

## Central Obesity and Normochromic, Normocytic Anemia

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### Abstract

**Objective:** Obesity is related to anemia which is explained its mechanism as disorder in iron absorption but the more rational reason is anemia of inflammation or anemia of chronic disease. The aim of this study was to define the prevalence of obesity in patients with normochromic normocytic anemia.

**Materials and methods:** We screened 406 patients who were referred to endocrine clinic. They were excluded from study if suffering from malignancy, hypo or hyperthyroidism, diabetes, growth hormone disorder, rheumatologic disorder or corticosteroid consumption. The complete blood count were checked in each participants. The patients with normochromic, normocytic anemia were diagnosed. Data was analyzed by SPSS17 software.

**Results:** Among this population, 26 persons had normochromic, normocytic anemia and 11 (42.3%) patients had central obesity. In remainder of persons (Without normochromic, normocytic anemia), 58.4% had central obesity. Overall, 49 patients had anemia and central obesity together. About 53% of them had normochromic normocytic anemia.

**Conclusion:** Central obesity is a common and complex phenomenon which is due to multiple etiologies. But based on our study, although the prevalence of central obesity was lower in patients with normochromic normocytic anemia, in 42.3% of them there was no source of inflammation except central obesity. Most patients with anemia and central obesity had normochromic normocytic anemia.

**Keywords:** Central obesity, Normochromic normocytic anemia, Inflammation, Anemia of chronic disease

### Introduction

According to the World Health Organization (WHO) reports, more than 1 billion adults are overweight and at least 300 million of them are obese (1). It was reported that Obesity is associated with anemia in adults in some countries (2-10). Inflammation associated with obesity which is a mechanism that links anemia with obesity

(11). Adipose tissue is currently recognized as an endocrine organ. It can contribute to the development of an inflammatory process by secreting pro-inflammatory cytokines and adipokines. Adipose tissue produces many cytokines and adipokines such as interleukin-6 (IL-6) interleukin-1 $\beta$  (IL-1 $\beta$ ), interleukin-8 (IL-8), tumor necrosis factor alpha (TNF-

alpha), leptin, adiponectin, resistin, lipocalin-2, C-reactive protein (CRP), monocyte chemo attractant protein 1 (MCP-1), complement components, plasminogen activator inhibitor-1 (PAI-1). (12) Cepeda-Lopez et al has shown that in obese Mexican women and children, CRP concentrations were 4 times more than normal-weight counterparts. (13) Also studies have shown that the CRP concentration decreases significantly after weight loss. (14) Anemia of inflammation (anemia of chronic disease) is characterized by impaired mobilization of iron stores, blunted response to erythropoietin and decreased erythrocyte life span. It is a hypo proliferative anemia accompanied by mildly elevated serum ferritin, hypoferrremia, and low transferrin saturation despite adequate reticuloendothelial iron stores (15). Karlee J. Ausk et al has showed that in overweight and obese persons were not more likely to be anemic compared with normal-weight persons but they saw that increasing BMI is associated with higher serum ferritin levels and lower serum levels of iron. Ferritin, although reduces during iron-deficiency anemia but it is an acute phase reactant so in obesity will increase. (2)

Hepcidin is a negative regulator of iron metabolism. It inhibits the absorption of iron in the small intestine and the release of recycled iron from macrophages. The synthesis of hepcidin in the liver is increased by inflammation. Hepcidin is an important hormone regulating iron metabolism during anemia of chronic disease (16) it can explain why anemia induced by chronic disease can get hypochromic and microcytic (17) while it is usually Normochromic and normocytic (18) The main mechanism that explained obesity-induced anemia is inflammation. We know

that anemia of inflammation is Normochromic, normocytic anemia. The aim of our study was to clarify how much of Normochromic, normocytic anemia is accompanied by central obesity.

## Materials and Methods

In this cross sectional study we collected data from 406 persons (18-65years old) that referred to endocrine clinic in Yazd province of Iran from January 2012 to January 2013. These patients were selected from 2120 patients. The patients referred to the clinic with a complaint other than anemia or obesity. They were excluded from the study if they had history of malignancy, hypo or hyperthyroidism, diabetes, growth hormone disorder, rheumatologic disorder, corticosteroid consumption.

For the patients, we request a complete blood count (CBC) and also their weight, height, waist circumference and hip circumference were measured. The normal range for these criteria has been shown in Table1. Patients with Normochromic, normocytic anemia were diagnosed based on hemoglobin concentration, mean cell volume and mean cell hemoglobin. Central obesity was determined according to waist and hip circumference. In this study, central obesity was assessed by waisttohip ratio. We compare the central obesity frequency in patients with Normochromic, normocytic anemia and control group (the others). The data were evaluated by SPSS17 software and T-test was done.

## Results

In this study, 406 people who were referred to endocrine clinic in Yazd province of Iran were studied. Totally 67 patient had anemia, that

**Table 1. Normal range of criteria**

Criteria	Sex	Normal range
Waist/hip ratio	Male	0.95 (19,20)
	Female	0.8 (19,20)
hemoglobin (mg/dl)	Male	≥14 mg/dl (21)
	Female	≥12 mg/dl (21)
Mean cell volume (MCV)		82-98 fL(21)
Mean cell hemoglobin (MCH)		27-33 pg (21)

among them 26 patient suffering from Normochromic, normocytic anemia (NNA). From these patients, 11 patients (%42.3) had central obesity according to waist to hip ratio.

At last, 57% of patients had central obesity and 10% were anemic but among patients with central obesity 12% were anemic.

As it has been shown in Table2, there were no significant difference between central obesity criteria (W/H ratio) in patients with Normochromic normocytic anemia and the others. (P value >0.05)

The obese patients who had central obesity and also Normochromic, normocytic anemia, were analyzed for their iron parameters. Iron/TIBC was abnormal only in 3 of them . As it is shown in Table2, the NNA is more frequent in men than women but hypo chromic microcytic anemia was seen in women more than men (%68 Vs. %32) but it wasn't significant. (P value > 0.05)

In the next step we compare the type of anemia in patients with central obesity that were anemic. Overall, 49 patients had anemia and central obesity together. About 53% of them had Normochromic normocytic anemia and the other hypochrom microcytic anemia.

## Conclusion

In this study, from 406 patients who was screened for anemia, we obtain 26 patients with Normochromic, normocytic anemia and %42.3 among of these patients had central obesity. In control group, 58.4% had central obesity. As it was mentioned, central obesity introduced as an inflammatory state because adipose tissue can secrete inflammatory agents. (12)

One study showed that diabetic patients had higher ferritin levels than non-diabetic patients (22). Also non-diabetic patients with metabolic syndrome showed higher ferritin levels than non-diabetic patients without metabolic syndrome (23). It can reject the hypoferremia as the reason of anemia in diabetic and obese patients because during iron deficiency anemia, ferritin is lower than normal range. In spite of all that, some studies conclude that iron deficiency due to hepcidine secretion is the mechanism of anemia in obese patients (2). The most patients with anemia and central obesity had Normochromic normocytic anemia. This fact supports this hypothesis that inflammation is the main mechanism of anemia in central obesity.

In this study, we did not find any correlation between Normochromic, normocytic anemia and central obesity .we excluded the patients with inflammatory path physiology in this study but it is not practical that exclude all of them. Nevertheless, we had 11 persons who had anemia of chronic disease but we don't find any source of inflammation except central obesity. Thus it can introduce central obesity as a differential diagnosis for anemia of chronic disease.

Because central obesity is a common and prevalent problem in world due to low physical activity and high caloric foods, it is necessary to evaluate central obesity in large sample size and also check inflammatory cytokines such as interleukins for this purpose. Also we recommend that in future studies, comparison of ferritin level in persons with central obesity and control group would be done.

**Table2. demographic data**

Variable	Normochromic, normocytic anemia	Non-anemic	P-value
Number	26	380	
Age(Y)	46.8±12.0	40.5±13.9	0.01
Sex			
male	15	62	<0.001
female	11	318	
Abnormal W/H ratio	11 (%42.3)	222 (%58.4)	>0.05
Body mass index	27.2±5.4	28.2±6.5	>0.05

## References

- 1- World Health Organization. Obesity and overweight. www.WHO.int- factsheet N\*311 2008.
- 2- Ausk K, Ioannou G. Is obesity associated with anemia of chronic disease? a population-based study. *Obesity* 2008;16(10):2356-61.
- 3- Eckhardt CL, Torheim LE, Monterrubio E, Barquera S, Ruel MT. The overlap of overweight and anaemia among women in three countries undergoing the nutrition transition. *European Journal of Clinical Nutrition* 2008;62(2):238-46.
- 4- Fanou-Fogny N, Saronga J, Koreissi Y, AM Dossa R, Melse-Boonstra A, Brouwer D. Weight status and iron deficiency among urban Malian women of reproductive age. *British Journal of Nutrition* 2011;105(04):574-9.
- 5- Gillum RF. Association of serum ferritin and indices of body fat distribution and obesity in Mexican American men--the Third National Health and Nutrition Examination Survey. *International journal of obesity and related metabolic disorders: journal of the International Association for the Study of Obesity* 2001;25(5):639-45.
- 6- Neymotin F, Sen U. Iron and obesity in females in the United States. *Obesity* 2011;19(1):191-9.
- 7- Karl JP, Lieberman HR, Cable SJ, Williams KW, Glickman EL, Young AJ, et al. Poor iron status is not associated with overweight or overfat in non-obese pre-menopausal women. *Journal of the American College of Nutrition* 2009;28(1):37-42.
- 8- Qin Y, Melse-Boonstra A, Pan X, Yuan B, Dai Y, Zhao J, et al. Anemia in relation to body mass index and waist circumference among Chinese women. *Nutr J* 2013;12(10).
- 9- Tussing-Humphreys LM, Liang H, Nemeth E, Freels S, Braunschweig CA. Excess adiposity, inflammation, and iron-deficiency in female adolescents. *Journal of the American Dietetic Association* 2009;109(2):297-302.
- 10- Cepeda-Lopez AC, Osendarp SJ, Melse-Boonstra A, Aeberli I, Gonzalez-Salazar F, Feskens E, et al. Sharply higher rates of iron deficiency in obese Mexican women and children are predicted by obesity-related inflammation rather than by differences in dietary iron intake. *The American journal of clinical nutrition* 2011;93(5):975-83.
- 11- McClung JP, Karl JP. Iron deficiency and obesity: the contribution of inflammation and diminished iron absorption. *Nutrition Reviews* 2009;67(2):100-4.
- 12- Kershaw EE, Flier JS. Adipose tissue as an endocrine organ. *The Journal of Clinical Endocrinology & Metabolism* 2004;89(6):2548-56.
- 13- Cepeda-Lopez AC, Aeberli I, Zimmermann MB. Does obesity increase risk for iron deficiency? A review of the literature and the potential mechanisms. *International journal for vitamin and nutrition research* 2010;80(4):263.
- 14- Nead KG, Halterman JS, Kaczorowski JM, Auinger P, Weitzman M. Overweight children and adolescents: a risk group for iron deficiency. *Pediatrics* 2004;114(1):104-8.
- 15- Means R. Hepcidin and anaemia. *Blood Revolution* 2004;18:219-25.
- 16- Zekanowska E, Boinska JOAN, Giemza-Kucharska PAUL, Kwapisz JUST. Obesity and iron metabolism. *BioTechnologia Journal of Biotechnology Computational Biology and Bionanotechnology* 2011;92(2).
- 17- Vreugdenhil G, Baltus CA, Van Eijk HG, Swaak AJ. Anaemia of chronic disease: diagnostic significance of erythrocyte and serological parameters in iron deficient rheumatoid arthritis patients. *British journal of rheumatology* 1990;29(2):105-10.
- 18- Weiss G, Goodnough LT. Anemia of chronic disease. *New England Journal of Medicine* 2005;352(10):1011-23.
- 19- Moreno LA, Mesana MI, Gonzalez-Gross M, Gil CM, Ortega FB, Fleta J, et al. Body fat distribution reference standards in Spanish adolescents: the AVENA Study. *International Journal of Obesity* 2007;31(12):1798-805.
- 20- Huang KC, Lin RCY, Kormas N, Lee LT, Chen CY, Gill TP, et al. Plasma leptin is associated with insulin resistance independent of age, body mass index, fat mass, lipids, and pubertal development in nondiabetic adolescents. *International Journal of Obesity* 2004;28(4):470-5.
- 21- Kasper DL, Fauci AS, Dan LL, Braunwald E, Hauser SL. *Harrison's textbook of internal medicine*. 18 ed. McGraw-Hill. 2012
- 22- Ford ES, Cogswell ME. Diabetes and serum ferritin concentration among US adults. *Diabetes care* 1999;22(12):1978-83.
- 23- González AS, Guerrero DB, Soto MB, Diaz SPi, Martinez-Olmos M, Vidal O. Metabolic syndrome, insulin resistance and the inflammation markers C-reactive protein and ferritin. *European Journal of Clinical Nutrition* 2006;60(6):802-9.