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Evaluation of efficacy of mentzer index for screening of beta - Thalassemia trait in antenatal women

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ABSTRACT

People with thalassemia trait should be distinguished from those who have anemia due to iron deficiency since they typically have mild microcytic hypochromic anemia and are mostly asymptomatic.
Objective: To evaluate efficacy of Mentzer index for screening Beta- Thalassemia trait in pregnant women.
Materials and Methods: From January 2023 to October 2023, the observational study was carried out in the Department of Gynecology & Obstetrics at Sri Guru Ram Das Charitable Hospital Amritsar. The study comprised 130 pregnant women with anemia. To assess microcytic hypochromic anemia, tests like complete blood count (CBC), peripheral blood smears, iron studies, and hemoglobin electrophoresis were performed. Mentzer Index (MI) was computed, and its specificity and sensitivity assessed.
Results: Of the 130 patients, 112 had Mentzer Index greater than 13 and 18 had Mentzer Index less than 13 but only 12 out of these18 had beta thal-trait according to HPLC. There were total 15 females having beta thal-trait as per HPLC, however 3 of the 15 had Mentzer >13. Conserding Beta thal-trait, the Mentzer Index's sensitivity and specificity were 80% and 95.65% in this study, and 95.33% and 86.96% for IDA.
Conclusion: Mentzer Index (MI) is a helpful tool to distinguish iron deficiency from thalassemia trait as its specificity and sensitivity is high as electrophoresis in diagnosis. In situations with limited resources, this proves to be advantageous in terms of cost-effectiveness.

1. Introduction

Pregnancy-related anemia has gained international attention.[1] It is more common in developing nations like India.[2] The incidence is 19% in developed nations and 35-75% in developing nations.[3] Anemia during pregnancy is primarily caused by iron deficiency, while hemoglobinopathies, most prevalent of which is Beta thal-trait, can also cause anemia. Globally, Beta thal trait is most prevalent genetic condition. According to WHO estimates, 5% of people worldwide are carriers of thalassemia, with higher prevalence in south-east Asia.[4]

India has the highest number of thalassemia major cases worldwide with 1 to1.5 lakh cases of thalassemia major and 42 million Beta thal-trait carriers,. The typical frequency of carriers in India is 3-4%,[5–7] with greater frequencies found among populations such as Gujaratis, Kolis, Bengalis, Sindhis etc.[7,8] People having no apparent ethnic connection can have the Beta thal- trait due to migration and inter-ethnic marriages. However, thalassemia is a genetic illness that can be avoided with rigorous screening procedures.[9] Microcytic hypochromic anemia is seen in both IDA and beta thalassemia cases. Additional specialized testing is needed to distinguish between the two.[10] While iron deficiency anemia is validated by ferritin levels and iron studies, beta thal-trait must be confirmed by HbA2 estimation. HbA2 LEVEL >3.5% is considered diagnostic of beta thal-trait.

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The beta thal-trait is major health concern in poor nations such as India since the treatment involves numerous blood transfusions and chelation therapy, which are out of reach for most affected individuals. Electrophoresis, a costly test that is challenging to conduct on the entire population, is required for carrier identification. Therefore, the creation of indices based on blood counts is necessary. It is necessary to have certain screening tests that are affordable and may be used widely in district health centers. Mentzer Index, Red Cell Distribution Index (RDWI), Red Cell Distribution, Red Blood Cell Count, and more screening tests are available. Mentzer Index, based on a complete blood count, utilized as a preliminary test, is a practical option among these.

In individuals with IDA, the bone marrow produces fewer RBCs, which leads to decreased Mean Corpuscular Volume (MCV) and RBC counts. So, Mentzer Index is greater than 13. RBC production is normal in thalassemia, but the beta- globin chain is faulty. As a result, RBCs are more brittle and tiny in size, which leads to a normal RBC count and low MCV. Mentzer Index is thus less than 13.

So current study had been carried out in pregnant females to assess role of Mentzer Index in discriminating between beta thal-trait and IDA using basic complete blood count data, keeping in mind the significance of thalassemia diagnosis.

2. Materials and Methods

The observational study was carried out at the Department of Obstetrics and Gynaecology at the Sri Guru Ram Das Charitable Hospital in Amritsar between January 2023 and October 2023. Included were all antenatal cases with hemoglobin levels between 8 and 11 gm/dl. The study excluded any known cases of hemolytic anemia, aplastic anemia, chronic illness-related anemia, or blood transfusions. The study's purpose was explained to the patients, and their informed consent was taken. Every detail was recorded on a proforma page. Their blood samples were sent to be tested for peripheral blood smears and complete blood counts (CBC). Every patient had their serum ferritin, serum iron, and HbA2 levels tested. The iron studies verified iron deficiency anemia, and the BIO RAD D10 Dual Reader using HPLC technology confirmed beta thalassemia by measuring elevated levels of HbA (>3.5%).

*The formula for:

Mentzer Index: * MCV (fl) / RBC (millions per microliter).

Version 20 of the Statistical Package for Social Services (SPSS) was used to evaluate the data that was gathered. Based on the information gathered, percentages were determined. A significant P value was defined as one that was less than or equal to 0.5. The Mentzer Index's sensitivity and specificity were computed.

True positive / (true positive + false negative) × 100 is the formula used to calculate sensitivity.

True negative / (true negative + false positive) x100 is the formula used to calculate specificity.

3. Result

130 pregnant women with anemia were included in the study. Mean age was 28.11 ± 3.12 years on average. 115 out of 130 females had IDA, and 15 had the beta thal-trait.

Table 1: Mentzer index

Mentzer Index	<13 No of cases	>13 No. of cases
Beta Thalassemia trait BY HPLC	12	3
Iron Deficiency anemia	6	109

Of the 115 individuals with iron deficiency, 109 had mentzer index greater than 13, out of 15 patients of beta thalassemia 12 had a Mentzer Index less than 13.

Table 2: With a sensitivity of 95.33%, the Mentzer Index is more useful for diagnosing true positive cases of IDA, while its specificity of 95.65% makes it more reliable in identifying true negative cases of beta thalassemia

Parameters of Mentzer Index	Sensitivity	Specificity	PPV	NPV
Iron Deficiency Anaemia (IDA)	95.33%	86.96%	97.14%	80%
Beta Thalassemia Trait	80%	95.65%	95.65%	97.35%

The study revealed that there is no correlation between age and Mentzer index. However, blood hemoglobin levels were shown to have a significant p value of 0.005, with a mean of 10.27+0.76 gm for MI >13, mean HB of 9.68 ± 1.03 gm with MI <13.

Table 3: Relationship between age and HB and the Mentzer index

Mentzer index	Age	Hb
<13	27.56±3.97	9.68±1.03
>13	28.21±4.35	10.27±0.76
p-value	0.554	0.005

4. Discussion

Microcytic anemia in India is commonly caused by IDA and beta thal trait, with Southeast Asian regions having the highest prevalance. Punjabis, Gujaratis, Sindhis, Bengalis, and Kachchis are among the most impacted as they have large no of thalassemia carriers.[11] The majority of people with beta thalassemia trait do not exhibit any symptoms, or if they do, they do so later in life.

Reduced PCV, MCV, MCH, and MCHC are the foundation of iron deficient anemia, which is verified by iron investigations. Serum ferritin and iron levels are

lowered, and total iron-binding capacity is raised, in IDA. Thalassemia is diagnosed based on blood HbA2 levels (>3.5%) measured by HPLC.[12]

Mentzer index (90.1%) was found to be best discrimination index as per Youden's criterion by Ehsani et al in 2009; the Ehsani et al index being the second (85.5%). Mentzer & Ehsani et al. accurately diagnosed 94.7% and 92.9% of patients in this investigation, respectively.[13]

The Mentzer index's sensitivity, specificity were determined by Batebi et al.[14] to be 86.3% and 85.4%, respectively. For Mentzers index, some research found a sensitivity of only 67%, while other investigations found a sensitivity of 82–95%.[15,16]

Ghafouri et al.[11] discovered comparable outcomes: For the Mentzer Index, sensitivity was 90.9% and specificity is 80.3%.

In current study, 11.54% of females studied had beta thal-trait and 88.56% had iron deficiency anemia.

Those with Mentzer Index greater than 13 were having IDA, with a sensitivity of 95.33% and a specificity of 95.65%, indicating no beta thalassemia risk. Conversely, individuals with a Mentzer Index of less than 13 exhibited the beta thalassemia trait with sensitivity of 80% and a specificity of 86.96%. For the beta thal-trait and iron deficiency anemia, the negative predictive values were 97.35% and 80%, respectively. Consequently, the Mentzer Index was more accurate in identifying iron deficiency anemia, ruling out beta thal-trait. The aforementioned numbers indicate that thalassemia carriers can be predicted using the Mentzer index. Mentzer Index can be used as screening tool to distinguish between beta thal-trait and iron deficiency anemia(IDA), according to the study.

A study carried out in India by Bose S et al. provides evidence in favour of current study.[17]

Munir AH et al. came to the same conclusion in their investigation.[18]

The findings of the present investigation are corroborated by a study conducted in Pakistan by Shagufta Tabassum et al., which indicated that the Mentzer Index had a sensitivity and specificity of 91% & 83% for IDA and 83% & 91% for beta thal trait.[19]

Muhammad Awais et al. concluded in the study thatMentzer Index T had better specificity, positive predictive value and diagnostic accuracy for beta thal trait.[20]

Rastogi et al. concluded that Sehgal index followed by Mentzer index had peoven to be helpful for screening MCHC anaemia.[21]

Mina Jahangiri et al. used 26 discriminating indices in Cluster analysis to determine indices having same diagnostic performance for differentiating beta thal trait and IDA.[22]

Surbhi Saxena et al. in 2020 evaluated diagnostic reliability of Mentzer index for beta thal trait and found that Mentzer index to be reliable in detecting true positive cases with 89% sensitivity and specific to detect true negative cases of IDA with 89% specificity.[23]

5. Conclusion

Microcytic hypochromic anemia is a result of both IDA and thalassemia trait. HPLC and iron studies are required for the final diagnosis of beta thal trait and iron deficiency. Mentzer index is screening technique that can be used in resource-poor environments where further studies are not feasible. This study contributes to the conclusion that cell count-based indices, particularly Mentzer index are practical and affordable means of identifying thalassemia trait. Even though there are numerous indices that use blood count characteristics, none of them have been 100% sensitive and specific.

6. Source of Funding

None.

7. Conflict of Interest

None.

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