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Assessment of Iron Status Among Menstruating Female Students of Madonna University, Elele Campus, Rivers State

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ABSTRACT

Background and Objective: Menstruation is a natural physiological process that causes regular blood loss and iron deficiency is a common concern among menstruating women due to the increased iron requirements to compensate for the loss. The aim of this study was to determine the effect of menstruation on iron status among female students attending Madonna University, Elele Campus, Rivers State. **Materials and Methods:** A total number of 60 students attending Madonna university Nigeria, Elele Campus were recruited for the study comprising of 30 menstruating students and 30 non menstruating students were used as control. As 5 mL of whole blood was collected from each subject by venipuncture from the antecubital vein and dispensed into a plain container. Serum iron and Total Iron Binding Capacity (TIBC) were analyzed spectrophotometrically while serum ferritin and transferrin were analyzed using Enzyme-Linked Immunosorbent Assay (ELISA). **Results:** Serum iron (74.24±20.68 µg/dL) and serum ferritin (92.40±16.57) in female not on menstruation were significantly higher than serum iron (35.83±12.31 µg/dL) and serum ferritin (66.73±14.80) in female on menstruation ($p<0.01$) while total iron binding capacity (520.65±32.19 µg/dL) and transferrin (2.54±0.91) in female not on menstruation were significantly lower than total iron binding capacity (561.62±20.16 µg/dL) and transferrin (3.92±0.524) in female on menstruation ($p<0.01$). **Conclusion:** This finding concludes that menstruation has a great effect on iron status which may result in iron deficiency anemia, however, the study highlighted the resilience of the body's iron metabolism during menstrual blood loss.

KEYWORDS

Menstruation, serum iron, serum ferritin, total iron binding capacity, transferrin, iron deficiency

INTRODUCTION

Menstruation, also known as the menstrual cycle, is the recurring release of blood and associated materials from the uterus, occurring from adolescence until menopause in response to the absence of pregnancy[1]. Variations exist in the length of the monthly cycle (the interval between the first day of menstrual bleeding

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and the day before the subsequent period), the duration of menstrual bleeding, the volume of blood discharged and other symptoms among individuals who menstruate. These differences can be attributed to various factors, including age, body weight, stress levels, dietary habits, alcohol consumption, smoking and underlying medical conditions.

Individuals with a menstrual cycle may also experience complex menstrual disorders or disruptions such as absence of menstrual periods (amenorrhea), infrequent menstrual periods (oligomenorrhea), menstrual pain (dysmenorrhea), abnormal growth of cells in the uterine muscle wall (adenomyosis) and the growth of endometrial tissue outside the uterus (endometriosis)[2].

Menstruation reflects variations in distinct bodily iron compartments and is impacted by various levels of iron deficiency. Some of the prominent measured values, including as serum ferritin, total iron binding capacity, serum iron and transferrin, allow for a detailed analysis of iron status.

Ferritin is predominantly found as a cytosolic protein in most tissues, with small quantities being discharged into the bloodstream, functioning as an iron carrier. The level of ferritin in the blood serves as an indirect indicator of the body's total iron reserves, making serum ferritin a valuable diagnostic tool for identifying iron-deficiency anemia. Aggregated ferritin degrades into a hazardous form of iron called hemosiderin[3]. The Total Iron-Binding Capacity (TIBC) is an important test for diagnosing iron-deficient anaemia and other iron metabolism problems. Iron binding capability refers to transferrin's ability to bind with iron[4].

Iron is a necessary mineral for several physiological processes in the body, including oxygen delivery, energy production and DNA synthesis. Iron deficiency is a global health concern that affects a variety of communities, notably menstruating women, who have higher iron requirements due to frequent menstrual blood loss. Menstruating female students may be at a higher risk of iron deficiency due to the combination of physiological demands, lifestyle factors and scholastic pressures[5].

Transferrins are glycoproteins present in vertebrates that bind to and so facilitate the movement of iron (Fe) through blood plasma. They are made in the liver and contain binding sites for two Fe^{3+} ions. The TF gene encodes human transferrin and produces a 76 kDa glycoprotein[6]. Menstruation is a natural physiological process that involves regular blood loss. Iron deficiency is a major worry among menstrual women because of the increased iron requirements to compensate for the loss[7]. The aim of the study is to determine the effect of menstruation on iron status among female students of Madonna University, Elele, Rivers State.

MATERIALS AND METHODS

Study area: The study was carried out from January to July, 2023 at Madonna University Nigeria, Elele Campus, Rivers State. It is located in the South-Southern geopolitical zone of Nigeria. The native language is Ikwerre, which lies between Latitudes 5024'N and 5033'N and Longitude 6058'E and 7006'E.

Study population: A total number of 60 students attending Madonna University Nigeria, Elele Campus, Rivers State were recruited for the study, comprising 30 menstruating students and 30 non-menstruating students who were used as control.

Selection criteria:

- Inclusion criteria
- Students who gave their consent
- Female students on menstruation

- Students who did not on folic acid or iron supplements
- Students who did not eat within 8 hrs before the sample collection

Exclusion criteria:

- Students who did not give their consent
- Students on folic acid or iron supplements
- Students who ate within 8 hours before the sample collection

Ethical approval/consideration: Before the commencement of the study, ethical approval was obtained from Ethical and Research Committee, Madonna University Nigeria, Elele Campus, Rivers State.

Informed consent: Individual consent was sought for and obtained from the subjects prior to sample collection.

Sample collection: The 5 mL of whole blood was collected from each student via venepuncture and was dispense into a plain container. The coagulated blood in the plain container was spun to retrieve the serum and the serum was stored in another plain container and refrigerated at -4°C.

Method of analysis: Serum iron and total iron binding capacity were analyzed by Spectrophotometric method. While serum ferritin and serum transferrin assay were analysed by Enzyme Linked Immuno-Sorbent Assay (ELISA) method.

RESULTS

Data analysis was conducted using a Statistical Package for Social Science (SPSS) version 22 Windows 10, the results were expressed in Mean±SD (standard deviation). Data was obtained from the analysis using paired samples t-test. Values were considered significant at $p<0.05$ and not significant at $p>0.05$.

Table 1 shows the demographic and characteristics of menstruating and non-menstruating female students of Madonna University, Elele, River State with mean ages of 20.47±1.25 and 21.87±2.56, respectively.

Table 2 shows a comparison of serum iron, total iron binding capacity, transferrin and serum ferritin between females in menstruation and females not in menstruation. Serum iron (74.24±20.68 µg/dL) and serum ferritin (92.40±16.57) in female not on menstruation were significantly higher than serum iron ((35.83±12.31 µg/dL) and serum ferritin (66.73±14.80) in female on menstruation ($P<0.01$) while total iron binding capacity (520.65±32.19 µg/dL) and transferrin (2.54±0.91) in female not on menstruation were significantly lower than total iron binding capacity (561.62±20.16 µg/dL) and transferrin (3.92±0.524) in female on menstruation ($p<0.01$).

Table 1: Demographics and characteristics of menstruating and non-menstruating students

Characteristic	N	Ages (years)	Percentage (%)	Mean±SD
Female on menstruation	30	18-22	50	20.47±1.25
Female not on menstruation	30	18-26	50	21.87±2.56

Table 2: Comparison of serum iron, total iron binding capacity, transferrin and serum ferritin between females in menstruation and females not in menstruation N = 30

Parameter	Menstruation	Non-menstruation	t-value	p-value
Serum iron(µg/dL)	35.83±12.31	74.24±20.68	-6.56	0.000
TIBC (µg/dl)	561.62±20.16	520.65±32.19	-4.47	0.001
Transferrin	3.92±0.524	2.54±0.91	5.57	0.000
Serum ferritin	66.73±14.80	92.40±16.57	-6.56	0.000

Significant at $p<0.01$

DISCUSSION

From current study, the demographic characteristics of menstruating and non-menstruating female students. The mean age of menstruating students was 20.47 years with a standard deviation of 1.25, while non-menstruating students had a mean age of 21.87 years with a standard deviation of 2.56.

Serum iron is a measure of the quantity of iron in the liquid part of the blood (the serum)[8]. Iron is an essential component of haemoglobin, the protein in red blood cells responsible for oxygen transport. Females who are not menstruating have significantly higher serum iron levels, indicating that they have more iron available in their bloodstream than females who are menstruating. This observation could be connected to the fact that monthly bleeding causes the loss of both blood and iron. Female's menstruation may experience a brief reduction in serum iron levels as a result[9].

Total iron binding capacity is a measure of the blood's ability to bind and transport iron. The findings of this study revealed that females who were not menstruating had considerably lower TIBC levels than females who were menstruating. Several reasons can explain the observed discrepancies in TIBC levels: Lower TIBC in females who are not menstruating indicates that they may have more easily available iron in their blood. This could be related to greater iron absorption or higher iron levels in the body[10]. Hormonal variations during the menstrual cycle might influence iron metabolism. The rise in TIBC during menstruation could be attributed to hormonal changes that affect iron-binding ability[11]. Dietary factors: Changes in TIBC levels can be attributed to variances in dietary intake, particularly iron-rich meals and supplements[11].

There was a significant difference in the comparison group's serum ferritin between females in menstruation and females not in menstruation. This was consistent with Kocaoz *et al*.[12] finding that ferritin levels and physical functions decreased dramatically as menstrual duration increased. Moschonis *et al*.[13] discovered that adolescent girls who menstruated had lower ferritin levels than females who did not menstruate. Ferritin depletion was discovered to be connected with high calcium intake, high consumption of fast foods and low consumption of chicken and fruits.

This study also found that females who are not menstruating have significantly lower transferrin levels than females who are menstruating. This was consistent with an earlier discovery that soluble transferrin is dramatically diminished in females not in menstruation when compared to females in menstruation[14]. This result indicates that when there is a decrease in iron levels due to menstrual blood loss, the body's iron-binding proteins, including transferrin, may become more active. Transferrin may increase its binding capacity to help transport and distribute the limited iron available in the bloodstream.

CONCLUSION

This research has demonstrated significant differences in iron status between females in menstruation and females not in menstruation. These findings have clinical implications for the assessment of iron status in females and highlight the need for considering menstrual status when interpreting hematological parameters. It also provides valuable insights into the impact of menstruation on these blood parameters and may have implications for clinical practice and further research in the field of women's health. It also highlights the resilience of the body's iron metabolism during menstruation. It is recommended that healthcare practitioners should consider the menstrual cycle when interpreting iron status and public health efforts should continue to promote iron-rich diets and menstrual health awareness among menstruating individuals. Investigating the influence of specific hormones and nutritional factors on iron status would provide a more comprehensive understanding. Further research may be needed to explore the underlying mechanisms behind these differences in iron status and to determine if they have any long-term health implications. Menstruating females considered at risk of iron deficiency should ensure

screening of iron status every 2-3 months. Regular and consistent tracking of the menstrual cycle for all menstruating females is recommended, specifically cycle length, menstrual bleeding length, relative heaviness of a menstrual bleed and cane or prevalence of premenstrual symptoms.

SIGNIFICANCE STATEMENT

The study investigated the impact of menstruation on iron levels among female students at Madonna University. It revealed significant differences in iron parameters between menstruating and non-menstruating females. Serum iron and ferritin were notably lower in menstruating females compared to their non-menstruating counterparts, indicating a potential risk of iron deficiency anemia. Conversely, total iron binding capacity and transferrin levels were higher in menstruating females, suggesting the body's compensatory response to menstrual blood loss. These findings underscore the importance of monitoring iron status in menstruating women to prevent iron deficiency complications.

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