Iron Deficiency Anemia in Relation to Body Weight in Egyptian Adolescents: A Cross Sectional Study

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Abstract

Background: Obesity & iron deficiency anemia are two global health problems, with major consequences on human health. Many studies found an association between them explained by chronic inflammatory mediators that increase in obese personnel affecting iron absorption & transport. On the contrary, other studies denied this association especially in adolescents.

Aim of Study: Assessment of the relation between obesity & iron deficiency anemia in Egyptian adolescents.

Patients and Methods: Thecross sectional study included 127 adolescent participants aged 14-19 years old attending outpatient clinic for Family Medicine, Kasr Al-Ainy Hospital. They were classified according to their body mass indexinto normal weight, overweight & obese according to growth using WHO growth curves. Demographic data, medical history & examination were done to confirm inclusion & exclusion criteria. A blood sample was taken for hemoglobin concentration & serum ferritin level.

Results: Iron deficiency anemia was more prevalent in normal than in overweight & obese patients (64%, 17.4%, 18.6% respectively). The difference was highly significant. ($p<0.001$).

Conclusion: Iron deficiency anemia is common in Egyptian adolescents (86 out of 127 participants). The higher incidence of anemia in normal weight than obese patients denotes that obesity is not a decisive factor in development of anemia in adolescents as suggested by other studies.

Key Words: *Iron deficiency anemia – Body weight – Adolescents.*

Introduction

OBESITY and iron deficiency anemia are two growing global health problems.

The worldwide prevalence of obesity ranges from 13-20% [1]. In adolescents (14-19 years) it reached an epidemic level. Egypt ranks 18th with highest prevalence of obesity worldwide. Fifteen percent of adolescents are presenting with obesity [2], often becoming obese adults with a large list of co-morbidities.

Iron deficiency anemia is also a serious problem in the world, especially in adolescents with an estimated prevalence of 24.8% [3]. The problem is an alarming health issue with serious medical, economic & social problems. It can be a cause for cognitive impairment & learning difficulties [4].

Many studies allover the world found an association between overweight/obesity & iron deficiency anemia [5-7], especially in adolescents. Body mass index >24.9-<30kg/m^2 & BMI >30kg/m^2 were considered reliable indices of overweight & obesity, respectively [8].

On the other hand, HB% & serum ferritin were considered reliable indicators for diagnosis of iron deficiency anemia. Poor iron intake, bad eating habits, increased need for iron and decreased iron absorption were among factors explaining the high prevalence of anemia in teenagers all over the world [9].

The association of higher BMI with iron deficiency anemia, recorded by many investigators [5-7] was explained by the presence of a chronic inflammatory process in obese persons with increased serum levels of proinflammatory cytokines. Chronic inflammation & increased leptin level lead to excess hepcidin secretion from the liver. This will ultimately decrease iron absorption [10].

Abbreviations:

BMI   : Body Mass Index.
IBC   : Iron Binding Capacity.
TIBC : Total Iron Binding Capacity.
DHS   : Demographic Health Survey.
CDC   : Centre of Disease Prevention & Control.
CRP   : C-Reactive Protein.
WHO : World Health Organization.

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In contrast to these studies, other researchers did not find any relation between HB% and BMI [11-13]. They found that serum iron levels had no relation to BMI [11]. No relation was found between serum iron, total iron binding capacity (TIBC), transferrin saturation index, serum ferritin & BMI [13].

Considering these conflicting results, this cross-section study was designed to assess the possible relation between obesity and iron deficiency anemia in Egyptian adolescents.

Patients and Methods

A cross sectional analytical study was carried out among adolescent patients (males & females) aged 14-19 years old attending outpatient clinic for Family Medicine, Kasr Al-Ainy Hospitals from 1st of August 2021 to end of June 2022.

Patients with known endocrine disease, history of food intolerance, receiving cortico steroids, known to have chronic disease, psychotic illness, chronic diarrhea or celiac disease were excluded.

Epi-cale 2000 was used to calculate sample size. Assuming 80% power, 0.05 level of significance, 16% null hypothesis value & estimated portion of 25.6%, the suitable sample size was found to be 127 patients. After taking consent, an interview questionnaire about demographic data was taken, clinical examination was done to confirm inclusion & exclusion criteria. Anthropometric measures including weight & height were taken. Body mass index was then calculatedaccording to DHS data [14]. To determine the height, participant stood up straight, with buttock shoulder blades & heals touching the back of the stadiometer, with feet facing outward at 60 degree angle. Measures were read to the nearest 0.1 cm. A balanced floor scale & an electronic floor scale were used after ensuring that the participant was not wearing too much clothing.

The measured BMI was plotted against WHO BMI for age charts [15]. Accordingly, patients were divided into 3 groups. The first group includednormal weight individuals, second group included overweight patients, & the third group included obese patients.

Blood analysis: To take blood sample patients were seated with back support. A large visible vein was selected & the site was cleaned with an alcohol pad, the needle was connected to a red heparinized tube. About 5ml of blood were sufficient. We measured HB% (normal 13.8-17.2g/dL in malesand 12.1-15.1g/dL in females) & serum ferritin level (reference range: 23-33.6ng/ml) according to WHO [3].

Anemia was defined as hemoglobin concentration of less than 12g/dL, a hematocrit level less than 36% and/or serum ferritin level less than 12.3 nanogram/ml.

Ethical considerations:
Study protocol was approved by Family Medicine Department Council held in December 2021. It was also approved by Research Ethical Committee of Family Medicine, Cairo University in March 2022 (No. MS-46-2022).

An informed consent was obtained from every patient. Patients were assured about strict confidentiality of any obtained data.

The authors declare no conflict of interest.

Statistical analysis:
Qualitative data were represented as frequencies & percentages. Chi square test was used to detect relation between different qualitative variables.

For quantitative variables, mean ± standard deviation (SD) & one way ANOVA test was used for detection of difference between quantitative values, with post hoc test to compare between groups.

Results were considered statistically significant when p-value was less than or equal to 0.05.

Results

Out of 127, patients 69 (54.3%) were males & 58 (45.7%) were females. Nearly 58% of participants have high education; 28% were in secondary schools & 15% was in primary school or less. Most of participants (89%) lived with their families. Four percent lived alone & 7% were living in dormitories.

Table (1): Prevalence of obesity in studied group (n=127).

Characteristic	Category	Study group (n=127)	
		No.	%
Weight	Normal	66	52
	Over weighted	30	23.6
	Obesity	31	24.4

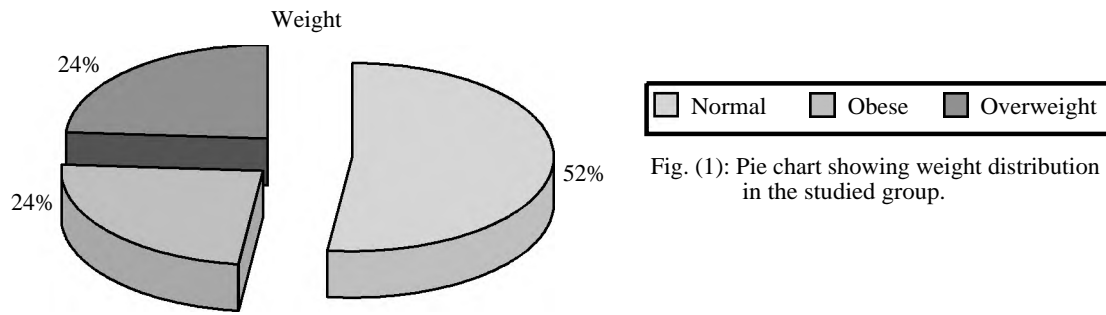This table shows that 24.4% of participants are obese. And 23.6% are overweight.

Fig. (1): Pie chart showing weight distribution in the studied group.

Table (2): Relation between sociodemographic character & presence of obesity.

Variables	Study group (n=127)		Weight						p-value
			Normal (n=66)		Overweight (n=30)		Obese (n=31)		
	No.	%	No.	%	No.	%	No.	%	
Gender:									
Male	69	54.3	52	75.4	5	7.2	12	17.4	<0.001
Female	58	45.7	14	24.1	25	43.1	19	32.8	
Education:									
Primary school or less	19	15	2	10.5	0	0	17	89.5	<0.001
Secondary school	35	27.6	26	74.3	0	0	9	25.7	
Higher education	38	57.6	38	52.1	30	41.1	5	6.8	
Residential status:									
Family	113	89	58	51.3	24	21.2	31	27.4	0.004*
Alone	5	3.9	5	100	0	0	0	0	
Dormitories	9	7.1	3	33.3	6	66.7	0	0	

As illustrated in Table (2), there was a statistically significant difference between the studied groups regarding gender where females predominate overweight & obese groups ($p<0.001$). 41 % of participants where highly educated ($p<0.01$). 66.7% of those living in dormitories were overweight.

Measurements of hemoglobin & serum ferritin levels showed that there was a statistically significant difference between groups as regards hemoglobin level ($p=0.002$) with the least hemoglobin levels in normal weight participants (10.02 ± 1.66gm/dL). As regards serum Ferritin level (nanogram/ml) the lowest level were in normal weight participants ($p=0.002$).

Table (3): Iron deficiency anemia in the studied group & its relation to weight.

Characteristic	Category	Study group (n=127)		Weight						p-value
				Normal (n=66)		Overweight (n=30)		Obese (n=31)		
		No.	%	No.	%	No.	%	No.	%	
Iron deficiency Anemia	No	41	32.3	11	26.8	15	36.6	15	36.6	<0.001*
	Yes	86	67.7	55	64	15	17.4	16	18.6	

This table shows that out of patients with iron deficiency anemia, 64% had normal weight, 17.4% were overweight & 18.6% were obese. The incidence of iron deficiency anemia in the whole group was 67.7%. On the other hand, about 80% of normal weight patients, 50% of overweight & 51 % of obese have iron deficiency anemia ($p<0.001$).
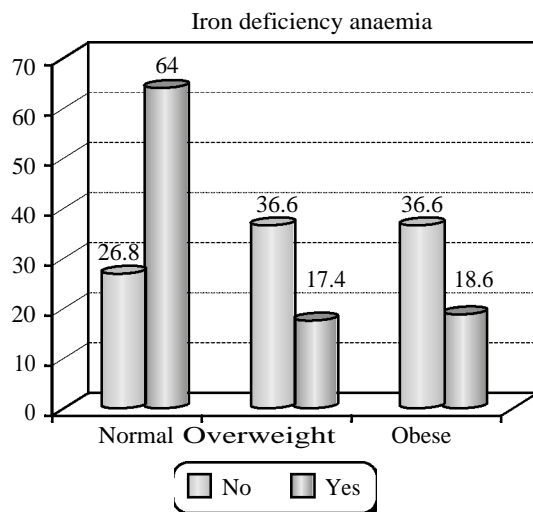
Iron deficiency anaemia

Fig. (2): Bar chart showing iron deficiency anemia among the studied group.

Discussion

Obesity & iron deficiency anemia are two major health problems with definite consequences on human health. Conflicting results regarding the association between them were reported.

The present study was done on adolescents of both sexes attending Kasr Al-Ainy outpatient Family Medicine clinics at Cairo University Hospitals aiming at studying the prevalence of iron deficiency anemia in relation to body weight.

In the current study 24.4% of participants were diagnosed as overweight & 23.6% were obese using BMI as an indicator. In agreement with these figures, recent studies by the CDC National Center for Health Statistics [16], found the prevalence rate of obesity in these age group was 21 %.

In Egypt, higher prevalence rates of obesity were reported by Egypt Demographic Health Surveys, [17] among adolescents (25%).

In the current study, 41% of overweight & obese patients were highly educated. This is in accordance with Schwartzstein et al., [18] who found that the highest level of obesity was in those who attended college & college graduates.

In our study the highest percentage of overweight & obese patients was in females. The same result was given in CDC report in USA [19]. Two thirds of our study group (67.7%) had iron deficiency anemia. A lower incidence, however was found in KSA, [20]. Few studies have examined the association between anemia & obesity, particularly among adolescents. In our study, iron deficiency anemia was more prevalent in normal weight patients compared to overweight or obese individuals. Our results were confirmed by a recent study by Mehdad et al., [21] in Morocco & by ElMoslimay et al., [5].

A large cross sectional study revealed that hemoglobin concentration as an indicator of anemia, was higher in overweight & obese patients compared to normal weight [22]. Another study by Lee showed no difference in hemoglobin concentrations & serum ferritin levels between BMI groups [23].

Our results are in contradiction with Stankowiak-Kulpa et al who showed that the presence of iron deficiency was significantly higher in obesethan in normal weight females [11]. In our study, hemoglobin level were even significantly lower in normal weight participants compared to overweight & obese. Nassar et al., [24] showed that the relation between hemoglobin level & BMI showed no significant correlation. In many studies & despite the excessive consumption of food, obese people, paradoxically, frequently have anemia [25]. This has been explained by a state of chronic inflammation usually associated with obesity & resulting in excessive secretion of interleukins, CRP, & hepsidin which is a peptide hormone secreted by the liver. These suppress erythropoietin, diminish iron absorption & block iron transfer into RBCs [26,27].

As regards serum ferritin level, there was a statistically significant difference in the 3 groups with the lowest level in normal weight patients. This has been supported by other studies [4,28].

As an explanation of our results, presence of chronic inflammatory state is doubted in this age group where their obesity is of short duration. Moreover, the main cause of iron deficiency anemia in this age group in our country is insufficient iron intake, deficient absorption & increased demand. Our study, however, concentrated on patients attending Kasr Al-Ainy Hospitals where most of them are of low socioeconomic level. This means that under & or malnutrition is expected.

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العلاقة بين أنيميا نقص الحديد والوزن
فى المراهقين المصريين :
دراسة مقطعية

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الخلفية : السمنة وفقر الدم الناجم عن نقص الحديد مشكلتان صحيتان عالميتان لهما عواقب وخيمة على صحة الإنسان. أثبتت العديد من الدراسات وجود ارتباط بين السمنة وفقر الدم الناجم عن نقص الحديد بسبب الالتهاب المزمن الذى يؤثر على امتصاص الحديد ونقله. على العكس من ذلك، نفت دراسات أخرى هذا الارتباط خاصة عند المراهقين. بالنظر إلى هذه النتائج المتضاربة، تم إجراء هذه الدراسة المقطعية بهدف تحديد هذه المسألة.

المرضى وطرق البحث : اشتملت الدراسة على ١٢٧ مراهقاً تتراوح أعمارهم بين ١٤ و ١٩ عاماً فى العيادة الخارجية لطب الأسرة بمستشفى القصر العينى. تم تصنيفهم وفقاً لمؤشر كتلة الجسم لديهم إلى : الوزن الطبيعى، زيادة الوزن والسمنة. تم إجراء البيانات الديموغرافية والتاريخ الطبى والفحص لتأكيد معايير التضمين والاستبعاد. تم أخذ عينة من الدم لقياس تركيز الهيموجلوبين وتقييم الفيريتين المصلى.

النتائج : على عكس العديد من الدراسات، كان فقر الدم الناجم عن نقص الحديد المزمن أكثر انتشاراً فى ذوى الوزن ($p<0.001$). الطبيعى منه فى المرضى الذين يعانون من زيادة الوزن والسمنة. كان الاختلاف مهماً للغاية.

الاستنتاجات : فقر الدم الناجم عن نقص الحديد شائع جداً بين المراهقين المصريين (٨٦ من أصل ١٢٧ مشاركاً) تم تفسير ارتفاع معدل الإصابة بفقر الدم فى الوزن الطبيعى عن مرضى السمنة بقلة تناول الحديد الامتصاص فى هذه الفئة العمرية. لا يمكن تطبيق عملية التهابية مزمنة كسبب لفقر الدم فى هذه الفئة العمرية الصغيرة. وبالتالى، فإن السمنة ليست عاملاً حاسماً فى الإصابة بفقر الدم لدى المراهقين.