

## **Original Article**

# **Prevalence of Obesity and its Relationship with Birth Weight among High School Female Students**

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### **Abstract**

**Introduction:** The idea that factors during early critical periods of life affect on long term health is now a major public health concern. In this study, in addition to investigating obesity prevalence among female high school students in Yazd, the relationship between obesity and birth weight was examined.

**Materials and Methods:** This cross sectional study was conducted among 312 students using random cluster sampling method.. According to the birth weight recorded on their growth cards, the students were divided to 3 weight groups of low birth weight (<2,500 g), fitting birth weight (between 2500 and 4000 g) and high birth weight (>4000 g). Anthropometric measurements including weight, height and waist circumference were also carried out. Based on NCHS standard values, BMI  $\leq 5^{\text{th}}$ , 5-85<sup>th</sup>, 85-95<sup>th</sup>, and  $\geq 95^{\text{th}}$  percentiles were considered as underweight, normal, overweight, and obese, respectively. In addition, 95<sup>th</sup> percentile  $\leq$  for waist circumference was considered abdominal obesity. Finally, the data were analyzed by SPSS 16 software.

**Results:** The mean of weight and BMI among participants were higher and the mean of their height was lower than 50<sup>th</sup> percentile of NCHS. Based on the results, 5.7% of the samples were underweight, 73.4% were normal, 17.1% were overweight and 3.8% were obese. Abdominal obesity rate was 18.7%. There was a significantly positive correlation between birth weight and current weight of the students ( $p= 0.001$  and  $r= 0.2$ ) and their BMI ( $p= 0.005$  and  $r= 0.15$ ).

**Conclusion:** We observed rather high prevalence of obesity and overweight in this study. Moreover, the relationship between birth weight and current weight was positive which it necessitate preventive strategies and training for this group of people.

**Keywords:** Female; Students; Overweight; Obesity; Birth Weight

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## Introduction

Overweight and obesity are among the fastest growing non-communicable health problems in the world [1]. Adolescent obesity is strongly associated with adult obesity and predicts both short- and long-term adverse health outcomes. According to the latest reported statistics, prevalence of obesity in developed countries is 21% [2]. Recent information from American Center of Disease Control and Prevention indicates that 14% of 14-19 year old adolescents are overweight [3]. The prevalence of obesity is also increasing in developing countries, now. In Iran, the incidence of obesity of children has been doubled from 1993 till 1999 [4].

The prevalence of overweight and obesity among adolescents (10-18 years old) who were from Tehran was estimated as 13.3% [5]. In another study the prevalence of obesity among female adolescents in Tehran was reported as 14% [6]. This rate was reported as 0.7% in Kerman [7]. The results of anthropometric studies among female high school students in Tabriz showed that 11.1% were overweight and 3.6% were obese [8]. Adolescent overweight and obesity have been implied as risk factors for metabolic (obesity and diabetes), cardiovascular, biliary, joint, oncological diseases, as well as the higher adult mortality [9-11].

Numerous factors such as dietary pattern, physical activity level, lifestyle and family background affect on the trend of overweight and obesity. One of the factors that has been recently proposed as a predictive factor for

overweight and obesity in adulthood is birth weight.

In 1992, David Barker proposed his theory that those who have had low birth weight are prone to obesity and chronic diseases [12,13]. Besides, many studies have indicated that high birth weight is correlated with high BMI in childhood and adolescence [14-18]. High birth weight which is correlated with increased number of fat cells (hyperplasia) in uterus can increase risk of obesity in adulthood [19].

The prevalence of the obesity and its complications in the developing countries are increased. On the other hand, the influence of birth weight on later obesity has not been adequately investigated in our country.

So, this study has been performed to investigate the prevalence of obesity and its correlation with birth weight among female adolescents in the city of Yazd.

## Materials and Methods

This cross-sectional study was done with the participation of 312 female high school students in Yazd. Considering 95% confidence level, 80% power, 20% sum of prevalence of total high (10%) and low (10%) birth weight in Yazd and also 1.47 relative risks, the approximate sample size of 300 subjects were obtained.

Students were selected through systematic clustering sampling from 43 girls' high schools and 63 girls' art schools in Yazd so that 3 schools from Region 1 and 3 schools from Region 2 were randomly selected. Introduction Letters were taken from General Education

Office for the districts and from the districts for the schools. Also, the classes in the schools were randomly selected. Existence of students' growth cards in the school offices was the inclusion criteria of the study. After obtaining informed consent, the students were divided to 3 groups based on the birth weight mentioned in their growth cards [20]:

1. Students with less than 2500 g birth weight (Small for Gestational Age) (SGA)
2. Students with fitting birth weight between 2500 and 4000 g (Appropriate for Gestational Age) (AGA)
3. Students with higher than 4000 g birth weight (Large for Gestational Age) (LGA)

Then, their weight was measured with light clothes on, without shoes and using Seca Scale with accuracy of 100 g. Their height was also measured while standing, without shoes and using Seca stadiometer with accuracy of 0.5 cm. After that, BMI was calculated based on ratio of weight (kg) to squared height (m). NCHS criterion was used to determine overweight and obesity in this study and the students were categorized to low weight ( $\leq 5^{\text{th}}$

percentile), normal ( $5\text{-}85^{\text{th}}$  percentile), overweight ( $85\text{-}95^{\text{th}}$  percentile) and obese ( $\geq 95^{\text{th}}$  percentile) based on BMI percentiles for age. Waist circumference was also measured to evaluate amount of abdominal fats and  $\geq 95^{\text{th}}$  percentile was considered as an indicator of abdominal obesity [21]. In such a way, anthropometric characteristics of the students were recorded. The data were reported as mean  $\pm$  standard deviation. T-test was used for quantitative tests to compare two variables; ANOVA was used to compare the groups (SGA, AGA and LGA); linear regression was used to investigate the relationship between quantitative, independent variables and dependent variables; also, Chi-square was used to investigate the qualitative variables. SPSS 16 software was applied analyze the data.

## Results

The mean of age and BMI among the 312 students were  $16.5 \pm 1.5$  years and  $21.8 \pm 3.5$   $\text{kg/m}^2$ , respectively, which were higher than  $50^{\text{th}}$  percentile of NCHS for this age group ( $20.6 \pm 0.7$ ). In addition, as observed in Table 1, according to ANOVA test, there was a significant difference between LGA and AGA groups in terms of mean BMI (p-value=0.002).

**Table 1.** Mean BMI in terms of birth weight among female high school students in city of Yazd-2013

Birth weight	number	percent	BMI( mean $\pm$ SD)
<2500 gr	36	11/5	22 /1 $\pm$ 3/9
2500 – 4000 gr	236	75/6	21/5 $\pm$ 3/5
> 4000 gr	40	12/8	23/8 $\pm$ 2/07

In Table 2, the mean of weight, height, and waist circumferences according to birth weight status were shown which are  $56.97 \pm 9.4$  kg,  $161.19 \pm 5.6$  cm, and  $70.2 \pm 11.7$  respectively.

The mean of weight and height of the 50<sup>th</sup> percentile of NCHS among this age group in girls is 55Kg and 163 Cm, respectively. The results from ANOVA

demonstrated a significant difference between LGA and AGA groups (p-value=0.002). In addition, there was a significant difference between the mean of waist circumference of students in SGA, LGA and AGA groups (p-value=0.01). But, no significant relationship was found between the students' height and birth weight status.

**Table 2.** Mean weight, height and waist circumference in terms of birth weight status among female high school students in city of Yazd-2013

Birth weight	<2500 gr	2500 – 4000 gr	> 4000 gr	P value
Current weight(Kg)	57.8±13.4	56.02±9.5	62.2±5.9	0.002
Current Height(Cm)	159.3±4.8	161.6±5.8	161.3±4.2	0.07
Waist circumference(Cm)	78.58±13.46	71.1±11.5	80±9.8	0.01

According to NCHS/CDC-2000 criteria [22] 5.7% of investigated students were underweight, 73.4% were normal, 17.1% were overweight and 3.8% were obese. As

observed in Table 3, the highest percent of overweight and obesity were in SGA and LGA groups compared with AGA group (p-value= 0.01).

**Table 3.** BMI status in terms of birth weight of female high school students in city of Yazd-2013

Birth weight(gr)	BMI (Kg/m <sup>2</sup> )				Sum (percent)
	<16.5(%)	16.5-24(%)	24-28(%)	>28(%)	
<2500	2(5.6)	15(41.7)	16(44.4)	3(8.3)	36(100)
2500–4000	16(7)	187(79.3)	24(9.7)	9(4)	236(100)
> 4000	0(0)	18(45)	22(55)	0(0)	40(100)

Prevalence of abdominal obesity was evaluated as 18.7%. In addition, the mean

waist circumference of SGA and LGA students was more than that of AGA students.

**Table 4.** Waist circumference in terms of birth weight among female high school students in city of Yazd

Birth weight status	<80 cm	>80 cm	Total
<2500 gr	14(38.9)	22(61.1)	36(100)
2500–4000 gr	162(68.6)	74(31.4)	236(100)
> 4000 gr	14(35)	26(65)	40(100)

The results obtained from this study showed that birth weight had a significantly positive correlation with students' weight ( $r=0.2$ ,  $p$ -value=0.001) and BMI ( $r=0.15$ ,  $p$ -value=0.005). In other words, LGA was related to weight and BMI among students. But, no significant relationship was observed between height and waist circumference with birth weight.

## Discussion

This study aimed to evaluate the prevalence of obesity and its relationship with birth weight among female high school students in the city of Yazd. Based on NCHS/CDC-2000 criteria, nearly 20% of the participants were overweight and obese. The study was carried out by National Research Institute using the same criteria showed that the prevalence of overweight and obesity in girls and boys adolescents was reported as 26% and 30%, respectively [23]. A research was conducted in Tabriz using NHANS-I criterion indicated 20% prevalence of overweight and obesity in male adolescents that is similar to our results [24]. Khoshfetrat also reported this rate in male adolescents of ZarrinShahr as 9.3% based on CDC-2000 criteria [25]. The differences observed in some results could be attributed to

the criterion used for determining overweight and obesity. While CDC/NCHS-2000 criterion was in the existing study to determine overweight and obesity, some studies have used WHO-1995 and MUST (NHANS-I). The studies conducted in other countries have indicated relatively higher prevalence [26-29].

In general, results of different studies have shown that overweight and obesity are epidemically increasing all around the world including developing countries. Studies have also suggested that risk of obesity in adulthood among obese children and adolescents is twice as much as normal ones [30]. Another study revealed that obesity between 8 and 18 years old increases overweight risk at 35 by two to four times [31]. Importance of overweight and obesity in Asia becomes more serious when it is observed that metabolic diseases occur at lower BMI among Asian populations. For example, hypertension in Japanese population with BMI of higher than 24.9 is tripled. Diabetes occurs more with BMI of higher than 22-23. It seems that Asians store more fat per unit of BMI and their fat is mostly accumulated as abdominal and visceral fat [32].

Mean birth weight had a significantly positive correlation with current weight and BMI of students in the city of Yazd. Results of

this study showed that high birth weight compare to normal birth weight was more related to the risk of overweight and obesity in adolescents. Evidence from other studies have also suggested that high birth weight is related to high BMI in childhood and adolescence, which could be due to increased number of fat cells (hyperplasia) in uterus <sup>[33]</sup>. So far, no similar studies have conducted in Iran to examine the probable relationship between birth weight, obesity and other chronic diseases in adulthood. In Delhi, one study was conducted on the relationship between birth weight and metabolic parameters in adulthood, the results of which demonstrated that half of the children with low birth weight had overweight and obesity in adulthood and more than 29% of men and women with metabolic syndrome had rapid weight gain in childhood and adolescence <sup>[34]</sup>. This study could confirm thrifty phenotype hypothesis which explain how thrifty genes are activated during an absolute hunger or malnutrition in uterus; then, they preserve foods after birth by endocrine changes and thereby make individuals prone to obesity. In fact, environmental factors (nutritional situation) affect genome and, by methylation, phosphorylation or acetylation of DNA, change function of genes <sup>[12,13]</sup>. Another study on 13-18 year old Asian adolescents

showed that low birth weight was related to abdominal obesity <sup>[35]</sup>.

One of the limitations of this study was its cross-sectional design that can not show any causality relationship. Most of the similar studies conducted on birth weight and its relationship with obesity and other chronic diseases in childhood, adolescence and adulthood have been prospective cohort studies. Cohort studies provide the possibility of controlling confounding factors like measuring birth weight in equal conditions using accurate measurement tools and methods and monthly and annual monitoring of people for controlling other confounding factors like level of physical activity and nutritional pattern. Due to our design we ignored confounding variables. Future research could take progressive steps by removing these limitations and using laboratory data in order to examine the relationship of hematological indices and chronic diseases on the one hand and low birth weight on the other. Considering the complications of overweight and obesity in increasing risk of metabolic diseases and imposing high medical costs, it is necessary for policy makers of health system to take preventive strategies in order to train mothers during pregnancy and even before that, students, and teachers by relevant authorities.

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