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Adolescent with Unfeasible Body Mass Index: A Risk Factor for Iron Deficiency Anemia

Keikhaei B[1]*, Askari R[1] and Aminzadeh M[2]

[1]Research Center for Thalassemia & Hemoglobinopathy, Ahvaz Jundishapur University of Medical Sciences, Ahvaz–Iran
[2]Ahvaz Jundishapur University of Medical Sciences, Ahvaz–Iran

Abstract

Iron deficiency anemia (IDA) is the most common disease in developing countries. It is a major health problem in the general population particularly in infants, pregnant women, pre-adolescents and adolescents. Overweight and underweight are common nutrition disorders of adolescents in southwest Iran. IDA has been associated with behavioural disturbances, growth and puberty delay, impaired cognitive functions and decreased exercise tolerance. The Study of IDA and weight parameters among adolescents in southwest Iran may appear to be of significance. Thus, this study aims to assess the prevalence of IDA among adolescents and also intends to evaluate the impact of body mass index (BMI) on iron deficient groups. A total of five hundred adolescents (240 boys and 260 girls) were enrolled in the study. Three millilitres of blood was obtained from each participant. Cell Blood Count (CBC) and ferritin were measured for everyone. A reliable scale and a standing height measuring device were selected for determining of BMI. Out of them 23 (4.6%) cases had IDA. The prevalence of IDA was not significant by gender and age (P: 0.194 and P: 0.225); however, the peak incidence of IDA was thirteen years old. Out of the five hundred subjects 91 individuals (18.2%) had abnormal BMI. Subjects with abnormal BMI envisage more IDA than individuals with normal BMI (p: 0.001).Conclusively, the prevalence of IDA among adolescents is 4.6% in southwest Iran. Unfeasible BMI is a risk factor for IDA developing in adolescents' period.

Keywords: Adolescence; IDA; BMI; Southwest Iran

Introduction

IDA is the most prevalent nutritional problem in many parts of the world and the most common cause of anemia in south west Iran especially among children and young females [1-4]. Recently attention over IDA in pregnancy time has shifted to pre–marital periods. Iron supplementation in Iranian high school girls are an invaluable interventional program in order to provide adequate iron stores prior to conception. Many factors jeopardize adolescents to IDA. Increase of body muscle mass, rapid growth spurt, expansion of blood volume, beginning of menstrual blood loss, increased physical activity, limited meat intake and increased fast food intake, overweight, obesity and unmanaged weight loss were predisposed adolescents to IDA. Daily iron requirements are higher in boys than girls during peak growth spurts because of the difference in sex hormones and consequently a greater increase in blood volume, muscle mass and myoglobin. After puberty development, iron intake continues to remain high in girls because of menstrual blood loss, which averages about 20 to 30 millilitres(20 mg of iron) per month, but may be as high as 50 to 80 millilitres (60-70 mg) in some girls [5-7]. Nutrition plays an important role in adolescents' lifelong health. Overweight, Obesity and underweight are three of the most common nutritional disorders worldwide especially in low socioeconomic groups. According to recent data from the National Center for Health Statistics, approximately 20% of children in the United States are overweight [8]. Low calories and essential trace elements intake and high consumption of carbohydrates and fats lead to underweight and obese adolescents respectively. Modern life style in adolescents who consume fast foods, carbohydrates, fats, in addition, laziness and inadequate physical activity because of more time spent watching television-viewing and video and computer games may be risk factors of obesity [9]. BMI is a useful assessment of body fitness in adolescents. It is simple to use. BMI is defined as body weight in kilograms divided by the square of height in meters (kg/m^2), is a weight-for-height index that meets to assess the underweight, normal weight, overweight and obese adolescents [10,11]. Underweight is expressed as BMI below 5th percentile, normal weight as BMI between 5th and 85th percentile, overweight, BMI above 85th percentile, but below 95th percentile and obese adolescents are defined as BMI above 95th percentile for age and gender [11,12]. Underweight ,overweight and obese adolescents are prone to IDA especially in girls adolescents [13,14]. IDA in adolescents is defined as serum ferritin below 12 ng/ml and Hb level below 12g/dl for females and lower than 12.5 g/dl for males [15,16]. Despite the high publications of relevance of this topic in literature, there have been no or few report concerning this issue in south west Iran. This study aims to assess the prevalence of IDA among adolescents and evaluates the effect of BMI on it.

Material and Methods

This trial was performed in Research Center for Thalassemia and Hemoglobinopathy at Shafa Hospital related to Ahvaz Jundishapur of Medical Sciences. The study was approved by the local Research Review Board of University.

After taking written informed consent from patients or their parents a structured questionnaire which included questions about the demographics, history of thalassemia and other hereditary anemia, chronic disease, recent and recurrent infection and medication were

*Corresponding author: Bijan Keikhaei, Associate Professor, Research Center for Thalassemia & Hemoglobinopathy, Ahvaz Jundishapur University of Medical Sciences, Ahvaz–Iran, Tel: 00989166173271; E-mail: keikhaeib@yahoo.com

designed and completed for each patient. A total of 500 normal subjects (240 males, 260 females) aging 12 to 17 years (mean: 14.5) enrolled in the study. The participants' numbers were selected through multistage sampling. Constructing the two districts was the first stage and seven blocks were chosen from within each selected district (second stage). Next, subjects were selected randomly within each selected block (third stage).

For everybody CBC and serum ferritin were done. Three millilitres pre-treated edetate disodium and non-citrate blood were collected from a peripheral vein and sent to the laboratory to perform the following tests: CBC and ferritin.

An automated blood cell counter (Coulter-Kobe/ Mindray BC 3000-Japan) was used for CBC and ferritin was assessed using a chemiluminescent analyzer (Advia Centauro CP, Bayer-Germany).

Laboratory tests and anthropometric parameters were measured in the fasting condition. Participants' weight and heights were measured with a reliable scale and standard high meter. After collecting data; statistical analysis was performed by SPSS 16.0.2. Values were presented as means ± SD. The level of significance between variables was determined by independent t-test, chi-squared and Fisher exact tests. Differences were considered significant at the level of $p < 0.05$.

Results

Among the 500 participants, 447 (89.4%) had a normal iron status, 23 (4.6%) suffered from IDA and 30 (6%) had ID without anemia. Out of 23 IDA, 8 were boys (3.3%) and 15 were girls (5.8%). The peak incidence was thirteen years old for boys and girls. There were no significant differences according to sex and age (p: 0.19 and 0.22 respectively).Out of 30 ID subjects, 18 were boys (7.6%) and 12 were girls (4.6%). The peak incidence was seventeen years old for boys and girls. The difference in prevalence of anemia in different age groups and both sexes were not statistically significant (p: 0.18 and 0.20 respectively). Ten subjects had non iron deficiency, microcytic anemia (2%). The total numbers of iron deficient (ID+ IDA) subjects were 53 (10.6%).There was no significant differences in this group according to sex and age (p: 0.12 and 0.16).

The participants were categorized by BMI into underweight (26:5.1%), normal (409:81.8%), overweight (42:8.4%) and obese (23:4.6%).The incidence of IDA in every BMI section is as follows: underweight (11.5%), normal weight (3.2%), overweight (11.9) and obese (8.7%).There was no positive correlation between IDA and weight status separately. But, there was a significant correlation between IDA in normal weight and abnormal weight (Underweight + Overweight + Obesity) with p: 0.001.

Discussion

ID and abnormal BMI are two nutritional disorders worldwide and particularly in developing countries [17]. During adolescent period, 20% of final adult height and 50% of adult weight are achieved .Because of this rapid growth; adolescents are especially vulnerable to anaemia [18]. The maximum physical, psychological and behavioural changes take place in these years of life and they do not follow dietary recommendation. Less than 2% of teenagers eat sufficient essential foods and nearly 20% of girls and 7% of boys do not eat adequately even one of the food groups [18]. Numerous dieting or constrained eating, missing meals, vegetarian eating styles, high carbohydrate

meals and fast foods are all risk factors for anemia in adolescents. In spite of bigger iron needs, many adolescents, especially girls; do not take enough iron from their diets. About 75% teenage girls, do not have adequate diet, especially in bioavailability of iron foods and do not meet their dietary requirements for iron from menstrual blood loss, compared to only 17% of teenaged boys. Therefore, teenagers are prone to ID and IDA.ID like IDA in adolescent period affects mental and cognition disturbances and causes fatigue and low work capacity [19,20]. It is expected that about 11% of female adolescents are ID in the united states [21]. This is in agreement with our collective data of IDA and ID in both genders. Our results show that the prevalence of IDA and ID in adolescent is 4.6% and 6% respectively that is lower than that of developing countries. The IDA is common in girls but ID is common in boys; however, the differences were not significant. In a study of Shams et al. the prevalence of IDA in girls Tehran University in older age group than that of the present study (18-25 years) was 3.8% [22]. In a research carried out by Gholamreza in the south-eastern part of the Caspian Sea in Iran, the prevalent rates of ID and IDA were 35.6% and 13.5%, respectively, in rural community women aged 18–35 years old. Akramipour R. et al. Another study showed ID and IDA in 23.7% and 12.2% of girls aged 14–20 years old in Western Iran [4]. The low rate of IDA and ID in current study compared to the mentioned results in other parts of Iran may be due to differences in nutrition life style. Two dominant tribes of Khuzestan province, i.e. Arab and Lor eat much meat and fish proteins in their daily nutritional schedules. Beginning iron supplementation among school-going adolescent girls is one of Iranian Health strategies recommended to improve iron status in prepregnant women. The other health strategy is to fortify foods with iron. These efforts may be effective ways to alleviate ID in adolescent girls as well as to improve prepregnancy iron store. The low prevalence of ID in this study might support this idea.

Humans are susceptible to the development of fat during certain periods in their growth [23]. Children with bigger BMI percentile before the age of 5 years are prone to high BMI in adult years [24]. During adolescent period, girls are particularly prone to developing persistent overweight; the body fat of teenaged females increases approximately 40% , in contrary to adolescent males, that their body fat decreases nearly 40% [25]. The prevalence of obesity among adolescents in the United States dramatically increased between 1976-1980 and 2007-2008 (from 5.0 to 18.1 %) [26,27]. At present, nearly one third of adolescents in the United States are either overweight or obese [27]. Sotoudeh et al. reported a 19% of overweight rate among adolescent girls in Islamshahr-Iran [28]. The prevalence of overweight and obesity in adolescent girls were 21.9 and 5.3%, respectively in north of Iran [29]. The overall prevalence rates of overweight and obesity in East Iranian children aged 7 to 18 years old were 4.8% and 1.8% respectively [30]. Moayeri reported that the prevalence of overweight and obesity among Tehrani students was 21.1% and 7.8%, respectively [31]. The prevalence rate of overweight and obese adolescents of the present study are 8.4% and 4.6% respectively. The results of present overweight prevalence are nearly similar to Gargari BP et al., Mostafavi H et al., Naci Öneret et al., El-Hazmi et al. [32-35]. The frequency of our findings in obese adolescents prevalence rates are in concordance with studies of El-Hazmi et al.and Saloojee H [35,36]. The prevalence of our obese adolescents is lower than ones in studies attributed to Naci Öneret et al.and Moayeri et al. [31,34] and higher than ones in studies of Taheri and Kazemi, Gargari BP et al. and Mostafavi H et al. [30,32,33]. The prevalence of underweight frequency in the present study is lower than that in studies of Naci Öneret et al. and Bener [34,37].

In addition to the risk of atherosclerosis morbidity in overweight and obese children and adolescents, they may be prone to IDA and ID despite their excessive dietary and caloric intake [38].The rate of ID among obese and overweight children are twice the rate of the children with normal weight [13]. Almost one of every 10 overweight adolescents is ID [13]. Seltzer and Mayer and Pinhas-Hamiel O et al. observed similar relationship between ID and weight status [39,40]. In the present study the prevalence of ID and IDA among underweight, overweight and obese subjects are higher than desirable weight. However, the correlation of each group with normal weight is not significant. Most of underweight subjects are normal and overweight groups of people who tend to loss their weight in a short period on an unscientific program without iron and trace elements supplements. In addition, severely underweight adolescents suffer from nutritional deficiencies including iron and other trace elements.

The causes of ID in overweight adolescents have not been known explicitly. Multiple different factors such as genetics, faster growth, physical inactivity, inadequate iron –rich diet and decrease in myoglobin iron recycling may be involved [41]. Kennedy and Filla et al. showed that the absorption of radiolabeled iron in obese mouse models are 2 to 2.5 times more than lean mice. Despite this increased absorption, the concentrations of iron in the obese mice tissues were significantly lower than lean mice. The authors concluded that variations in the tissue distribution and metabolism of iron lead to changes in tissue concentrations of trace metals in obese mice [42,43].

Conclusion

The overall prevalence of ID and IDA among southwest Iranian adolescents is 10.6%.The frequency is lower than other developing countries and higher than developed countries. It is related to Iranian lifestyle in this region, which is based on the consumption of lamb and sea food protein as well as using iron supplementation in adolescent school students and fortified iron foods. The prevalence of IDA and ID were not different between gender and age. Nearly 20% of adolescents had unfeasible BMI. The percentage of overweight and obese adolescents was equal to those of developed countries. The frequency of IDA and ID were higher in individuals with abnormal BMI than desirable BMI. Because of the potentially harmful effects of ID, underweight, overweight and obese adolescents should be routinely screened and treated as necessary. Exercise, besides improving quality of life, body fitness, decreasing cardiac disease, it may also improve iron balance and decrease ID prevalence. The final message of this article is move for health. Exercise keeps BMI feasible BMI maintains normal iron status and adequate hemoglobin; in addition, iron status encourages adolescents to do more activities.

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