

# The Relationship between Anthropometric Factors and Iron Deficiency Anemia Factors

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## Abstract

**Background:** Iron deficiency is often observed in obese individuals. The prevalence of obesity has increased at an epidemic rate. A few small studies have noted a possible association between iron deficiency and obesity. The purpose of the study has been determined relationship between anthropometric including body mass index and the size of abdomen and iron-shortage anemia.

**Materials and Methods:** Descriptive, analytical, and cross sectional methods of research have been applied in the study. The instruments used to collect the data were a set of organized items in the questionnaire and a checklist contained the measurement of abdominal obesity, height, weight, BMI, the results of ferritin levels, hemoglobin, hematocrit, and TIBC and MCV. The tools were validated via content validity and test-retest. The participants were the staff (n=300) of Hamadan branch, Islamic Azad university, Iran, who were selected via census sampling technique. To analyze the data, descriptive statistics and inferential statistics, that is, chi-square, Pearson correlation coefficient, and ANOVA were run using SPSS software.

**Results:** 48.4% had overweight and 43.9% had various degrees of general obesity. 45.7% of women and 1.9% of men suffered from abdominal obesity. 3.2% of men had ferritin levels less than 20ng/dl and 79.2% of them had high levels of TIBC, while 31.5% of women had ferritin serum less than 12ng per dl and 73.9% of them had high TIBC. There was a significant relationship between abdominal obesity and TIBC, HB, HCT, and ferritin serum ( $p < 0.0005$ ).

**Conclusion:** The results of this study indicate the high prevalence of overweight, obesity, and abdominal obesity and their relationship with iron deficiency anemia. These are non-communicable disease, which are directly related to the lifestyle.

**Keywords:** Obesity, Body mass index, Obesity abdominal, Anemia, Iron-Deficiency

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## Introduction

Chronic non-communicable diseases (CNCDs) are reaching epidemic proportions worldwide<sup>1-3</sup>. These diseases which include cardiovascular conditions

(mainly heart disease and stroke), some cancers, chronic respiratory conditions, and type II diabetes, affect people of all ages, nationalities and classes. Conditions cause the greatest global share of death and disability, accounting for around 60% of all

deaths worldwide. Some 80% of chronic-disease deaths occur in low and middle-income countries. They account for 44% of premature deaths worldwide. The number of deaths from these diseases is double the number of deaths that result from a combination of infectious diseases (including HIV/AIDS, tuberculosis and malaria), maternal and perinatal conditions, and nutritional deficiencies<sup>4</sup>.

Over the coming decades the burden from CNCNDs is projected to rise particularly fast in the developing world. Without concerted action some 388 million people worldwide will die of one or more CNCNDs in the next 10 years. With concerted action, we can avert at least 36 million premature deaths by 2015. Some 17 million of these prevented deaths would be among people under the age of 70<sup>2</sup>.

CNCNDs have a huge negative economic impact<sup>5</sup>. During the next 10 years, China, India, and the United Kingdom are projected to lose \$558 billion, \$237 billion, and \$33 billion, respectively, in national income as a result of heart disease, stroke and diabetes, partly as a result of reduced economic productivity<sup>2</sup>.

Several factors are implicated in this increasing burden, including longer average lifespan, tobacco use, decreasing physical activity, and increasing consumption of unhealthy foods. Fortunately, CNCNDs are largely preventable<sup>6</sup>. Up to 80% of premature deaths from heart disease, stroke and diabetes can be averted with known behavioral and pharmaceutical interventions<sup>2</sup>. Yet the prevention of disability and death from CNCNDs gets scant attention worldwide<sup>7</sup>.

The iron deficiency anemia is the most prevalent form of malnutrition that has affected more than 2 billion people in the world<sup>8</sup>. The problem yet exists even in the developed countries where there are no other forms of malnutrition<sup>9</sup>.

Nowadays, obesity is an important problem threatening health all over the world, Iran is part of it. It causes individuals to be affected by many chronic diseases. The recent studies have shown that the increasing prevalence of obesity and overweight is waning in the developing and developed countries<sup>10,11</sup>. The World Health Organization describes obesity as one of the chronic diseases which is developing and has occupied the place of many health problems<sup>12</sup>.

Statistically, 8 million Iranian people are fat and 5.16 million ones are overweight. The studies show that at the beginning of 2001s, within three years, overweight and obesity (accompanied by abdominal obesity) have increased to the extent of 4% and 5% respectively in all ages, especially in ages ranging from 20 to 60 years old and particularly in Tehranian women<sup>13</sup>. The side effects of obesity may be diabetes type 2, cardiovascular diseases, and hypertension, the diseases related to the gallbladder, some kinds of cancers, joint diseases, and mental and social disorders. Moreover, the economic losses of this disease are on the rise<sup>10</sup>.

As mentioned above, Obesity and iron deficiency (ID) are two of the most common nutritional disorders worldwide. ID has been associated with decreased exercise capacity, impaired cognitive function, developmental delays, and behavioral disturbances. Obese children are at risk of increased morbidity starting already in childhood or adolescence. Interestingly, despite their excessive diet and caloric intake, obese children and adolescents may be at risk of ID because they tend to consume unbalanced meals, particularly rich in carbohydrates and fat. Both obesity and ID are also more prevalent in lower socioeconomic groups, who consume low-cost, fast foods, which are low in essential nutrients and rich in fats, sugars and preservatives. Screening for iron-deficiency anemia (IDA) by a blood count with indices, is recommended only in infants, because of the critical role of iron in brain development, and in menstruating adolescents<sup>4</sup>. However, we were impressed by the number of children and adolescents, referred to our obesity clinics, who had evidence of microcytic anemia on complete blood count screen. To determine the prevalence of ID in this patient population, we measured serum iron levels as an early sensitive screen. Low serum iron together with low percent iron saturation precede microcytosis and hypochromia, which in turn leads to IDA. Our findings suggest that obese children and adolescents are commonly iron deficient<sup>14</sup>. Also, Morbid obesity is a health problem that has been shown to be refractory to diet, exercise, and medical treatment. According to the National Health and Nutrition Examination Survey conducted in 2003–2004, 32.3% of the US population are obese and 4.8% is morbidly

**Table 1:** Reference values of hematological parameters of anemia status assessment.

	Male	Female
<b>Hematocrit</b>	42%- 52%	35% - 47%
<b>Hemoglobin</b>	13-18mg/dl	12-16mg/dl
<b>Ferritin</b>	20-250ng/dl	12-250ng/dl
<b>TIBC</b>	250 -475ng/dl	

obese. Over the last few decades, bariatric surgery has been demonstrated to be an effective treatment for obesity<sup>15</sup>.

## Methods

In this cross sectional study, that being agreed by the chancellor and research deputy of Islamic Azad university of Hamadan, the researchers entered the setting of the study and began to collect the data from the staff using the questionnaire, and the checklist as instruments developed based on the purposes of the study. The questionnaire included demographic features and the items related to the factors of obesity, iron deficiency anemia, and lifestyle. It was made based on the pieces of information existing in the related literature. The checklist was used to measure instances, such as the extent of abdominal obesity (Waist circumference), weight, and height (measuring body mass index). To measure the waist circumference (the area of the lowest rib to the tip) a plastic meter was used. To determine the level of ferritin, hemoglobin, hematocrit and TIBC, blood was taken from the staff and all the samples of blood were analyzed in one of the laboratories controlled by the medical sciences university of Hamadan and the results were recorded on the checklist. The criteria of World Health Organization to diagnose anemia are as follows: For men: hemoglobin less than 13 g per dl for women while menstruating: hemoglobin less than 12 g per dl<sup>10</sup> (Table 1). The research participants (n = 300) were the staff of Islamic Azad university of Hamadan who were selected via census sampling technique. Before sampling, the written consent of the participants was obtained and none of them was obliged to be a candidate. Moreover, all pieces of information about participants were kept strictly confidential. In this study, to validate the instrument used, content validity was given priority, but concerning reliability we used test-re test. To do so,

the questionnaire was administered to 10 of the research participants two times with 10 days interval. Using Kronbach's alpha, the reliability turned out to be 93% which is acceptable. Despite this, the questionnaire was further revised and its final form was assembled. The pieces of information or data collected via the questionnaire were coded and the codes were fed into SPSS software to be analyzed through descriptive and inferential statistics such as chi-square, Pearson correlation coefficient, as well as ANOVA.

The limitations of the study included: The stuff that was on leave at the time of blood sampling was not accessible, hence there was attrition. Those who had the following problem(s) were not included in the study: taking blood cholesterol reducing medicines or other medicines concerning lipid metabolism, evident disorder of kidney, thyroid, or liver; those inflicted with acute, inflammatory, and chronic disease; immobility; new surgery operations; any vascular-brain event happened 3 months ago; pregnancy and those who had given birth for less than six months.

To follow ethics in research throughout the study, the following moral considerations were taken into account: providing the units or departments under the study with the necessary explanation about the research questions and purposes, receiving a consent letter from the participants and including only the volunteers in the study, taking care of the participants' human dignity, and employing homogeneous researchers to take blood and measure the waist and hip circumferences of the participants.

## Results

Totally, 240 participants whose age men were  $35.08 \pm 8.20$  were studied. In this sample One-third of participants 34.4% or 92 people of the participants were female and 62.6% or 154 people of them were male. Concerning body mass index and its relation to estimating general obesity, the results showed that totals 48.4% or 119 people had overweight. 31.7% or 78 people had a body mass index of 30 – 34.9 or grade I obesity. The percentage of males and females with body mass index of 35 – 39.9 or grade II obesity was 11.4% (28 people), and 0.8% had a body mass index of at least 40.

The size of waist circumference of 45.7% of the

**Table 2:** The mean of Clinical characteristics of the subjects.

Hct (%)	Male:	47.9±3.1*10 <sup>3</sup>
	Female	41.4±2.7*10 <sup>3</sup>
Ferritin (µg)	Male:	1.82±158.3
	Female	45±73.3
TIBC (ng/dl)	Male:	4.38±65.7
	Female	4.2±70.3
BMI (m <sup>2</sup> )	Male:	25.7±4.9
	Female	29.7±1.1
Waist circumference (cm)	Male:	89.3±10.2
	Female	8.4±9.8

women was at least 91 centimeters. In other words, they had abdominal obesity. However, that of the 1.9% of men was 89 or more centimeters (Table 2).

The laboratory findings showed that 15.3% of women and 21.5% of men who were affected with abdominal obesity were in need of much extent of iron, one of the criteria to diagnose iron deficiency anemia (Table 2, 3).

To determine the relationship between abdominal and general obesity and the factors related to iron deficiency anemia, first we examined the normality of the data using Kolmogorov-Simonov test. The results showed that only hematocrit and TIBC were normally distributed. Since the distribution of general and abdominal obesity was not normal, we used Spearman correlation coefficient.

There was a significant positive correlation between mean serum iron levels, Hb, Hct and MCV in the normal Waist circumference participants was significantly lower than that of the abdominal obesity in men and women ( $p < 0.0005$ ), and TIBC more significantly upper than that of the normal- Waist

circumference participants ( $p < 0.001$ ).

However, based on the results no statistical meaningful relationship was observed between general obesity and factors related to iron deficiency anemia.

## Discussion

Obesity is increasing worldwide, reaching epidemic proportions. Poor nutrition is one of the main reasons. It is also one of the main reasons for ID<sup>14</sup>. The results of many studies imply the growing cases of obesity and overweight as well as the diseases originating from them in the urban areas. In the study, 43.9% of the cases studied were affected to various degrees of obesity and 48.4% had overweight. However, central obesity was higher in men than it was in women. In other studies conducted in Tehran, overweight and obesity have been reported to be 38.3% and 17.5%, respectively, which have been more prevalent in women than men<sup>16</sup>. According to the recent report of World Health Organization, more than one billion people of the adult population all over the world have overweight and at least 300 million of them are tort, and the phenomenon is unfortunately increasing in children and adults<sup>17</sup>:

Most studies conducted have dealt with the relationship between anemia and body mass index as well as general obesity. However, they have found the statistical meaningful relationship between abdominal (central) obesity and TIBC, hemoglobin, hematocrit, and ferritin ( $p < 0.0005$ ). Iron loss may be a reason for ID in menstruating women. However, in our study, serum iron levels were low also in males. Therefore, iron loss because of menstruation alone is not a sufficient explanation for the observed findings.

Zekanowsk et al, (2011), in a case study entitled "obesity and iron metabolism", reported that there was a relationship between obesity and iron

**Table 3:** The results of clinical experiments.

	Women		Men	
	Minimum	Maximum	Minimum	maximum
<b>Hemoglobin</b>	11.9 g / dl	17.7 g / dl	11.8 g / dl	19.40
<b>Hematocrit</b>	34.5 g / dl	50.9 g / dl	37.11	55.4
<b>TIBC</b>	41 mg / dl	640 mg / dl	40 mg / dl	610

**Table 4:** The relationship between abdominal obesity and general obesity and associated factors of iron deficiency anemia by Spearman correlation coefficient.

		TIBC	HGB	HCT	ferritin	
<b>Spearman's rho</b>	<b>Abdominal obesity</b>	Correlation Coefficient	.141*	.361**	.391**	.383**
		P- value	.041	.000	.000	.000
		N	212	233	233	219
<b>Spearman's rho</b>	<b>General obesity</b>	Correlation Coefficient	.006	.090	.109	.130
		P- Value	.928	.168	.095	.053
		N	215	237	237	223

\*\* Correlation is significant at the 0.01 level (P- Value).

\* Correlation is significant at the 0.05 level (P- Value).

deficiency, but the pathomechanism of that relationship was not clear to them. The shortage of iron in the fat people may be attributed to taking less iron (for example, due to unbalanced diet) or the reduction of iron absorption in small intestine assuming that fat people need more iron to have more volume of blood. Moreover, obesity is accompanied by chronic inflammation of the intestine and consequently iron is analyzed via inflammatory factors, hence iron deficiency in fat people<sup>17</sup>. The findings of the current study imply that there is no a meaningful relationship between various groups of body mass index and the level of hemoglobin, hematocrit, ferritin and TIBC. While Eftekhari *et al*, (2009) as a result of a study they conducted concerning the relationship between body mass index and the extent of ferritin reported that the shortage of iron and iron deficiency anemia are more prevalent in people with overweight if compared with those with natural weight. 72.8% of adolescents with natural weight had low levels of hemoglobin. Considering the classification of body mass index, as the body mass index increases the iron deficiency anemia increases as well. The analyses of regression outputs also showed that there was a negative correlation between the irons stored and body mass index. The researchers have continued to add that their study has covered the Iranian female adolescents, and taking into account the strong negative correlation between body mass index increase and the decrease of ferritin, if obesity increases as it is, it will be an introduction to a considerable increase of anemia in the adult in a few future years<sup>18</sup>.

Paknahad *et al*, (2001) also conducted a study to determine the relationship between body mass index

and hematologic status of iron in the women at the age of pregnancy in Marand, Iran. They reported that there was a meaningful relationship between hematologic variables (hemoglobin, hematocrit, and TIBC) and body measurement (weight, height, and higher mass body index, lie, general obesity)<sup>19</sup>. The findings of the present study imply that there is a meaningful relationship between various groups of body mass index and the level of hemoglobin, hematocrit, ferritin, and TIBC.

Some other studies have shown that the shortage of iron is related to the tolerant sports with the maximum physical capacity. Hence, the weakness in the sport capacity (lack of tolerance) causes iron deficiency which, in turn, causes obesity<sup>18</sup>.

The main limitation of our study is the use of serum iron level, which was selected because it is readily available in many biochemical tests. However, infections and inflammations can decrease serum iron concentration, and there may be day-to-day variations within individuals. Other parameters such as transferring should be studied as well in the future.

## Conclusion

The experts believe that the non-communicable disease is the actual threat to today's life and they are the outcomes of machine life. The consequences of today's machine life are overweight, blood cholesterol and sugar increase and the problems such as obesity, especially the abdominal one, and eventually non communicable diseases including cardiovascular ones, diabetes, cancer, etc.<sup>20</sup>. The majority of the people know that they are not living in a healthy way; however, they want to satisfy their

immediate and main needs. To fight unhealthy way of life the factors influencing the people's life should be perceived and changed to make a healthy life possible<sup>21</sup>. Changing the style of life and increasing bodily activities, we can prevent 80 percent of cardiac diseases, 90 percent of diabetes type 2, and one third of cancer<sup>20</sup>. Attempts may be done toward screening, patient finding, due treatment, and reducing the side effects of diseases through individual or group education.

During the last 20 years, the World Health Organization's definition of lifestyle has caused a broader perception of the determining factors of a healthy life. According to the definition, lifestyle is a way of living based upon definable models of behavior which is determined via the interaction among individual's characteristics, social interaction, and the socioeconomic condition of an individual's life. Based on the definition attempts should be geared toward the promotion of health via making people competent to change themselves and the condition of their social life<sup>21</sup>. According to the international and European instructions the adjusting plans of lifestyle are as follows: giving up smoking, health, nutrition, movement, the acquisition of ideal weight, and controlling cholesterol, blood pressure and sugar<sup>22,23</sup>.

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