International Journal of Advances in Medicine
Sikri T et al. Int J Adv Med. 2020 Feb;7(2):233-238
http://www.ijmedicine.com
pISSN 2349-3925 | eISSN 2349-3933
DOI: http://dx.doi.org/10.18203/2349-3933.ijam20200006

Original Research Article

Comparative evaluation of iron profile in premenopausal obese women with women of normal body mass index

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Received: 20 December 2019
Accepted: 26 December 2019

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ABSTRACT

Background: Obesity has become a common problem worldwide due to changes in lifestyle and food habits. Obesity has been associated with many chronic diseases like diabetes mellitus, hypertension, gallstones etc. Excessive adipose tissue through release of adipokines maybe a risk factor for derangements in iron parameters. Authors aim is to study Serum Iron, TIBC, and Serum Ferritin levels in Obese women (BMI >25 kg/m^2) in age group of 16 to 45 years and its comparison with normal BMI women.
Methods: The case control study was conducted on 100 patients divided into two groups. Group A included 50 patients of obese women (BMI >25 kg/m^2) in age group of 16 to 45 years. Group B consists of 50 control patients in similar age group with BMI of 18-23 kg/m^2. Serum Iron, TIBC, and Serum Ferritin levels were measured in both groups and compared.
Results: The study showed significant derangements of iron parameters in obese women.
Serum Ferritin was significantly raised ($p<0.001$) in obese women whereas Serum Iron and TIBC were significantly decreased in obese women as compared to control group. No significant difference was seen in Serum Hemoglobin and MCV.
Conclusions: Obesity is associated with derangements in iron parameters in women of reproductive age group similar to derangements seen in chronic inflammatory state.

Keywords: Body mass index, Obese women, Serum Ferritin, Serum Iron, Total iron binding capacity

INTRODUCTION

Obesity and Iron deficiency are two of the most common health problems worldwide. Obesity is defined as an abnormal or excessive fat accumulation that presents a risk to health.[1] Rising level of income, sedentary lifestyle and adoption of western high fat diets have led to rapid increase in prevalence of obesity in developing countries also like India.[2] Guidelines for diagnosis of obesity and abdominal obesity for India has been published in TheJournal of the Association of Physicians of India (JAPI 2009) that a BMI over 25 kg/m^2 is considered obese.[3]

The Journal of Association of Physicians of India (JAPI 2009) criteria for obesity has mentioned normal BMI to be between 18.0-22.9, overweight to be between 23.0 to 24.9, and obesity above 25. (Table 1). Adipose tissue in addition to its function as storage organ, also functions as an endocrine organ. It secretes a number of cytokines, termed adipokines. Excessive adipose tissue changes the amount and function of immune cells, especially

macrophages. These macrophage also releases adipokines in state of obesity. These adipokines are pro-inflammatory cytokines which in excess leads to systemic chronic low grade inflammatory state.[4] The C-reactive protein (CRP) is the first cytokine to be elevated in inflammatory conditions such as obesity. A strong relationship between obesity and CRP has been observed in all populations. Many studies have shown a link between obesity and derangements in iron parameters. Increased body adipose tissue, particularly visceral deposits, is associated with increased risk of iron deficiency which may be masked by high serum ferritin levels, presumably because the increase cytokines result in increased acute phase reactant synthesis resulting in increased macrophage sequestration and/or decreased intestinal absorption.[6]

Increased proinflammatory cytokines result in increased hepcidin synthesis and secretion. Hepcidin due to its negative control over Ferroportin, the primary iron exporter from the gut to plasma transferrin, results in decreased iron absorption. Hepcidin also causes sequestration of iron in macrophages and decreased availability of iron for Hemoglobin synthesis.[5] Increased acute phase reactant synthesis seen in inflammatory states has been evolved to primarily deprive microbes of iron in the body.

Table 1: JAPI classification of obesity.

JAPI 2009	BMI(kg/m2)
Normal BMI	18.0-22.9
Overweight	23.0-24.9
Obesity	>25.0

Generally premenopausal women are at higher risk for iron deficiency anemia. Regular menstrual loss, low iron intake and restrictive diets for losing weight increases the risk of iron deficiency among this group. Maternal iron deficiency has adverse effects on birth consequences, neonatal cognitive development and increased risk of postpartum depression. Therefore, insufficient iron level is an important issue which necessitates further studies of iron status among this population. In this study, we aimed to evaluate iron status and its association with obesity by studying iron biomarkers in a group of premenopausal obese women.

METHODS

The aims and objectives of this study to identify Obese women using Body Mass Index.(japi2009 Indian criteria).

- To evaluate S.iron, TIBC and S.ferritin values in both obese women and normal BMI women.
- To compare S.iron, TIBC and S.ferritin values in obese women and normal BMI women.
- Association of S.iron, TIBC and S.ferritin with BMI.

The study was done on 100 patients which were divided into two groups. Group A included 50 obese women (BMI>25kg/m2) in age group of 16-45 years. Group B consisted of 50 control women in age group of 16-45 with normal range BMI. Serum iron levels, Total Iron binding capacity and Serum Ferritin levels were measured in all patients included in the study. These cases were compared with controls. This was a case-control study conducted at OPD/IPD/EMERGENCY of SGRD Hospital, Vallah, Sri Amritsar over a period of 1.8 years from Jan 2018 to Aug 2019. Written consent for the trial was obtained from all patients for participating in the study.

Inclusion criteria (Group A)

This study population will include 50 obese premenopausal women aged between 16 to 45 with a measured body mass index (BMI) ≥ 25 Kg/m² (japi2009 Indian criteria).

Exclusion criteria

Diabetes, Hypothyroidism and Cushing disease, Hepatic disease including hemochromatosis, Renal disorder, Malignancy, Pregnancy or breast feeding, Infectious diseases, Bleeding disorders, Gastrointestinal bleed, Menorrhagia.

Hormonal contraceptive methods, or intake of specific drugs or substances(ACE Inhibitors, Levothyroxine, quinolones, carbidopa decreases iron absorption) which influence iron profile, body weight and inflammatory conditions such as zinc supplements and bariatric surgery.

Those who report iron supplementation, blood transfusion or donation will be recruited in the study after a washout period of 3 months. Subjects that received vitamin supplements, fish oil and minerals will be included in the study after a washout period of 2 weeks. Patients who fulfilled the inclusion criteria were included in the study. All patients and their relatives were informed about the study in their vernacular language and written consent was taken.

Detailed history of each patient was taken. Complete clinical examination was done and all the routine investigations like Complete Blood Count, Renal function tests, HbA1c, Thyroid profile, Liver function tests, Renal function tests, fasting blood sugar , Ultrasound whole abdomen were done.

The data collected was compiled and analysed statistically. Statistical analysis was done using percentages, mean values, standard deviation, Chi-square test. The level of significance used was 0.05 level for the corresponding degree of freedom to draw the inference. A p-value < 0.05 was considered statistically significant and a p > 0.05 was considered as not statistically significant.

RESULTS

In this study, there is statistically significant difference in mean Serum Iron levels between obese women and healthy controls (p value=0.028). Mean Serum Iron levels in obese women and healthy controls are 55.87±10.23 and 61.66±15.22 respectively i.e Serum Iron levels were lower in Obese women.

Mean Serum Iron in BMI group 18 to 20.5 is 62.33±15.31, in BMI group 20.51 to 23.0 is 61.28±15.41, in BMI group 25 to 27.5 is 59.52±9.71, in BMI group 27.51 to 30.0 is 55.75 ± 10.94 , in BMI group above 30.0 is 50.45±7.44 (Table 2).

Table 2: Correlation of BMI with serum iron.

BMI	Case		Control	
	Mean	SD	Mean	SD
18-20.5	62.333	15.3124	-	-
20.51-23.0	61.281	15.4117	-	-
25-27.5	-	-	59.529	9.7154
27.51-30.0	-	-	55.759	10.9401
>30	-	-	50.455	7.4480
Mean serum iron	55.874	10.2309	61.660	15.2274
p-value	0.028			

Table 3: Correlation of BMI with TIBC.

BMI	Case		Control	
	Mean	SD	Mean	SD
18-20.5	372.167	35.3923	-	-
20.51-23.0	368.688	63.2269	-	-
25-27.5	-	-	364.200	26.4316
27.51-30.0	-	-	340.727	44.8629
>30	-	-	332.909	55.2566
Mean TIBC	346.988	43.3440	369.940	54.4660
p-value	0.022			

In this study, there is statistically significant difference in mean TIBC between obese women and healthy controls (p value=0.022). Mean TIBC in obese women and healthy controls are 346.98±43.34 and 369.94±54.46 respectively i.e mean TIBC levels were lower in Obese women.

Mean TIBC in BMI group 18 to 20.5 is 372.16±35.39, in BMI group 20.51 to 23.0 is 368.68±63.22, in BMI group 25 to 27.5 is 364.2 ± 26.43, in BMI group 27.51 to 30.0 is 340.72±44.86, in BMI group above 30.0 is 332.90±55.25 (Table 3).

Figure 2 shows mean Serum Iron, TIBC, Serum Ferritin in different BMI groups. In BMI group of 18 to 20.5, mean S. Iron, TIBC and S. Ferritin is 62.33, 372.16 and 37.67 respectively. Similarly, in BMI group of 20.51 to 23.0, mean S.iron, TIBC and S. ferritin is 61.28, 368.68 and 58.67 respectively. In BMI group of 25.0 to 27.50, mean S. iron, TIBC and S. ferritin is 59.52, 364.20 and 59.49 respectively. In BMI group of 27.51 to 30.0, mean S. iron, TIBC and S. ferritin is 55.75, 340.72 and 109.55 respectively. In BMI group above 30, mean S.iron, TIBC and S. ferritin is 50.45, 332.9 and 140.79 respectively (Figure 2).

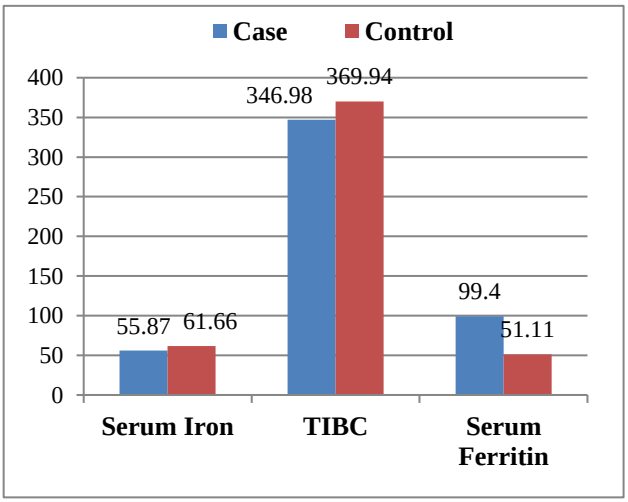

Figure 1: Mean S.iron, TIBC and S. ferritin in cases and control. Mean S.iron, TIBC and S. Ferritin in cases is 55.87, 346.98 and 99.4 respectively; and in control are 61.66, 369.94 and 51.11 respectively.

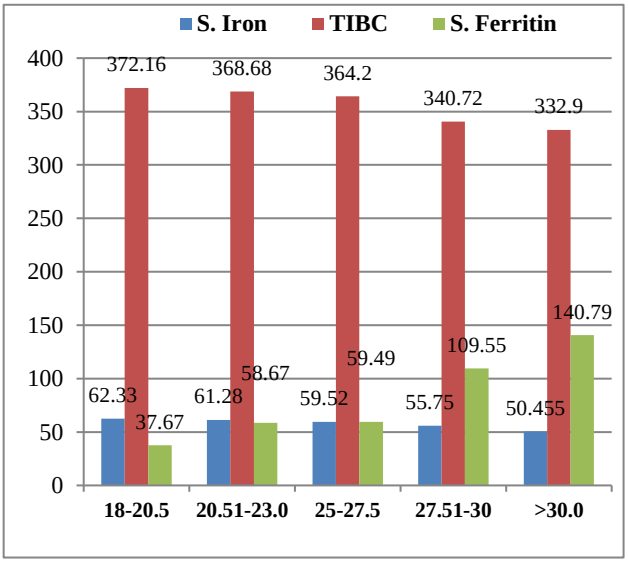

Figure 2: Mean serum iron , TIBC and serum ferritin in different BMI groups

In this study, there is statistically significant difference in Mean Serum Ferritin levels between obese women and healthy controls (p value= 0.001). Mean Ferritin levels in obese women and healthy controls are 99.41±43.90 and 51.11±18.13 respectively i.e Serum Ferritin level is

higher in Obese women. Mean S. Ferritin in BMI group 18 to 20.5 is 37.67±13.07 , in BMI group 20.51 to 23.0 is 58.67±16.18, in BMI group 25 to 27.5 is 59.49±8.94, in BMI group 27.51 to 30.0 is 109.55±33.16, in BMI group above 30.0 is 140.79±46.76 (Table 4).

Table 4: Correlation of serum ferritin with BMI.

BMI	Case		Control	
	Mean	SD	Mean	SD
18-20.5	37.672	13.0779	-	-
20.51-23.0	58.672	16.1821	-	-
25-27.5	-	-	59.494	8.9420
27.51-30.0	-	-	109.559	33.1697
>30	-	-	140.791	46.7644
Mean serum ferritin	99.408	43.9018	51.112	18.1295
p-value	0.001			

Table 5: Correlation of serum hemoglobin with BMI.

BMI	Case		Control	
	Mean	SD	Mean	SD
18-20.5	12.417	.6973	-	-
20.51-23.0	12.334	.8079	-	-
25-27.5	-	-	12.312	0.5904
27.51-30.0	-	-	12.250	0.7866
>30	-	-	11.809	0.7063
Mean Hb	12.174	.7211	12.364	0.7637
p-value	0.204			

In this study, there is no difference seen in mean Serum Hemoglobin between obese women and healthy controls (p value= 0.204). Mean Serum Hemoglobin levels in obese women and healthy controls is 12.17± 0.72 and 12.36±0.76 respectively i.e in this study, although Serum Hemoglobin was lower in obese women than healthy controls but it was not statistically significant. Mean Serum Hemoglobin in BMI group 18 to 20.5 is 12.41±0.69, in BMI group 20.51 to 23.0 is 12.33±0.80, in BMI group 25 to 27.5 is 12.31±0.59, in BMI group 27.51 to 30.0 is 12.25±0.78, in BMI group above 30.0 is 11.80±0.70 (Table 5).

In this study, there is no difference seen in mean MCV between obese women and healthy controls(p value= 0.122). Mean MCV levels in obese women and healthy controls is 81.87±5.93 and 83.60±5.08 respectively i.e in this study, although MCV was lower in obese women than healthy controls but it was not statistically significant. Mean MCV in BMI group 18 to 20.5 is 82.63±4.93, in BMI group 20.51 to 23.0 is 84.14±5.15, in BMI group 25 to 27.5 is 84.61±5.83, in BMI group 27.51 to 30.0 is 79.80±6.94, in BMI group above 30.0 is 78.80±6.94 (Table 6).

Table 6: Correlation of MCV with BMI.

	Case		Control	
	Mean	SD	Mean	SD
18-20.5	82.633	4.9395	-	-
20.51-23.0	84.144	5.1561	-	-
25-27.5	-	-	84.612	5.8390
27.51-30.0	-	-	81.300	4.6779
>30	-	-	78.809	6.9418
Mean MCV	81.878	5.9332	83.600	5.0814
p-value	0.122			

DISCUSSION

In this present study, author have evaluated the levels of Serum Iron, TIBC and Serum Ferritin in obese women of reproductive age and have compared this with controls.

Iron and TIBC

In this study, mean serum iron in obese group patients (55.87±10.23) was significantly lower($p<0.028$) than healthy controls (61.66 ±15.22). In this study, mean TIBC in obese group patients (346.98±43.34) was significantly lower ($p<0.022$) than healthy controls (369.94±54.46). The results of this is similar to study conducted by Neymotin F et al, results suggested a negative relationship between levels of iron blood content and individual BMI.[6] Other studies that supported this study is the study conducted by Del Giudice EM et al, also showed lower iron and transferrin saturation in obese children compared with controls.[7]

Cepeda-Lopez et al, found that overweight individuals are at higher risk of iron deficiency than normal weight individuals.[8] Cepeda-Lopez AC et al, showed that obese Mexican women had significantly higher risk of iron deficiency than normal weight individuals.[9] Stankowiak-Kulpa H et al, showed that obese women were characterized by a significantly lowere mean Red blood cell volume, serum iron level, and transferrin saturation.[10] Study conducted by Zhao L et al, concluded that obesity is significantly associated with iron deficiency, and early monitoring and treatment of iron deficiency and obese individuals was recommended.[11] Study conducted by Chambers EC et al, showed an inverse association of measures of body fat distribution and total fat mass with serum iron level in Hispanic women.[12] Obesity being a state of chronic low grade inflammation results in activation of hepcidin Ferroportin axis and decreased iron absorption and transport.[5]

Ferritin

In this study, mean Serum Ferritin in obese group patients (99.41±43.90) was significantly lower($p<0.001$) than healthy controls.(51.11±18.13). Study conducted by LB Yanoff et al, showed that Serum Iron, transferrin receptor was lower while ferritin was higher in obese than non-

obese subjects.[13] Faiza Alam et al, showed that obese women showed increased serum Ferritin and CRP in obese versus lean subjects.[14] Akram Ghadiri found no difference in serum hemoglobin, MCV, serum iron, TIBC, and ferritin between normal weight and obese subjects was found.[15] This may be due to age group of 18-65 adults patients which is different from premenopausal age group women of 16 to 45 years in this study. A study conducted by Fogelholm M et al, showed that number of reported bleeding days was significantly associated with ferritin.[16] Thus menstruating women included in this study may be responsible for different result compared to Akram Ghadiri et al. Study conducted by Ya-Fang Huang et al, showed that percentage of low plasma ferritin declined as BMI increased, but the percentage of low Serum Iron rose, from underweight to obesity groups.[17]

Study conducted by Abidullah Khanet et al, Ferritin has been strong positive correlation with BMI.[18] Study conducted by Shattnawi KK et al, showed that plasma ferritin was higher in obese and overweight adolescents versus normal weight adolescents.[19] Study conducted by Iwasaki T et al, showed that serum ferritin was significantly correlated with visceral fat area, subcutaneous fat area, and the hepatic fat content indicating that serum ferritin may be a useful indicator of systemic fat content and degree of insulin resistance.20

The increase in serum ferritin observed in this study maybe due to effect of adipokines which result in chronic low-grade inflammation further resulting in iron sequestration and role of ferritin as a inflammatory marker. Thus, in obese subjects, Serum ferritin may not be a correct indicator.

CONCLUSION

Author conclude that in obese women of reproductive age group, serum Iron and TIBC are significantly decreased compared with controls, whereas serum ferritin is significantly increased compared with controls. Therefore, improvement in BMI to normal range in this age group may improve iron parameters. Obesity adds to the derangements in iron parameters as women of reproductive age group are already predisposed to iron deficiency.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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Cite this article as: Sikri T, Singh R, Kaur J, Kaur I. Comparative evaluation of iron profile in premenopausal obese women with women of normal body mass index. Int J Adv Med 2020;7:233-8.