Original Article

Access this article online

Quick Response Code:

Website:
www.jehp.net

DOI:
10.4103/jehp.jehp_371_18

Obesity and iron-deficiency anemia in women of reproductive age in northern Iran

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Received: 13-11-2018
Accepted: 12-02-2019

Abstract:

BACKGROUND: Obesity and iron deficiency (ID) are two forms of the most usual nutritional disorders worldwide. Some studies have discovered a correlation between ID and obesity although more investigation is required. This study was aimed to determine the association between obesity and ID anemia (IDA) in Iranian childbearing age women.

MATERIALS AND METHODS: This cross-sectional study was done on 256 women of reproductive age in northern Iran. The anthropometric measurements including height and weight were measured, and body mass index (BMI) was calculated. Low blood index of the hemoglobin (Hb), mean cell volume (MCV), and mean corpuscular hemoglobin (MCH) were evaluated with ferritin, serum iron, and total iron-binding capacity. Baseline data were expressed as means ± standard deviations. Chi-square test was applied to compare the categorical variable. Differences between the two groups were evaluated with independent samples *t*-test. A value of $P < 0.05$ was considered as statistically significant.

RESULTS: Obesity was in urban women higher than rural women (55.1% vs. 44.9%), and this difference was significant ($P < 0.021$). There was found no association between hematological characteristics and BMI. The data showed that only 13.4% of obese women and 17.1% of the women with normal weight had IDA (odds ratio = 0.75; 95% confidence interval: 0.39–1.49, $P > 0.05$).

CONCLUSIONS: According to the results of this study, it seems that the relationship between obesity and IDA is controversial. Hence, further studies are needed to be done.

Keywords:

Body mass index, iron-deficiency anemia, obesity, reproductive age

Introduction

Globally, obesity has approximately doubled over the last three decades.[1] While obesity has become a socioeconomic load in industrialized countries over the last centenary, the prevalence is currently also increasing in developing countries with the expanse of energy-dense food compounds and a low-level lifestyle.[2]

The universal incidence of obesity has increased over the past 50 years. Recently, more than 1 billion people are thought to have BMIof more than 30 kg/m^2, and the number is expected to increase over the next 30 years.[3] Among micronutrients, iron plays a main role not only for Hb synthesis alone but also for oxidative metabolism and energy product. ID and IDAhave been shown to underlie serious public health issues; decreased iron reserves affect cognitive development and behavior, energy metabolism, immune status, bone health, and work capacity in humans.[4]

Obesity and ID are two forms of the most usual nutritional disorders worldwide.[5]

How to cite this article: Adib Rad H, Sefidgar SA, Tamadoni A, Sedaghat S, Bakouei F, Bijani A, *et al*. Obesity and iron-deficiency anemia in women of reproductive age in northern Iran. J Edu Health Promot 2019;8:115.

The prevalence of ID and IDA is highest in the developing country; however, the scarce iron situation continues to exist in the developed countries.

Epidemiological evaluation has shown that the prevalence of anemia excesses with age.[6] Both obesity and ID are independently major disease burdens.[7] Studies have described an association between ID and obesity in children and adults.[8,9] Low level of serum iron was observed with weight gain and increasing BMI in the decades ago that confirmed in the subsequent evaluations.[10] Both ID and obesity are worldwide epidemics affecting billions with regional variation.[11] Globally, childbearing age women are at risk of IDA, which causes important morbidity and mortality.[12,13] This may be due to an increase in their parity that reduces the supply of iron in these women.[14]

ID and anemia may lead to exhaustion and therewith to an additional decline in physical activity, further irritating weight gain.[15] It has become obvious that ID and obesity do not just represent the coincidence of two frequent status but are molecularly linked and mutually affect each other.[16] The most important complication of obesity includes Type 2 diabetes, cardiovascular diseases, and an increased rate of various cancers.[17,18]

The relationship between obesity and anemia should be explored further because they affect the health outcomes.[19] The current study aimed to determine the association between obesity and ID anemia in women of reproductive age in Babol, Iran.

Materials and Methods

Participants and data collection

This cross-sectional study was conducted on 256 women of childbearing age (115 normal weight and 141 obese) in urban and rural areas of Babol in northern Iran. Nonpregnant and nonlactating women of reproductive age with one and two parity were interviewed by questionnaire. Demographic characteristics, medical history, and reproductive information were collected. Inclusion criteria included women between 20 and 35 years of age, those willing to be examined, and not using any medication during the study. Exclusion criteria included women more than the age of 35 years and under 20 years, unwillingness to participate in the study, known risk of anemia other than ID anemia, chronic infectious and noninfectious diseases, use of iron in the past 3 months and at present, the use of methods of contraception such as DMPA, IUD, OCP, and other hormonal methods.

Measurements and laboratory data

The anthropometric measurements including height and weight were measured, and BMI was calculated. Women' weight was measured with light clothes, without shoes (by Seca Sensa 804, Hamburg, Germany), and the height was measured (by Seca 206, Hamburg, Germany). BMI (kg/m^2) was calculated for all persons by dividing weight in kilograms by the square of their height. Women were classified as normal weight (BMI ≥18.5–<25 kg/m^2) and obese (BMI ≥30 kg/m^2), according to the WHO criteria.[15]

Five milliliters of 8 h-fasting venous blood samples were taken from all participants during follicular phases of the menstrual cycle. Blood samples were evaluated for red blood cells (RBC), Hb, hematocrit (Hct), MCV, and MCH.

Hb concentration was measured in the field on ethylenediaminetetraacetic acid. Serum iron concentration and total iron-binding capacity (TIBC) were determined spectrophotometrically with an RA-1000-automated system (Technicon, Tarrytown, NY, USA) using a colorimetric method (Fe SYS 1 and test-combination iron-binding capacity; Boehringer Mannheim). Furthermore, additional tests were done to confirm the IDA in two groups included ferritin, serum iron and TIBC.

The serum was evaluated for ferritin, TIBC, and iron if the blood samples were with Hb <12 g/dL, MCV <80 fL, and MCH <27 pg. The serum iron <50 μg/dL, ferritin <15 ng/mL, and TIBC >400 μg/dL were considered as ID anemia.

Test results were considered as minor thalassemia if they were included normal or high-level Hb and serum iron, low-level MCV and MCH as well as normal-level serum ferritin and TIBC. Therefore, people with minor thalassemia excluded from the study.

Furthermore, Hb >15 was considered as polycythemia and excluded from the study.[20] The institutional ethical review board of Babol University of Medical Sciences, Iran, approved the research protocol (ID: MUBABOL.REC.1833). The inform consent forms were signed by all the participants before the study on the Declaration of Helsinki.

Statistical analysis

Statistical analysis was performed using Statistical Package for the Social Science (SPSS) 18.0 software. Baseline data were expressed as means ± standard deviations. Chi-square test was applied to compare the categorical variable. Differences between two groups were evaluated with independent samples *t*-test. A value of $P < 0.05$ was considered as statistically significant.

Results

The general characteristics of the women are shown in Table 1. The mean age of all the women (n = 256) was

27.88 ± 4.53 years. The majority of the normal weight and obese women were homemakers (94.4% vs. 93.6%, respectively). Obesity was in urban women higher than rural women (55.1% vs. 44.9%), and this difference was significant ($P < 0.021$). The average duration of menstruation in normal weight and obese women was 6.16 ± 1.37 and 6.09 ± 1.42, respectively [Table 2].

A summary of the laboratory and BMI characteristics of the total sample of women is presented in Table 3. There was found no association between hematological characteristics and BMI [Table 3].

The data showed that only 13.4% of obese women and 17.1% of the women with normal weight had IDA (odds ratio = 0.75; 95% confidence interval: 0.39–1.49).There was no significant difference in the ferritin, serum iron and TIBC between the two groups.

Discussion

Obesity is recently considered a universal pandemic, while ID maintains to be the most prevalent single micronutrient deficiency in the world.[21] ID, in developed countries, is the most popular nutritional deficiency and has been linked to obesity in adults and children.[22] This is of noticeable fear for the health of the population given that obese people are at enhanced danger for morbidities, functional decrease, impaired quality of life, promoted use of health-care sources, and increased mortality.[23]

The results of our study showed no significant difference of anemia in the two groups of obese and normal weight, and it was not significant clinically.

Furthermore, Laillou *et al*. reported BMI category was not associated with ID anemia or folate status.[24] Other study showed no difference in plasma iron and TIBC in normal weight and obese women, and obese women of reproductive age have higher iron stores than the nonobese women.[25] Al-Hashem's study showed that the mean Hb level was positively associated with WC and negatively associated with BMI.[26] In another study, the prevalence of ID was 9% in the overweight group, and no true ID cases were recorded in the overweight and obese groups.[27] Paknahad *et al*. reported a significant correlation between BMI quartile, Hb, and Hct.[28] Other

Table 1: Demographic characteristics and body mass index of the participants

Demographic characteristics	Normal (18.5-24.9) (*n*=115), *n* (%)	Obese (≥30) (*n*=141), *n* (%)	*P*†
Age (years)			
20-24	37 (28.9)	42 (32.8)	0.165
25-30	47 (36.7)	33 (25.8)	
31-35	44 (34.4)	53 (41.4)	
Job status			
Homemaker	119 (94.4)	117 (93.6)	0.089
Employee	7 (5.6)	8 (6.4)	
Educational status			
Under diploma	61 (47.7)	70 (54.7)	0.623
Diploma	53 (41.4)	46 (35.9)	
University	14 (10.9)	12 (9.4)	
Residence area			
Urban	52 (40.6)	70 (55.1)	0.021
Rural	76 (59.4)	57 (44.9)	
Satisfaction rate of income			
Good	37 (28.9)	33 (26)	0.820
Moderate	80 (62.5)	81 (63.8)	
Weak	11 (8.6)	13 (10.2)	

†The data were assessed using Chi-square test

Table 2: Reproductive status and body mass index of the participants

Reproductive status	Normal (18.5-24.9) (*n*=115)	Obese (≥30) (*n*=141)	*P*†
Menarche age (mean±SD, year)	13.46±1.33	13.21±1.13	0.103
Menstrual status (mean±SD, day)			
Duration	6.16±1.37	6.09±1.42	0.068
Interval	27.96±3.41	29.22±6.88	0.666
Gravity (mean±SD)	1.72±0.72	1.82±0.79	0.286
Parity (mean±SD)	1.52±0.50	1.59±0.49	0.260
Abortion (mean±SD)	0.19±0.430	0.27±0.52	0.194
Interbirth intervals (mean±SD, year)	2.59±0.58	2.66±0.56	0.523

†The data were assessed using *t*-test. SD=Standard deviation

Table 3: Laboratory characteristics of the participants according to body mass index

Laboratory characteristics	Normal (18.5-24.9) (*n*=115)	Obese (≥30) (*n*=141)	*P*†
Hb (g/dL)	13.48±2.43	13.62±1.98	0.623
Hct (%)	40.05±6.65	40.03±6.43	0.984
MCV (fL)	84.89±0.5.13	84.24±5.57	0.331
MCH (pg)	28.53±2.44	28.59±2.74	0.842
RBC (M/μL)	5.00±3.22	5.22±4.83	0.662

†The data were assessed using *t*-test. Hb=Hemoglobin, Hct=Hematocrit, MCV=Mean cell volume, MCH=Mean corpuscular hemoglobin, RBC=Red blood cells

studies showed that mean Hb and plasma ferritin concentrations were significantly greater in obese weight and high BMI. Hct was also significantly greater in higher BMI quartiles.[13,14,29,30]

On the other hand, other study showed that overweight adults had lower iron compared with normal weight persons.[31] Neymotin and Sen reported a negative correlation between levels of iron blood content and individual BMI after controlling for other individual characteristics.[32] Other studies results indicated that heavier-weight female adolescents are at greater risk for ID.[33-35]

Mujica-Coopman *et al*. reported that FE absorption was lower in obese in another study, women than overweight and normal weight women; they had more serum ferritin ($P < 0.01$) and Hb ($P < 0.05$) concentrations.

Therefore, they stated that lower FE absorption may be due to subclinical inflammation associated with obesity.[21] Menzie *et al*. found that the obese and the nonobese individuals did not differ in total daily iron consumption, but the fat mass was a significant negative predictor of serum iron level.[36] Furthermore, in another study an increase of BMI has been associated with low serum iron and Hb as well as high serum ferritin levels.[37]

In our study, the low level of anemia in two groups may be due to the low number of gravity and parity.

The results of our study showed no significant difference in reproductive and demographic information in the two groups of obese and normal weight, but the obesity rate was lower in rural women. Furthermore, in another study, age, menarche, and poverty status were similar between the two groups and were not independent predictors of ID or serum iron levels.[29]

Whereas Paknahad *et al*. showed a significant correlation between BMI and parity ($r = 0.0102$ and $P = 0.007$) and BMI higher among the urban women.[28] In other study by Amirkhizi *et al*., BMI was positively associated with age ($r = 0.32$, $P < 0.0001$) and number of pregnancy ($r = 0.26$, $P < 0.003$).[25] Furthermore, Patil *et al*. reported that 41.9% of study participants were anemic, and there was a significant association of anemia with educational status.[38]

Obesity is generally correlated with more nutrition and ID with lower nutrition.[39] ID might outcome from the increased iron demand of obese people because of their larger blood volume and their utilization of energy-dense, nutrient-poor foods.[19]

It seems that the relationship between obesity and IDA is controversial. Therefore, further studies are needed to be done.

These researches may be explained by the low-grade chronic inflammation of obesity and have been implicated in many obesity-related difficulties. In our study, the lower rate of obesity in rural women can be due to more activity. Therefore, urban women should be encouraged to activity and exercise. The limitation of our study was that the sampling only included nonpregnant women, nonlactating, and healthy participants without any history of illness or drug use, and the sampling was hardly done.

Conclusions

Comparing our study with other studies showed that the relationship between obesity and IDA is controversial. Therefore, we suggest that future investigation should be designed on the women of reproductive age with an emphasis on food intake.

Acknowledgments
The authors would like to thank Babol University of Medical Sciences and the study participants for their support. Furthermore, the authors acknowledge the very helpful contributions of the reviewers to the quality of the final manuscript.

Financial support and sponsorship
This study was supported by a research grant from the Babol University of Medical Sciences (Grant Number: 76344/29).

Conflicts of interest
There are no conflicts of interest.

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