Original Article

Obesity as an Emerging Risk Factor for Anemia

Benash Altaf, Rana Khurram Aftab, Zeeshan Ali Khan, Rana Muhammad Tahir Salam, Fakiha Behram

ABSTRACT

Background: Obesity and anemia are important health challenges worldwide particularly in females and children. These conditions are prevalent in most developing countries and have devastating effect on mental as well as physical health. Evidences are available showing the association between these two conditions. The aim of the study was to determine the frequency of anemia among obese subjects and to find association between BMI and hemoglobin.

Methodology: A cross-sectional comparative study comprised of 216 subjects was conducted at Aziz Fatimah Medical and Dental College, Faisalabad from April 2018 to September 2018. After approval from ethical committee, all the relevant data including gender, age, height and weight were recorded on a predesigned proforma. BMI was calculated with help of a formula height in meter^2/weight in kg. Hemoglobin (Hb) levels were obtained by Sahli's method. Data was analyzed by using SPSS 21.0. Hemoglobin levels were compared between obese and non-obese subjects by Mann whitney test. Percentages were compared by X^2. Regression analysis was used to find association between BMI and Hb.

Results: Study comprised of 216 subjects of mean age 19.9±0.88. Of total studied population 38 .0% were obese having BMI ≥ 25kg/m^2. Significant differences were observed in the mean BMI (P value= 0.001*) and Hb (P value= 0.021*) between the studied groups. Hemoglobin levels were lower in obese individuals than non-obese. (10.4 Vs 12.18) Regression analysis reveals significant negative association of BMI with Hb (β, - 1.036, P value =0.000*).

Conclusion: Anemia is more prevalent among obese individuals than non-obese subjects.

Key Words: Anemia, BMI, Hemoglobin, Sahli's method.

Introduction

Anemia is an intractable public health problem in which oxygen carrying capacity of blood is reduced usually due to reduction in hemoglobin (Hb) which is insufficient to fulfill the body requirements.[1] Global prevalence of anemia is 43% in developing countries and 9% in developed nations.[2] Prevalence of this condition is continuously increasing affecting all the age groups, caused by lack of balance diet in both rural as well as urban areas of developing countries.[2] Poor eating habits due to lack of unavailability of balanced diet and lack of knowledge of healthy eating habits are responsible for developing non-communicable and communicable diseases like, obesity and anemia etc.[3] It is well documented that anemia has a huge impact on cognition level, decreases physical and mental output and labor productivity, hence retards economic and social development.[4] Role of negative iron balance in contribution of anemia has been well documented. It is evident that iron homeostasis is affected by obesity and obesity-related insulin resistance. Iron deficiency and anemia are frequent findings in subjects with progressing morbid obesity.[5] Decreased dietary iron uptake due to lower enterocyte iron absorption can be considered as the pathophysiological hallmark of iron dysregulation in obesity.[6] Reduced iron absorption is most probably due to elevated iron regulatory hormone, hepcidin which blocks cellular iron export by blocking iron exporter ferroportin (FPN) found in duodenal enterocytes.[5,7] Elevation of pro-inflammatory cytokines which interfere with erythropoietin synthesis and also suppress the response of erythroid precursors to erythropoietin is a well-recognized mechanism in the development of anemia in chronic conditions like morbid obesity.[8] Usually iron deficiency develops gradually and become clinically apparent during adolescence when iron requirements are increased, and

Dr. Benash Altaf
Assistant Professor
Aziz Fatimah Medical and Dental College, Faisalabad.
Dr. Rana Khurram Aftab
Assistant Professor
King Edward Medical University, Lahore
Dr. Zeeshan Ali Khan
Senior Registrar Orthopedic
DHQ Hospital Faisalabad
Dr. Rana Muhammad Tahir Salam
Sonologist
Aziz Fatimah Hospital, Faisalabad.
Fakiha Behram
Final year Student BS Bio.Tech
Foreman Christian College Lahore
Correspondence:
Dr. Benash Altaf
Email: altafbenash@gmail.com

in morbid obesity during adulthood. Anemia has detrimental effects on the course of obesity-related conditions; thorough screening and management are required for both conditions.

Objective

The objective of the study was to determine the frequency of anemia among obese subjects and to evaluate association of hemoglobin with body mass index (BMI).

Methodology

A cross sectional study was conducted at a Faisalabad based Medical Institute from April 2018 till September 2018. It was comprised of 216 medical students, who were enrolled in this study by convenient non-probability sampling technique after obtaining approval from the ethical review committee. Informed consent was taken from each participant before recruiting into the study. Relevant information regarding socioeconomic status, dietary habits, medical history about drugs and diseases like, hemoglobinopathies, worm infestation, cardiac diseases, peptic ulcers and menstrual history from the female participants were recorded on predesigned proforma to rule out the other causes for anemia**.** Their physical examination was performed to look for signs of anemia and dehydration. Weight and height were measured by a stadiometer by asking the subject to remove his/her shoes. BMI was calculated by the formula weight in kg/height in meter^2.Participants were grouped as obese and non-obese on the basis of BMI cut off values recommended by world health organization (WHO) for Asians. Subjects with BMI $\geq$ 25kg/m^{2}were considered as obese and $\leq$ 25kg/m^2 were taken as non-obese.[9] Hemoglobin levels were determined by Sahli's hemoglobinometer in physiology laboratory. All the steps were carried out cautiously to minimize inaccuracy. To make our results more authenticated Hb results obtained from Sahli's apparatus were also correlated clinically by general physical examination. Hb less than 13gm/dl for male and less than 12gm/dl for females were consider as anemic as per WHO recommendation.[4]

Statistical analysis

Data was analyzed by Statistical package for social science (SPSS) version 21.0. Continuous variables like age, height, weight and Hb are presented as mean± standard deviation(SD). Categorical variable (gender, anemia,obesity) are presented as frequency and percentages. Proportions were compared by chi square (X^2) test. Shapiro-Wilk test was used to test normality of the data. P value $\leq$ 0.05 in Shaprio- wilk test was obtained showing data was not normally distributed. Non-parametric test (Mann Whitney test) for the comparison of means was used. Association between haemoglobin (Dependent variable) and BMI (Independent variable) was analyzed by regression analysis and presented as beta coefficient (β) and Standard error (SE).

Result

Study was comprised of 216 subjects of mean age 19.9±0.88. Descriptives of studied population are described in table 1. Of total studied population 34.2% were obese having BMI $\geq$ 25kg/m^2 and 65.7% were non-obese with BMI $\leq$ 25kg/m^2 (Figure1) Significant difference was observed in BMI among the obese and non-obese groups (58.4 Vs 21.9) (P value= 0.001*) (Table 2). Hemoglobin levels were lower in obese individuals than non-obese (10.4 Vs 12.28), which was proved to be significant difference at P value 0.021*. Of the total obese 53.2% were anemic as compared to 46.8% of non-obese students but difference was statistically not significant at P value 0.77 (figure 2). Regression analysis reveals significant negative association of BMI with Hb (β= - 1.036, P value= 0.000*) indicating obese subject are more prone to develop anemia.

Table:1 Descriptive statistics of the studied population (N=216)

Variable	Mean± SD
Age (years)	19.9±0.88
Height (cm)	112.8±52.3
Weight (kg)	60.2±14.09
BMI (weight in kg/height in meter^2)	34.4±16.2
Hb (g/dl)	11.2±1.59

BMI = body mass index, SD= standard deviation
Hb= hemoglobin

Table 2: Comparison of study variables among the studied group (N=216)

Variable	Obese (N= 74)		Non-obese (N=142)		P value
	Mean	SD	Mean	SD	
BMI	58.4	2.71	21.19	2.32	0.001*
Hb	10.4	1.44	12.28	1.65	0.021*

BMI = body mass index, SD= standard deviation
Hb= hemoglobin
P-value $\leq$ 0.05 is considered statistically significant

Table 3: Regression analysis between hemoglobin and BMI (N=216)

Variable	β	S.E	P value	C.I
BMI	- 1.036	0.024	0.000*	0.837 - 1.23

Dependent Variable: Hb, independent Variable: BMI body,
P-value$\leq$ 0.05 is considered statistically significant
C.I= confidence interval, β= beta coefficient ,S.E= standard error

Figure 1. Distribution of obesity in studied population (N=216)

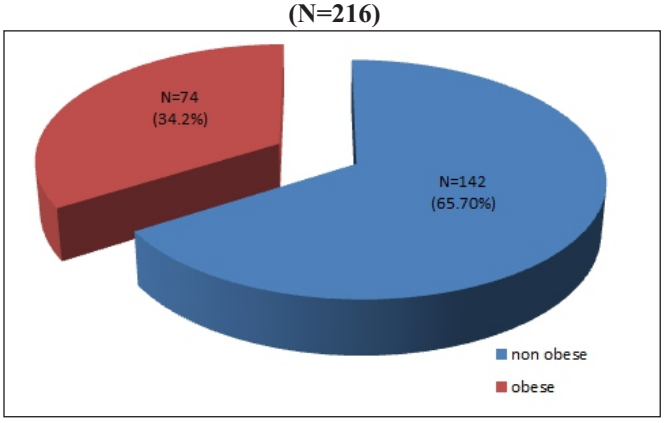
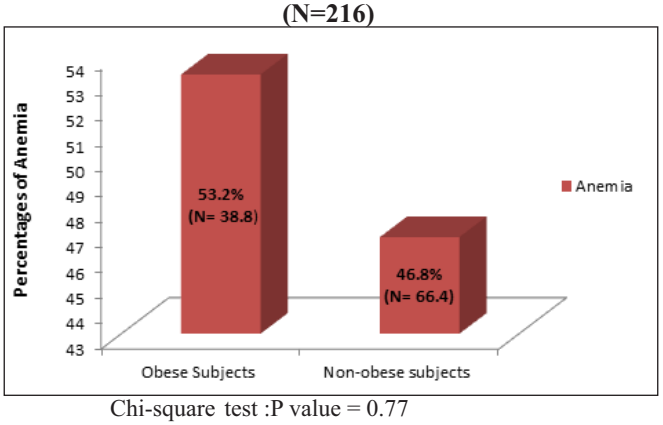


Figure 2: Percentages of Anemia among Study Groups (N=216)



Chi-square test :P value = 0.77
P-value ≤ 0.05 is considered statistically significant

Discussion

Anemia is a global health challenge which is affecting physical as well as mental status of both urban and rural population. Main causes of obesity are sedentary life style and consumption of junk food along with the use of smart technologies like laptops, hence cutting down the healthy eating habits and outdoor activities.[10] Other contributing factors include hemoglobinopathies, worm infestation and menstrual disorders in female but leading cause is the lack of iron intake due to nutritional deficiency. It has a major health impact on our infants, children and the younger population as well as pregnant ladies. Association of anemia with obesity is evident from previous studies.[10] Reduced enteral iron absorption most probably due to elevated hepicidin is common contributing factor. Previous studies documented the key role of raised hepcidin in developing iron deficiency anemia. It is highly expressed in liver and adipose tissue that interferes with intestinal iron absorption by blocking iron transporters leading to anemia.[12]Obese subjects have higher level of hepcidin and low level of serum iron than non-obese.[5,13] Other possible mechanism of anemia in obese subjects is elevation of pro-inflammatory cytokines which interfere with erythropoietin synthesis and results in decrease erythropoiesis.[8] Previous studies showed inconsistent results for BMI and anemia. Some previous studies found anemia in normal weight subjects following underweight, and then obese, and other studies showed increase levels of hemoglobin in obese subjects showing that they are not prone to have anemia.[11] Saxena Y et al study showed inverse association of hemoglobin with BMI showing the obese subjects are more prone to get anemia.[12] In current study, out of 216 subjects, 34.2% (n=74) subjects were obese and 65.70% (n=142) were non obese .Our study results are also showing that 53.2% of the total obese subjects were anemic in contrast to 46.8% of anemic non-obese students. However, this difference was statistically not significant (P value= 0.77). Current study also revealed negative association of BMI with Hb (β - 0.036, P value 0.000*) indicating obese persons are more prone to have anemia. These results are in accordance with previous studies which reported anemia was more prevalent among obese subjects.[10,12] Some studies are not in agreement with current results showing more prevalence of anemia among the underweight subjects.[13,14] Researches on broader scale should be conducted to explore the exact mechanism of anemia in obesity. Awareness programs should be arranged in order to make population aware concerning hazards of obesity related to anemia. So the young population can adopt healthy habit before they develop obesity and prevent its hazards.

Conclusion

Obese subjects have lower levels of hemoglobin than non-obese and they are more prone to develop anemia.

Limitation of the study

In this study we estimated only Hb with clinical correlation. Other parameters of iron status and inflammation were not included. Future studies on a broader scale should be conducted to evaluate the association of BMI with anemia with measuring iron status.

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Author`s Contribution

Dr. Benash Altaf: Contributed to data analysis, interpretation of results, write-up editing and formatting of the manuscript. Reviewed and approved the manuscript.

Dr. Rana Khurram Aftab: Study design, data collection, writing manuscript and reviewed and approved it.

Dr. Zeeshan Ali Khan: Data collection, writing the manuscript and review and approved it.

Dr. Rana Muhammad Tahir Salam: Data acquisition, formulation of tables, formatting and editing the manuscript review the article and approved it.

Fakiha Behram: Data collection, data analysis, reviewed and approved the manuscript.

All the authors are guarantors of this work and take responsibility for the integrity of the data and the accuracy of the data analysis.