Original Research Article

**Serum Ferritin, Percentage Transferrin saturation and Soluble Transferrin Receptor Levels in Apparently Healthy Nigerian Population.**

**ABSTRACT**

**BACKGROUND:** Iron markers are valuable in the assessment of iron deficiency as well as iron deficiency anemia. Values from white populations are usually dependent on despite variations in mean values of iron markers from region to region, race, age, gender and disease states.

**OBJECTIVES**: This study determines the mean serum Ferritin, Percentage Transferrin saturation and Soluble Transferrin Receptor Levels in Apparently Healthy Nigerian Population.

**METHODS**: This a cross-sectional study involving one hundred and twelve (112) apparently healthy adult persons age 18-70yrs. Full blood count (FBC), soluble Transferrin receptor assay was done. Percentage transferrin saturation (TSAT) was calculated from assay of the serum iron and the total iron binding capacity (TIBC) using the colorimetric method. Data was analyzed using SPSS software version 22.0. The level of statistical significance was set at p-value < 0.05.

**RESULTS:** The mean serum ferritin, TSAT and sTfR were 98.38±52.03ng/L, 32.73±6.86%, 17.68±6.11nmol/L respectively. The mean serum ferritin for males was 106.94±54.62 while that of females was 73.90±34.02ng/L. There was no significant statistical difference in the mean TSAT and sTfR among males and females. The reference range of serum ferritin, TSAT, sTfR among participants was 20.0-218.4ng/L, 21.5-47.4% and 8.8-26.9nmol/L.

**CONCLUSION:** The mean serum ferritin values in male participants in our study was almost twice that of the female participant. Serum ferritin appears to be higher in blacks than in white population. There appears to be a wide variations in sTfR levels from one population to another.

Key words: Ferritin, soluble transferrin receptor, TSAT, reference range, apparently Healthy.

**INTRODUCTION**

Iron deficiency is more prevalent in the developing world with effects more pronounced in infants as well as women of child bearing age, however it affects all human population with men inclusive [1]. Up to 50% of anemic cases worldwide has been linked to iron deficiency with about 2 billion persons said to be anemic [2]. Anemia is associated with diminished cognitive function and increased mortality and morbidity worldwide [3].

Cognitive and motor development are adversely impacted in children with iron deficiency anemia while adults may suffer from reduced productivity, exhaustion and diminished physical performance. Decrease in cognitive function, frailty and general increase in mortality and morbidity are common consequences of anemia in the elderly population [4,5].   
Iron status in human population is best measured using serum ferritin and transferrin receptor. Serum ferritin assess iron store. It usage as a tool for assessing iron status is limited in conditions of inflammation. Serum ferritin concentration falsely elevated in conditions of infection and also inflammation. Transferrin receptor concentration are not affected with inflammation and thus combining serum ferritin and soluble transferrin receptor provides a unique way of differentiating inflammation from iron deficiency [6].

Serum ferritin value of less than <30µg/L defines absolute iron deficiency in human population [7]. Study done by Jacobs et al in Uk shows a mean serum ferritin of 69.2ng/ml in men and 34.8mg/ml in females [8]. More recent studies on serum ferritin done by Beutler et al shows a value of 59.15ng/ml among African-American woman and 142.20ng/ml among African American Men [9]. Reference value for serum ferritin in study done by Munoz M among adults shows a value of 30–360 ng/ml [ 10].

Establishment of ranges in normal population is essential to interpret serum transferrin receptor levels in clinical settings due to non-availability of international standards and standardized methodology. Ranges in serum transferrin receptor levels in some related human studies ranges from 2.2 to 5.0 in adult male and 1.9 to 4.4 mg/l in adult female [11, 12]. A transferrin saturation (TSAT) less than 15% have been demonstrated to be insufficient for erythropoiesis [13]. Thus value of TSAT less than 15% defines iron deficiency.

Iron markers are valuable in the assessment of iron deficiency as well as iron deficiency anemia. The levels of iron markers are use in evaluating patients with iron deficiency with the hope of making diagnosis, monitoring patients and for research purposes. There are variations in mean values of most hematological parameters from region to region, race, age, gender and disease states. In most Literatures, values from white populations are usually dependent on. There is paucity of information on serum Ferritin, Percentage Transferrin saturation and Soluble Transferrin Receptor Levels in Apparently Healthy Nigerian Population, hence the need for this study.

METHODOLOGY:

Study Design

This a cross-sectional study conducted at the University of Ilorin Teaching Hospital, Ilorin, Kwara state, Nigeria. The study was done between July 2017 and October 2018.

Study Population

One hundred and twelve (112) apparently healthy adult persons age 18-70yrs were recruited consecutively among hospital staffs, Medical and Technologist students and Patient’s relative who gave consenting agreement. The recruitment was carried out with the use convenience sampling method. The study included 97 males and 29 females.

Inclusion Criteria

Apparently healthy adult volunteers age 18-70yrs who gave consent were also recruited.

Exclusion Criteria

-Those on hematinics

-Volunteer who are blood donor

-Those who had blood transfusion in the last one year

-Volunteer with febrile illness

Methods

Study Tools:

Written and verbal informed consent was taken. The socio-demographic data of the participants were collected using a self-administered structured questionnaire. With an aseptic technique, 4mls of venous blood was collected and subsequently dispensed into a well labeled vacutainer EDTA bottles. Full blood count (FBC) was run same day using 5 parts automated hematology analyzer, Sysmex KX-21 (Sysmex Corporation, Kobe, Japan).while serum ferritin was measured using ELISA with human Fe (ferritin) Elisa kit ( Elabscience, USA). Soluble Transferrin receptor assay was carried out using the sandwich ELISA methodology as per manufacturer’s insert in the kit (Monobind Inc Lake Forest, CA USA) with procedure done according to manufacturer’s instruction.

Blood samples of participants with normal hemoglobin levels and normal red blood indices and those with serum ferritin ≥12ng/ml were subsequently stored at -200C for the determination of soluble transferrin receptor levels. Percentage transferrin saturation was calculated from assay of the serum iron and TIBC using the colorimetric method (POINTE SCIENTFIC, INC iron/TIBC test kit, USA).

ETHICAL CONSIDERATION

Ethical approval for this study was obtained from the committee on Ethics Research of the University of Ilorin Teaching Hospital, Ilorin.

An informed written and verbal consent was obtained from the participants using a consent form.

STATISTICAL ANALYSIS

The Reference range and the mean values of the serum ferritin, TSAT and sTfR were analysed using descriptive and inferential statistics on SPSS software version 22.0. The reference limits of 95% proportion was determined from the 2.5th percentile and the 97.5th percentile

The level of statistical significance was set at p-value < 0.05.

**RESULTS**

The study population consist of 112 participants with 83(74.1%) males and 29(25.9%) females. Majority of the participants are within the ages of 46-65yrs. Table 1.

The mean Serum ferritin, TSAT and sTfR were 98.38±52.03ng/L, 32.73±6.86% and 17.68±6.11nmol/L respectively. The mean serum ferritin for males was 106.94±54.62 while that of females was 73.90±34.02ng/L with a higher statistically significant difference, p-value of 0.007. There was no significant statistical difference in the mean TSAT and sTfR among males and females. Table 2 and 3.

The reference range of serum ferritin, TSAT, sTfR among participants was 20.0-218.4ng/L, 21.5-47.4% and 8.8-26.9nmol/L. Table 4.

**DISCUSSION**

The mean serum ferritin for males in our study was 106.94±54.62 while that of females was 73.90±34.02ng/L. This result is similar to the report of Odunukwe in Lagos, Nigeria where mean ferritin among adults males and females participant who were malaria negative were 99.6±50.5ng/L and 66.5±44ng/L respectively [14].

The result of our findings is higher than that of Oluboyede et al done at lagos with a mean value of 72.4ng/L and 34ng/L in male and female respectively. This observe difference could be due to the fact that anemic and patients with low red cell indices were not excluded from the later study [15].However the mean serum ferritin values in male participant in our study was almost twice that of the female participant and is similar to report of Oluboyede et al. Jacob et al recorded a lower mean serum ferritin of 69.2ng/L in men and 34.8ng/L in women [8]. This is not surprising as serum ferritin appears to be higher in blacks than in white population as reported by Beutler et al [16].The reference range of serum ferritin in our study was 20.0-218.4ng/L.

The mean soluble transferrin receptor in our study was 17.68±6.86ng/L. Reference range of 8.8-26.9nmol/L. The mean sTfR in male was 17.76±6.17nmol/L while Female 17.47±6.03nmol/L was recorded among the female participants. Allen et al in USA reported a mean value of 19.6 ±5.0nmol/L among healthy adults population. with their mean value in Male being 20.1 ±4.8nmol/L and premenopausal female, 19.0 ±4.9nmol/L [17]. Similar study done among the Arabs and non-whites by Knox-macaulay shows a mean value of 21.8±7.7nmol/L with a reference range of 10.7-38.7nmol/L [18].Study done at Efobi R et al in PortHarcourt, reported a lower mean value of 10.4706±5.4118nmol/L with Male, 10.8nmol/L±5.76nmol/L and female, 9.6471±4.35nmol/L [19]. Van dan Bosch et al reported a lower mean value of 13.53 ± 3.06nmol/L with a reference interval of 10.12-20.71nmol/L [20].Higher values of mean serum sTfR compared to our findings was reported by Simek et al and Flower et al with a mean value of 21.65±9.4nmol/L and 66.24±1.12nmol/L [21,22].There appears to be a wide variations in sTfR levels from one population to another. Factors responsible for these variations may be due to assay method used as well as racial and genetic differences. Other factors may be attributable to environmental and dietary differences.

There was no significant difference in the mean values of serum sTfR among genders in our study as reported in some earlier studies done by Efobi et al, van den Bosch et al and Allen et al [17, 19, 21].

In healthy subjects concentration of sTfR concentrations offers useful assessment of iron-deficiency erythropoiesis [23].

However, there are problems associated with the reference ranges and different units used for the assays. There is a need for standardization of the methodology used for measurement of sTfR to enhance its usefulness.

The mean value of TSAT in our study was 32.73±6.86%. Male-32.74±6.72 and females- 32.70±7.37. The reference range of TSAT was 21.5-47.4%. The mean value of TSAT among males in our study is similar to report of previous findings by Oluboyede et al in Nigeria and that of Jacobs at al in Wales where values of 29.4% and 30.6% were reported respectively [8, 15]. The mean value of TSAT among females in our study is similar that of Cook et al in with a value of 31.2% but in contrast to that of Oluboyede and Jacobs were values of 23.8% and 22.0% were reported [8, 15, 24]. The discrepancy in the findings of these two studies may be due to the fact that Cook used a selected group in whom anemia and iron-deficient erythropoiesis were excluded. There is no significant difference in the mean TSAT among the genders in our study and this is similar to the findings in the study done by Milman et al [25].

**Conclusion:** The mean serum ferritin values in male participant in our study was almost twice that of the female participant. Serum ferritin appears to be higher in blacks than in white population. There was no significant difference in the mean values of serum sTfR and TSAT among genders in our study. There appears to be a wide variations in sTfR levels from one population to another.

This study provides information on the reference range of serum ferritn, serum sTfR and TSAT and the racial variations. However, studies with large sample size will be valuable in arriving at an acceptable reference range for serum ferritin among the blacks.

**Declaration Section**

**Ethical considerations**: Approval from the ethical committee of the University of Ilorin Teaching Hospital.

**Availability of data and material:** Data and material for the research work are available

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**Table 1: The Summary of Demographic Characteristics**

|  |  |  |  |
| --- | --- | --- | --- |
| N=112 | | Frequency | Percent |
| SEX | Male | 83 | 74.1 |
| Female | 29 | 25.9 |
|  |  |  |  |
| Age\_group | </= 25 | 7 | 6.3 |
| 26 – 35 | 8 | 7.1 |
| 36 – 45 | 13 | 11.6 |
| 46 – 55 | 31 | 27.7 |
| 56 – 65 | 33 | 29.5 |
| > 65 | 20 | 17.9 |
|  |  |  |  |
| Occupation | Trader | 15 | 13.4 |
| Civil servant | 64 | 57.1 |
| Teacher | 5 | 4.5 |
| Student | 3 | 2.7 |
| Retired | 2 | 1.8 |
| Others | 23 | 20.5 |
|  |  |  |  |
| EDUCATION | None | 14 | 12.5 |
| Primary | 16 | 14.3 |
| Secondary | 81 | 72.3 |
| Tertiary | 1 | .9 |
|  |  |  |  |
| RELIGION | Christianity | 41 | 36.6 |
| Islam | 71 | 63.4 |

**Table2: Mean values of Serum Ferritin. TSAT and sTFr**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **N=112** |  |  | **Shapiro-Wilk** | |
| **Mean** | **SD** | **Statistic** | **pValue** |
| **FERRITIN** | 98.38 | 52.03 | .928 | .000 |
| **TSAT** | 32.73 | 6.86 | .954 | .001 |
| **sTFr** | 17.68 | 6.11 | .922 | .000 |
| \* Normal Distribution p>0.05 | | | | |

\*Shapiro-wilk Test of Normality (Shapiro-wilk Test is greater 0.05, the data is normal. Below 0.05, the data significantly deviate from a normal distribution

**Table 3: The Mean Values of Iron Markers among Gender**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **SEX** | | N | Mean | PValue | Test |
| **TSAT** | **Male** | 83 | 32.74(6.72) |  |  |
| **Female** | 29 | 32.70(7.37) | 0.915 | Mann-Whitney U |
| **STFr** | **Male** | 83 | 17.76(6.17) |  |  |
| **Female** | 29 | 17.47(6.03) | 0.897 | Mann-Whitney U |
| **FERRITIN** | **Male** | 83 | 106.94(54.62)\* |  |  |
| **Female** | 29 | 73.90(34.02)\* | 0.007 | Mann-Whitney U |
| **Table** | | | |  |  |

**Table 4: Reference Range of serum ferritin, TSAT and sTFr among studied Participants**

|  |  |  |  |
| --- | --- | --- | --- |
| **Percentile** | **FERRITIN** | **TSAT** | **sTFr** |
| **2.5** | 20.0 | 21.5 | 8.8 |
| **5** | 22.6 | 23.5 | 8.9 |
| **10** | 35.0 | 24.4 | 9.8 |
| **25** | 64.0 | 27.4 | 13.0 |
| **50** | 88.0 | 32.0 | 16.8 |
| **75** | 122.0 | 37.3 | 23.8 |
| **90** | 186.0 | 43.9 | 26.2 |
| **95** | 215.4 | 46.4 | 26.3 |
| **97.5** | 218.4 | 47.4 | 26.9 |