ratio of mean corpuscular volume (MCV) to red blood cell (RBC) count, the Mentzer Index offers a quick and simple method to assess whether anemia is due to iron deficiency or thalassemia, which require distinctly different management approaches.<sup>16</sup> During pregnancy, the increased demand for iron to support the growing fetus, the placenta, and the expanded blood volume can lead to iron deficiency, resulting in IDA. Women with IDA may experience fatigue, weakness, and an increased risk of complications, including preterm delivery, low birth weight, and impaired fetal development. The Mentzer Index can aid in the early identification of IDA by identifying a high index value (>13), indicating a reduced RBC count relative to the MCV. This is a typical feature of iron deficiency, where the production of red blood cells is limited by insufficient iron, resulting in smaller and fewer red blood cells. Prompt identification of IDA allows for the timely initiation of iron supplementation, which is critical in improving maternal and fetal health outcomes.<sup>17</sup>

On the other hand, thalassemia trait (TT), a genetic disorder that results in abnormal hemoglobin production, is prevalent in certain regions and can be mistaken for IDA due to overlapping symptoms, such as

microcytic anemia and low hemoglobin. However, unlike IDA, thalassemia is not caused by a lack of iron and does not respond to iron supplementation. The Mentzer Index is particularly useful in differentiating TT from IDA by providing a value less than 13, which suggests that the reduction in MCV is greater than the reduction in RBC count—characteristic of thalassemia trait. Thalassemia trait can lead to mild anemia but does not require iron supplementation and may instead require genetic counseling and monitoring to avoid unnecessary iron therapy, which can lead to iron overload and further complications.<sup>18</sup> Pregnant women with thalassemia trait may face a higher risk of complications, such as preeclampsia, growth restriction, and fetal anemia, if the condition is not appropriately identified and managed. Using the Mentzer Index to screen for thalassemia trait allows healthcare providers to make more accurate diagnoses and provide appropriate care. The Mentzer Index enables the differentiation between IDA and TT, offering a non-invasive and cost-effective approach to identifying the underlying cause of anemia in pregnancy, particularly in areas where access to advanced diagnostic methods like hemoglobin electrophoresis may be limited.<sup>19</sup> Although the Mentzer Index is a useful screening tool, it should not be used in isolation. The index's accuracy can be influenced by factors such as mixed anemia, inflammation, and concurrent medical conditions. For example, pregnant women may experience anemia due to factors such as folate deficiency or anemia of chronic disease, which may not be distinguished accurately using the Mentzer Index alone. Therefore, while the Mentzer Index serves as an essential first step, further confirmatory testing, including serum ferritin levels, hemoglobin electrophoresis, or genetic testing, is necessary for a definitive diagnosis.<sup>20</sup>

### Benefits of the Mentzer Index in Anemia Diagnosis

The Mentzer Index provides several advantages in the diagnosis of anemia, especially in distinguishing between iron deficiency anemia (IDA) and thalassemia trait (TT), two common causes of microcytic anemia. The primary benefits of using the Mentzer Index in anemia diagnosis are its simplicity, cost-effectiveness, accessibility, and efficiency in guiding further diagnostic and treatment decisions.<sup>21</sup> Below are the key benefits of utilizing the Mentzer Index:

#### 1. Simplicity and Ease of Use

One of the major advantages of the Mentzer Index is its simplicity. The calculation requires only two basic laboratory parameters: mean corpuscular volume (MCV) and red blood cell (RBC) count. These values are routinely measured in standard complete blood count (CBC) tests, which are commonly available in most healthcare settings. The formula for calculating the Mentzer Index is straightforward, making it easy for clinicians to apply without the need for complex equipment or additional tests. This simplicity allows for quick decision-making in clinical practice, especially in settings with limited resources.<sup>22</sup>

#### 2. Cost-Effectiveness

The Mentzer Index is an affordable diagnostic tool. Unlike more advanced diagnostic methods, such as hemoglobin electrophoresis or genetic testing, which can be expensive and may not be accessible in resource-limited areas, the Mentzer Index relies on widely available and low-cost tests, such as the CBC. In settings where advanced diagnostic tools are not readily available, the Mentzer Index can serve as a crucial first step in diagnosing anemia and guiding treatment decisions. This makes it a particularly valuable tool in low-income or developing regions where cost-effective healthcare solutions are essential.<sup>23</sup>

#### 3. Quick and Efficient Differentiation

One of the most significant benefits of the Mentzer Index is its ability to quickly and effectively differentiate between IDA and thalassemia trait (TT), which require different treatment strategies. IDA is caused by insufficient iron, while TT is a genetic condition that does not respond to iron supplementation. The Mentzer Index allows healthcare providers to identify which condition is most likely, enabling early intervention. For instance, if the index is greater than 13, IDA is more likely, prompting the administration of iron supplements. Conversely, a value below 13 typically suggests TT, avoiding the unnecessary and potentially harmful iron supplementation. This rapid differentiation ensures that the appropriate treatment is started without delay.<sup>24</sup>

#### 4. Helps Avoid Misdiagnosis and Unnecessary Treatments

The Mentzer Index is particularly useful in preventing the misdiagnosis of anemia, which is common due to the overlap in symptoms of IDA and TT, such as fatigue and low hemoglobin levels. If thalassemia trait is misdiagnosed as IDA, patients may be prescribed iron supplements, which will not only be ineffective but can also lead to iron overload, causing further complications such as organ damage. By distinguishing between these two causes of anemia, the Mentzer Index helps avoid unnecessary iron therapy and ensures that patients receive the correct management. This leads to better patient outcomes by preventing the risks associated with inappropriate treatments.<sup>25</sup>

#### 5. Supports Early Detection in Pregnancy

Pregnancy is a time when anemia is common, and accurate diagnosis is essential to prevent complications for both the mother and fetus. The Mentzer Index is particularly beneficial in pregnancy, where iron deficiency anemia is prevalent, but thalassemia trait is also a concern, especially in regions with high carrier rates. It enables healthcare providers to promptly identify the cause of anemia and provide appropriate care. For example, in pregnant women diagnosed with IDA based on the Mentzer Index, iron supplementation can be started to improve maternal and fetal health. In contrast, if thalassemia trait is identified, iron supplementation can be avoided, and further genetic counseling can be provided as needed.<sup>26</sup>

## 6. Aids in Clinical Decision-Making and Resource Allocation

The Mentzer Index assists clinicians in making informed decisions quickly, leading to better clinical outcomes. By providing an initial guide for whether anemia is likely due to iron deficiency or thalassemia trait, the index can help prioritize further testing or treatment. This is especially helpful in resource-limited settings where healthcare resources may be scarce, and prioritizing the most likely cause of anemia is necessary. Additionally, the index can guide the appropriate allocation of resources, ensuring that treatments, such as iron supplementation or genetic counseling, are directed to the right patients.<sup>27</sup>

## Limitations and Challenges of the Mentzer Index

While the Mentzer Index offers numerous benefits in anemia diagnosis, it is not without its limitations and challenges. These limitations may affect its accuracy and the appropriateness of its use in certain clinical scenarios. Below are the key limitations and challenges associated with the Mentzer Index:

### 1. Influence of Mixed Anemia

The Mentzer Index is most effective in distinguishing between iron deficiency anemia (IDA) and thalassemia trait (TT), but it may not perform well in cases where a patient has mixed anemia. Mixed anemia occurs when a patient has two or more underlying causes of anemia, such as IDA coexisting with vitamin B12 or folate deficiency, or anemia of chronic disease. In such cases, the calculation of the Mentzer Index may fall within a range that does not accurately reflect the primary cause of anemia. For instance, a patient with both IDA and thalassemia trait could present with a Mentzer Index value that lies within the range for mixed anemia, leading to potential misclassification. This limitation emphasizes the need for additional testing and clinical judgment.<sup>20</sup>

### 2. Impact of Inflammation and Other Co-morbidities

The presence of chronic inflammation, infection, or other co-morbidities can skew the results of the Mentzer Index. Conditions such as chronic kidney disease, autoimmune diseases, or active infections can affect red blood cell production, alter MCV, and even change RBC count. In such cases, the Mentzer Index may not provide an accurate reflection of the underlying anemia etiology. For example, inflammatory responses may lead to anemia of chronic disease, which typically presents with low MCV, resembling the presentation of IDA. Thus, the presence of other health conditions could lead to false positives or false negatives when interpreting the Mentzer Index, highlighting the need for a broader clinical evaluation.<sup>21</sup>

### 3. Limited Accuracy in Certain Populations

The Mentzer Index is most effective when used in populations with a high prevalence of thalassemia trait and iron deficiency anemia, such as in regions where

these conditions are common. However, in populations where other forms of anemia (e.g., anemia due to folate deficiency, vitamin B12 deficiency, or hemoglobinopathies other than thalassemia) are more prevalent, the Mentzer Index may be less reliable. Additionally, its use in pregnant women or other populations with altered hematologic parameters may not always yield accurate results, as pregnancy-related anemia often has multiple contributing factors, complicating the interpretation of the index. In these cases, further confirmatory testing, such as serum ferritin, hemoglobin electrophoresis, or genetic testing, is needed to make a definitive diagnosis.<sup>22</sup>

### 4. Difficulty in Identifying Other Hemoglobinopathies

While the Mentzer Index is useful for distinguishing between IDA and thalassemia trait, it is less effective in identifying other hemoglobinopathies or genetic conditions that cause microcytic anemia, such as hemoglobin E, hemoglobin D, or sickle cell trait. These conditions may present with similar hematologic features to thalassemia trait, yet they are not differentiated by the Mentzer Index. As a result, patients with other hemoglobinopathies may be misdiagnosed, leading to suboptimal treatment. This underscores the limitation of the Mentzer Index as a screening tool for a broader spectrum of inherited blood disorders, necessitating additional tests for comprehensive anemia diagnosis.<sup>23</sup>

### 5. Variability in Laboratory Parameters

The accuracy of the Mentzer Index depends on the reliability of the MCV and RBC count, both of which can vary due to laboratory equipment, technique, or errors in sample handling. Variability in laboratory results can lead to inaccurate Mentzer Index calculations, which may in turn affect clinical decision-making. For instance, if MCV or RBC count is mismeasured due to poor sample quality or technical issues, the Mentzer Index may not reflect the true underlying cause of anemia, leading to potential misclassification. Consequently, it is important to ensure that laboratory tests are performed accurately and consistently to maximize the value of the Mentzer Index.<sup>26</sup>

### 6. Over-reliance on a Single Diagnostic Tool

Another challenge is the tendency for clinicians to over-rely on the Mentzer Index as a definitive diagnostic tool, without considering other important factors or clinical context. While the Mentzer Index is useful as an initial screening tool, it should not be the sole determinant in diagnosing anemia. It is important to integrate the index with other diagnostic tests, patient history, physical examination, and clinical judgment. An over-reliance on the Mentzer Index may lead to diagnostic oversights, especially in complex cases where multiple factors contribute to anemia.<sup>27</sup>

## Conclusion

The Mentzer Index is a valuable and cost-effective tool for differentiating between iron deficiency anemia and thalassemia trait, two common causes of microcytic

anemia. Its simplicity, ease of calculation, and accessibility make it an attractive first-line diagnostic approach, particularly in resource-limited settings. However, the tool has limitations, including its reduced accuracy in cases of mixed anemia, the influence of inflammation or co-morbidities, and its inability to identify other hemoglobinopathies. Furthermore, laboratory variability and the potential for over-reliance on a single diagnostic parameter highlight the importance of integrating the Mentzer Index with a comprehensive clinical evaluation. Despite these challenges, when used as part of a broader diagnostic strategy, the Mentzer Index remains a crucial aid in anemia management, helping to guide treatment decisions and improve patient outcomes, particularly in populations with high rates of iron deficiency and thalassemia. Ultimately, a multifaceted approach that includes clinical judgment, additional laboratory tests, and patient history is essential for accurate anemia diagnosis and management.

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## References

- Rahman MM, Abe SK, Rahman MS, Kanda M, Narita S, Bilano V, Ota E, Gilmour S, Shibuya K. Maternal anemia and risk of adverse birth and health outcomes in low-and middle-income countries: systematic review and meta-analysis. *The American journal of clinical nutrition*. 2016; 103(2):495-504. <https://doi.org/10.3945/ajcn.115.107896> PMID:26739036
- Obeagu EI, Ezimah AC, Obeagu GU. Erythropoietin in the anaemias of pregnancy: a review. *Int J Curr Res Chem Pharm Sci*. 2016;3(3):10-18. <https://doi.org/10.22270/ijmspr.v10i2.95>
- Okamgba OC, Nwosu DC, Nwobodo EI, Agu GC, Ozims SJ, Obeagu EI, Ibang IE, Obioma-Elemba IE, Ihekaire DE, Obasi CC, Amah HC. Iron Status of Pregnant and Post-Partum Women with Malaria Parasitaemia in Abia State, Nigeria. *Annals of Clinical and Laboratory Research*. 2017;5(4):206.
- Petrakos G, Andriopoulos P, Tsironi M. Pregnancy in women with thalassemia: challenges and solutions. *International journal of women's health*. 2016;441-451. <https://doi.org/10.2147/IJWH.S89308> PMID:27660493 PMCID:PMC5019437
- Obeagu EI, Adepoju OJ, Okafor CJ, Obeagu GU, Ibekwe AM, Okpala PU, Agu CC. Assessment of Haematological Changes in Pregnant Women of Ido, Ondo State, Nigeria. *J Res Med Dent Sci*. 2021 Apr;9(4):145-148.
- Agreen FC, Obeagu EI. Anaemia among pregnant women: A review of African pregnant teenagers. *Journal of Public Health and Nutrition*. 2023;6(1):138.
- Arora S, Rana D, Kolte S, Dawson L, Dhawan I. Validation of new indices for differentiation between iron deficiency anemia and beta thalassemia trait, a study in pregnant females. *International Journal of Scientific Reports*. 2018; 4(2):26. <https://doi.org/10.18203/issn.2454-2156.IntJSciRep20180394>
- Obeagu EI, Obeagu GU. Insights into Maternal Health: Mentzer Index for Early Anemia Detection, *International Journal of Medical Sciences and Pharma Research*, 2024;10(4):44-49 <https://doi.org/10.22270/ijmspr.v10i4.122>
- Obeagu EI, Influence of Hemoglobin Variants on Vaso-Occlusive Phenomena in Sickle Cell Anemia: A Review, *International Journal of Medical Sciences and Pharma Research*, 2024;10(2):54-59 <https://doi.org/10.22270/ijmspr.v10i2.104>
- Iolascon A, Andolfo I, Russo R, Sanchez M, Busti F, Swinkels D, Aguilar Martinez P, Bou-Fakhredin R, Muckenthaler MU, Unal S, Porto G. Recommendations for diagnosis, treatment, and prevention of iron deficiency and iron deficiency anemia. *Hemasphere*. 2024; 8(7):e108. <https://doi.org/10.1002/hem3.108> PMID:39011129 PMCID:PMC11247274
- Obeagu EI, Obeagu GU, Chukwueze CM, Ikpenwa JN, Ramos GF. Evaluation of protein C, protein S and fibrinogen of pregnant women with malaria in Owerri metropolis. *Madonna University journal of Medicine and Health Sciences* ISSN: 2814-3035. 2022 Apr 19;2(2):1-9.
- Obeagu EI, Obeagu GU. Neonatal Outcomes in Children Born to Mothers with Severe Malaria, HIV, and Transfusion History: A Review. *Elite Journal of Nursing and Health Science*, 2024; 2(3): 38-58
- Sahli CA, Bibi A, Ouali F, Fredj SH, Dakhlaoui B, Othmani R, Laouini N, Jouini L, Ouenniche F, Siala H, Touhami I. Red cell indices: differentiation between  $\beta$ -thalassemia trait and iron deficiency anemia and application to sickle-cell disease and sickle-cell thalassemia. *Clinical Chemistry and Laboratory Medicine (CCLM)*. 2013; 51(11):2115-24. <https://doi.org/10.1515/cclm-2013-0354> PMID:23800659
- Hoffmann JJ, Nabbe KC, van den Broek NM. Effect of age and gender on reference intervals of red blood cell distribution width (RDW) and mean red cell volume (MCV). *Clinical Chemistry and Laboratory Medicine (CCLM)*. 2015; 53(12):2015-9. <https://doi.org/10.1515/cclm-2015-0155> PMID:26536583
- Miftahussurur M, Husada D, Ningtyas WS. Association Association Of Shine and Lal Index B-Thalassemia Trait Screening Results with Anaemia and Low Birth Weigh. *International Journal of Nursing And Midwifery Science (IJNMS)*. 2023; 7(3):290-296. <https://doi.org/10.29082/IJNMS/2023/Vol7/Iss3/543>
- Shahid H, Saleem M, Naseer N, Tabussam S, Aziz A, Ullah S. Evaluation of Srivastava index to distinguishing Beta-Thalassemia Trait from Iron Deficiency. *Pakistan Journal of Medical & Health Sciences*. 2022;16(05):1225. <https://doi.org/10.53350/pjmhs221651225>
- Vehapoglu A, Ozgurhan G, Demir AD, Uzuner S, Nursoy MA, Turkmen S, Kacan A. Hematological indices for differential diagnosis of Beta thalassemia trait and iron deficiency anemia. *Anemia*. 2014; 2014(1):576738. <https://doi.org/10.1155/2014/576738> PMID:24818016 PMCID:PMC4003757
- Urrechaga E. Discriminant value of % microcytic/% hypochromic ratio in the differential diagnosis of microcytic anemia. *Clinical chemistry and laboratory medicine*. 2008;46(12):1752-1758. <https://doi.org/10.1515/CCLM.2008.355> PMID:19055451
- Obeagu EI, Obeagu GU. Anemia in Pregnancy: Mentzer Index as a Predictor for Iron Supplementation Needs, *International Journal of Medical Sciences and Pharma Research*, 2024;10(4):39-43 <https://doi.org/10.22270/ijmspr.v10i4.121>
- Obeagu EI, Obeagu GU. Sickle cell anaemia in pregnancy: a review. *International Research in Medical and Health Sciences*. 2023 Jun 10;6(2):10-13. <https://doi.org/10.22270/ijmspr.v10i2.103>
- Obeagu EI, Ubosi NI, Uzoma G. Antioxidant Supplementation in Pregnancy: Effects on Maternal and Infant Health. *Int. J. Adv. Multidiscip. Res*. 2023;10(11):60-70.

22. Obeagu EI, Obeagu GU. Mitigating Oxidative Stress in Pregnancy through Antioxidant Supplementation: A Narrative Review. *Int. J. Curr. Res. Chem. Pharm. Sci.* 2024;11(9):7-17.
23. Obeagu EI, Obeagu GU. Enhancing Maternal and Fetal Well-being: The Role of Antioxidants in Pregnancy. *Elite Journal of Medical Sciences.* 2024;2(4):76-87.
24. Obeagu EI, Obeagu GU. Antioxidant Supplementation and Prevention of Early Pregnancy Loss: A Narrative Review. *Int. J. Curr. Res. Chem. Pharm. Sci.* 2024;11(9):28-37.  
<https://doi.org/10.22270/ijmspr.v10i4.120>
25. Obeagu EI, Obeagu GU. Molar Pregnancy: Update of prevalence and risk factors. *Int. J. Curr. Res. Med. Sci.* 2023;9(7):25-28.  
<https://doi.org/10.19080/JGWH.2023.25.556169>
26. Obeagu EI, Obeagu GU. Hypoxia-induced Metabolic Changes in Pregnancy: Clinical Perspectives. *Elite Journal of Medicine.* 2024;2(8):50-59.
27. Obeagu EI, Obeagu GU. Hemolysis Challenges for Pregnant Women with Sickle Cell Anemia: A Review. *Elite Journal of Haematology.* 2024;2(3):67-80.