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Obesity and visceral fat: Indicators for anemia among household women visiting a health camp on world obesity day

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ABSTRACT

Background: Obesity and anemia are among most common non-communicable diseases not only in India but around the world. These conditions are observed together more among females. Obesity being a risk factor for various lifestyle disease, is hypothesized to affect iron absorption and hence level of hemoglobin.
Objectives: To find the prevalence of obesity and anemia among given sample population and to find out various factors affecting obesity and anemia.
Methods: A cross sectional study was done among married females visiting a health camp on World Obesity Day. They were assessed using a self-administered semi-structured questionnaire and anthropometric examination. Basic clinical examination, body fat analysis and blood indices were also done.
Results: The mean age of study participants was found to be 30.27 ± 5.3 years. 487 (70.78%) of the study participants were found obese with BMI >23 kg/m^2 and 61 (8.86%%) participants were found to be anemic. Increasing age, education level, menstrual flow, gravida, parity were found to be significantly associated with obesity. Among participants who were anemic, majority (86.9%) had low visceral fat, suggesting the relationship of anemia and fat metabolism is more related to peripheral fat deposition and not much to visceral fat ($p < 0.05$).
Conclusion: Our study findings suggest there is a need to carry out in-depth longitudinal and multicentric studies on larger population to see the exact relationship between visceral fat/obesity and anemia as in our study, the prevalence of anemia was very less and thus giving confusing results about visceral and total body fat relation with anaemia.

1. Introduction

In times of epidemic of non-communicable diseases, prevalence of dietary and lifestyle diseases is on the rise. Among others, obesity and iron deficiency anemia have affected many people worldwide.[1,2] Obesity is among various risk factors for various other diseases like diabetes, cardiovascular diseases, and hypertension.[3] Anemia, specifically iron deficiency anemia is among most prevalent nutritional deficiencies around the world.[4]

An alarming trend of increased proportions of overweight/obese women is observed across various low- and middle-income countries. The reason for this is attributed to state of demographic transitions in these countries and lifestyles changes being observed across the world.[5] India has also seen a steady rise in several lifestyle diseases. Obesity and iron deficiency anemia cases are also on the rise across all age groups and gender, but a greater prevalence is observed among females especially for iron deficiency anemia.[6,7]

Various theories have been proposed to indicate relationship between obesity and iron deficiency anemia. Dietary habits, increased blood volume among obese individuals, genetic factors are few factors which may explain this relationship but role of hepcidin explains the co-existence of obesity and anemia to a great extent.[8–11] Hepcidin regulates absorption of iron from the gut and is one of inflammatory cytokines released from adipose tissues. It is suggested that hepcidin related mechanism of iron absorption may cause iron deficiency among obese individuals.

Considering the importance of maintenance of Hb and keeping the BMI in normal range, it is imperative to know the status of problem

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among various strata of society and across various age groups of women. It is also important to enquire about any possible relation between anemia or other factors with obesity.

Since there is paucity of literature on relationship of obesity as a condition and anemia among females in India. The association of body fat and visceral fat with anemia is least explored in our settings. As obesity as a lifestyle disease is affected by large number of factors, association of specific factors in conjunction with anemia is also least explored.

A study was planned to be conducted at a health camp on world obesity day with objectives of finding the prevalence of obesity and anemia among given sample population and to find out various factors affecting obesity and anemia.

2. Material and methods

A cross sectional study was conducted as a part of World Obesity Day Celebrations in which a Health Camp was organized at a central location of a central govt employees' colony considering the diversity of population residing there. Residents of the colony could visit the camp where health education was imparted to all. Specific screening for obesity and anemia was done for all adult married females residing in the colony.

Married female residents of more than 18 years of age without any complain who volunteered to attend the health camp were asked to be a part of the study. All consenting female homemakers, who were residing in the colony for more than 6 months were included in the study. All those who were working, having any known co-morbid condition were excluded from the study.

All participants were assessed using a questionnaire, anthropometry, body fat analysis and blood investigation for hemoglobin and blood indices. The study tool used was a pre-tested, semi structured questionnaire to collect data regarding socio-demography (age, native state, education etc), dietary habits and menstrual history.

They were also asked to undergo basic anthropometric measurements including height and weight. The weight was measured using digital weighing scale (SECA 874U digital scale) and height was measured using a stadiometer (SECA 213 Stadiometer) and BMI was calculated. Body Fat Analysis was done for each participant using digital body fat analyzer (Omron – Karada HBF- 375 Body Fat Analyzer). Karada Scan measures body resistance by using weak currency flowing through both hands and both feet by BI method (Bioelectrical Impedance/biological resistance method). Thus tissues with more water content in human body tend to conduct electricity (such as muscle and vein) easily. Fat tissue almost conducts no electricity. The body feature is used to calculate rate of fat tissue and non-fat tissue, also visceral and peripheral fat. Blood pressure was also measured using a digital blood pressure monitor (Omron Hem 7124 In BP Monitor) and BP, pulse rate was recorded.

Veinous blood samples were also collected for laboratory investigations including hemoglobin, RBC, MCV and MCHC. These samples were sent to central laboratory of nearest government hospital of the area.

The study protocol was pre-approved from Institutional ethics committee. All participants were informed in detail about the study objectives and procedure. A written consent was taken from each participant. All data collected was kept for research purpose only and confidentiality was maintained. The data collected was entered in MS Excel for analysis. Analysis was done using SPSS Ver 21.0. The statistical analysis was done using chi-square/fisher's exact test and unpaired *t*-test. A p value of less than 0.05 was considered significant.

3. Results

A total of 688 females participated in the study. Mean age of the population was 30.56 ± 5.27 years. Maximum number of participants (119, 17.3%) belonged to the state of Uttar Pradesh followed by Maharashtra (99, 14.4%). This was followed by Bihar (65, 9.4%), Uttarakhand (53, 7.7%), West Bengal (39, 5.7%) and Jammu & Kashmir (38, 5.5%). Only 01 participant each belonged to Arunachal Pradesh, Delhi, and Tripura. One participant also belonged to Nepal. Majority (415, 56.9%) of them were in the age group 18–30 years followed by in the age group 30–40 years (288, 39.5%). Only 26 (3.6%) of the participants were above 40 years of age.

When asked about their educational status, it was observed that majority (550, 75.5%) of them had completed their higher education. Majority (385, 52.8%) of the participants had non-veg as dietary preference.

Out of 688 females who participated, 487 (70.78%) were found to have BMI more than 23 kg/m^2 and were categorized as obese and 61 (8.86%%) participants were found to be anemic with a hemoglobin value of less than 12 g per dl.

Among participants who had normal BMI, three fourth (75.12%) were of age 18–30 years and those who were obese majority (~50.0%) of them were of age 30–40 years. This difference was found to be significant ($p < 0.05$). Also, among participants with normal BMI, most of them (47.76%) were non-vegetarian, majority (52.24%) were graduate and above, majority (50.75%) had their last-born child in the age group 1–5 years and majority (89.39%) of them had medium menstrual flow. Among obese participants, though majority (53.80%) of them were non-vegetarian ($p = 0.27$), but many of them were either educated to higher secondary school or graduate and above (34.29% and 38.19%), a large number had their last-born child in the age group of 1–5 and 5–12 years (40.29% and 40.08%). These differences were found to be significant ($p = 0.007$ and < 0.05). Majority (86.07%) of the obese participants also reported their menstrual flow to be moderate ($p = 0.235$). (Table 1).

Mean age of the participants who had normal BMI was 28.26 ± 4.81 years as compared to 31.51 ± 5.16 years for participants who were obese. This difference was found to be significant ($p < 0.05$). Mean Gravida and parity status of participants having normal BMI was 1.97 ± 0.176 and 1.57 ± 0.816 as compared to 2.24 ± 1.026 and 1.82 ± 0.754 of participants having obesity. This difference was also found to be significant ($p < 0.05$). Mean of number of living children for participants who had normal BMI were 1.54 ± 0.775 as compared to 1.81 ± 0.748 of obese participants. This difference was found to be significant ($p < 0.05$). Mean height was less (155.73 ± 5.44 cm vs 157.44 ± 5.72 cm)

Table 1
Sociodemographic profile and Obesity status of study participants (N = 688).

Sl No	Variable	BMI		p value
		Less than 23 kg/m^2	More than 23 kg/m^2	
01.	**Age Group**			**P<0.05**
	18–30 years	**151 (75.12%)**	225 (46.2%)	
	30–40 years	46 (22.88%)	**240 (49.28%)**	
	40 years and above	04 (2.0%)	22 (4.52%)	
02.	**Diet**			P = 0.275
	Veg	16 (7.97%)	28 (5.75%)	
	Non-veg	**96 (47.76%)**	**262 (53.80%)**	
	Egg-veg	89 (44.27%)	197 (40.45%)	
03.	**Education**			**P = 0.007**
	Primary	05 (2.49%)	16 (3.28%)	
	Secondary	33 (16.42%)	118 (24.24%)	
	Sr Secondary	58 (28.85%)	167 (34.29%)	
	Graduate and above	**105 (52.24%)**	**186 (38.19%)**	
04.	**Age of last child born**			**P<0.05**
	0–1 years	41 (20.61%)	48 (10.02%)	
	1–5 years	**101 (50.75%)**	**193 (40.29%)**	
	5–12 years	49 (24.62%)	192 (40.08%)	
	>12 years	08 (4.02%)	46 (9.61%)	
05.	**Menstrual flow**			P = 0.235
	Light	11 (5.55%)	45 (9.49%)	
	Medium	**177 (89.39%)**	**408 (86.07%)**	
	Heavy	10 (5.06%)	21 (4.44%)	

and mean weight was more (66.56 ± 9.145 kg vs 51.142 ± 5.723 kg) among obese participants and these differences were found to be significant ($p < 0.05$). Mean diastolic and systolic blood pressures were also found to be raised among obese participants as compared to participants with normal BMI, this difference was also found to be significant ($p < 0.05$). (Table 2).

71.1% participants with Hb levels >12 g/dl were found to be obese while among participants with Hb level <12 g/dl, 67.2% were found to be obese. This difference was however not found to be significant ($p = 0.520$). Among participants having high visceral fat proportion of participants having Hb levels >12 g/dl was more than those having Hb < 12 g/dl. Three fourth (76.2%) of the study participants having Hb level <12 g/dl were found to have normal visceral fat while almost 90% (86.9%) of the participants having Hb < 12 g/dl had normal visceral fat. This difference of proportions was also found to be significant ($p = 0.036$). 61.6% of the participants with Hb > 12 g/dl were having high body fat percentage and 55.7% of participants having Hb < 12 g/dl were having high body fat percentage. This difference of proportion was not significant ($p = 0.410$) (Table 4).

4. Discussion

Obesity is thought to because of multiple physiological problems and being related to excess deposition of fat is also thought to be a cause of anemia.[12,13] Multiple studies have shown increased prevalence of obesity during past few years, its distribution of obesity across various age groups and indicators of obesity.[14,15]

In the present study also, more than two third (70.78%) of the participants were found to be obese with BMI >23 kg/m^2. Similar results were reported by R B Singh et al.[16] in their study, where 55% of women were obese with maximum (67%) being from Calcutta. 8.86% of the participants in the present study were also found to be anemic with Hb < 12 g/dl. This prevalence of anemia was far lower from as reported in NFHS-5 and by ME Bently and PL Griffiths in their study where 66.4% and 48.79% females were reported to be anemic.[17,18] This difference may be attributed to socio-economic and educational attributes apart from the small size and study area.

Majority of women who were obese in this study, were in age group of 30–40 years and the association was statistically significant and there was increased prevalence of obesity as the age increased ($p < 0.05$). Similar results were reported by Sangita Girdhar et al.,[19] where majority of obese participants were of 30 years and above and increased prevalence of obesity was reported as the age increased. Education is also found to be significantly associated ($p < 0.05$) with obesity in the present study, with majority of participants who had their BMI <23 kg/m^2, being graduate and above like the results reported by S Girdhar et al.[19] in their study.

Mean systolic and diastolic blood pressure was found to be significantly increased among obese participants as compared to participants with normal BMI ($p < 0.05$). This supports the multifactorial causation theory of non-communicable diseases and further studies may investigate the relationship with other factors associated.

Many study participants having normal as well as higher BMI in the present study reported to have their menstrual flow be moderate, differing from the results reported by Monika Singh et al.,[20] where moderate to high flow was reported by majority of participants who were found to be obese. This may be attributed to the different age profile of study participants of their study. Mean gravida and parity was reported to be significantly more among females with BMI>23 kg/m2 as compared to females with normal BMI ($p < 0.05$) in the present study, like the results of study by Hajar Adib Rad et al.[21]

Though study participants having normal Hb level were proportionately more than those with anemia according to their BMI and body fat percentage, this difference was found to be non-significant ($p = 0.520$ and 0.410). The results here differed from the study done by Thamban V et al., where anemia was found to be significantly associated ($p = 0.000$).[22]

Among participants who were anemic, many (86.9%) had low visceral fat, significantly suggesting the relationship of anemia and fat metabolism is more related to peripheral fat deposition and not much to

Table 2
Anthropometric/menstrual profile and obesity status of study participants (N = 688).

Sl No.	Variable	BMI		P value
		Less than 23 kg/m^2	More than 23 kg/m^2	
01.	Age (mean ± SD, years)	28.26 ± 4.812	31.51 ± 5.169	**P<0.05**
02.	Gravida (mean ± SD)	1.97 ± 1.176	2.24 ± 1.026	**P<0.05**
03.	Parity (mean ± SD)	1.57 ± 0.816	1.82 ± 0.754	**P<0.05**
04.	Abortion (mean ± SD)	0.4 ± 0.694	0.44 ± 0.655	P = 0.46
05.	Living children (mean ± SD)	1.54 ± 0.775	1.81 ± 0.748	**P<0.05**
06.	**Menstruation**			
	Cycle frequency (mean ± SD, Days)	30.97 ± 7.047	31.42 ± 7.768	P = 0.48
	Duration of flow (mean ± SD, days)	4.12 ± 1.203	4.07 ± 1.765	P = 0.70
07.	Height (mean ± SD, cm)	157.44 ± 5.724	155.73 ± 5.446	**P<0.05**
08.	Weight (mean ± SD, kg)	51.142 ± 5.723	66.56 ± 9.145	**P<0.05**
09.	Pulse (mean ± SD, per min)	86.75 ± 10.69	88.22 ± 9.99	P = 0.08
10.	BP Systolic (mean ± SD, mm of Hg)	116.96 ± 10.96	123.80 ± 11.48	**P<0.05**
11.	BP Diastolic (mean ± SD, mm of Hg)	74.33 ± 7.77	79.17 ± 7.301	**P<0.05**

Table 3
Distribution of study participants according to Blood indices and Obesity status (N = 688).

Sl No.	Variable	BMI		P value
		Less than 23 kg/m^2	More than 23 kg/m^2	
01.	Hb level (mean ± SD, g/dl)	12.4 ± 1.173	12.574 ± 1.03	P = 0.05
02.	RBC (mean ± SD)	4.67 ± 0.404	4.66 ± 0.407	P = 0.74
03.	MCV (mean ± SD)	82.63 ± 7.001	83.59 ± 5.672	P = 0.06
04.	MCHC (mean ± SD)	33.76 ± 1.240	33.67 ± 1.980	**P = 0.01**

Mean Hb level, RBC and MCV were found to be 12.4 ± 1.17 g/dl, 4.67 ± 0.40 and 82.63 ± 7.00, respectively among participants with normal BMI and 12.574 ± 1.03 g/dl, 4.66 ± 0.40 and 83.59 ± 5.67 respectively among obese participants. However, these differences were not significant ($p > 0.05$). Mean MCHC was found to be significantly different among participants with normal BMI and among obese participants ($p = 0.019$) (Table 3).

Table 4
Association of Fat indices of study participants and anemia status (N = 688).

Sl No	Variable	Hemoglobin level		p value
		More than 12.0 g/dl	Less than 12.0 g/dl	
01.	**BMI**			P = 0.52
	Normal	181 (28.9%)	20 (32.8%)	
	Obese	**446 (71.1%)**	**41 (67.2%)**	
02.	**Visceral Fat content**			**P = 0.03**
	High	149 (23.8%)	08 (13.1%)	
	Normal	**478 (76.2%)**	**53 (86.9%)**	
03.	**Body Fat percentage**			P = 0.41
	High	**386 (61.6%)**	**34 (55.7%)**	
	Normal	241 (38.4%)	27 (44.3%)	

visceral fat ($p < 0.05$). Not much could be found exploring this relationship of fat distribution status and anemia in the literature, despite best efforts. So, more studies need to be planned for this to strengthen the concept being put forward.

Of course like any other study, this study also had limitations where in the sample size was small and the study was cross-sectional in nature. Our sample only included only married women and unmarried girls were not included, single study area and limited population distribution.

5. Conclusion

Age, Gravida, parity, and number of living children had a statistically significant association with obesity/overweight ($P < 0.05$). Visceral fat had statistically significant association with those with anaemia. Among participants who were anemic, majority (86.9%) had low visceral fat, suggesting the relationship of anemia and fat metabolism is more related to peripheral fat deposition and not much to visceral fat ($p < 0.05$). Our study findings suggest there is a need to carry out in-depth longitudinal and multicentric studies on a larger population to see the exact relationship between visceral fat/obesity and anaemia as in our study, the prevalence of anaemia was very less and thus giving confusing results about visceral and total body fat relation with anaemia.

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Declaration of competing interest

Nil.

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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