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The Association of Body Image Concern with Anthropometric Indices and Dietary Intakes in Adolescent Girls: A Cross-Sectional Study

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ABSTRACT

Background: Due to the increasing prevalence of body image concern (BIC), especially in adolescent girls, and its potential associations with lifestyle factors and anthropometric indices, the present study was designed to evaluate the associations between BIC with anthropometric indices and dietary intake in adolescent girls. **Methods:** In this cross-section study, 210 adolescent girls aged 14-16 years were selected from high schools in Shiraz, Iran. Their anthropometric and demographic information were carefully recorded. Physical activity data were recorded through the International Physical Activity Questionnaire and information on dietary intake was collected using a 24-hour recall. To assess BIC, Littleton BIC questionnaire was applied. Regression analysis was used to assess the associations between variables. **Results:** Based on the results, 121 girls (55.8%) of the participants had no BIC, 70 (32.3%) had little, and 26 (12.0%) had medium BIC. Mean values of BMI, BMI for age centile, and z-scores were significantly different between BIC subgroups (P=0.008, 0.023, and 0.009, respectively). Mean values of height, and height for age centile, and z-scores were significantly different between BIC subgroups (P=0.018, 0.021, and 0.029, respectively). Risk of BIC increased, by 77% with 1 unit increase in z-score of height for age. Also, 1 kcal increase in daily energy intake led to 1% decrease in the risk of BIC. **Conclusion:** BIC was associated with lower calorie intake and higher z-score of height for age in adolescent girls.

Keywords**:** *Body image concern; Anthropometric indices; Dietary intake*

Introduction

Body image can be defined as a multi-dimensional concept that describes the personal prescription of body structure and physical appearance (Soares *et al.*, 2020). Body image dissatisfaction means dissatisfaction with the current body shape, having unrealistic views and being concerned about others' opinions about your appearance (Alipour *et al.*, 2015). In

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adolescence, concerns about body shape are very bold, especially in overweight or obesity cases. There is high discrimination towards adolescent body images. In many societies, the lean body image for girls and the muscular body image for boys are considered acceptable shapes. This can cause high concerns among adolescents regarding their body image (Soares *et al.*, 2020).

The body image of everyone can be affected by various psychological and cultural factors, biological variables (such as anthropometric conditions), social media, as well as different demographic factors such as age, gender, marital status, etc. Studies have reported that body image dissatisfaction has been more prevalent among women than men and mostly has caused negative effects in their lives (Alipour *et al.*, 2015). Most studies have asserted that body image satisfaction had an inverse relationship with body mass index (BMI) and direct association with physical activity (Kargarnovin *et al.*, 2013). Different results have been reported about the impact of diet composition on body image and this issue needs further investigation (Oliveira *et al.*, 2020).

Although it was generally believed that body image dissatisfaction is a matter of Western countries, today, with the expansion of social media and industrialization of the countries, this issue has increased in many countries. Prevalence of body image dissatisfaction in the Iranian population is also high (Garrusi and Baneshi, 2017). Even sometimes, Iranian women with normal weight are not satisfied with their body image, which can cause eating disorders in this population (Nikniaz *et al.*, 2016).

This cross-sectional study investigated the relationship between body image concern (BIC) with body mass index (BMI), physical activity, and diet composition among adolescent girls. By considering multiple factors, the main causes affecting the body image can be determined in order to apply appropriate interventions in this field. So far, most studies have been done on school age children up to 17 years old (Baharvand *et al.*, 2020), while paying attention to lower ages can also help plan better preventive or interventional strategies in this regard.

Materials and Methods

Study design and participants: In this cross-sectional study, 210 adolescent girls were studied from high schools of Shiraz, Iran in 2018. The sample size was determined based on the study by Alharballeh *et al.* The sample size of 210 was determined by considering p=36.7, q=63.3, d=0.2p (Alharballeh and Dodeen, 2021). The inclusion criterion was age range of 14-16 years. Those adolescents undergoing professional physical activity practices, pregnant girls, and those who did not complete the questionnaires correctly were excluded from the study.

Measurements: Demographic information of participants were collected through interview. Measurements of anthropometric indices were measured using standard methods. Weight was measured using the digital Omnor scale without shoes and with the lowest coating. The participants were asked to stand next to the wall to measure their height with the standard equipment for measuring height. An experienced nutritionist carried out both measurements. Then BMI was calculated for each individual by dividing weight in kilograms by square of height in meters and were compared with BMI for age percentile of each individual. Z-scores of BMI, weight, and height for age were determined using WHO Anthro-plus software.

Physical activity data were obtained through the Iranian version of International Physical Activity Questionnaire (IPAQ); which has a good validity according to a study by Moghaddam with Cronbach's alpha coefficient of 0.7, representing good internal consistency (Moghaddam *et al.*, 2012). This questionnaire is used to evaluate the physical activity of each person. It includes questions related to sleep duration, home activities, sitting activities, and professional sports, each of them is mentioned in an average hour and minute. Finally, according to the total Met, the individual could be categorized in terms of physical activity.

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Information about food intake of participants was collected through a 24-hour recall (Lytle *et al.*, 1993), that asked about each of the meals accurately and a nutritionist recorded the information by face to face interview. Then, the information was analyzed using nutritionist IV software and the data regarding energy and nutrient intakes were extracted. Nutrient adequacy ratio (NAR) was calculated for selected nutrients, such as protein, carbohydrate and total fiber, by dividing the amount of participants' intake over the recommended daily allowance of that nutrient (Raymond and Morrow, 2020). NAR was also calculated for selected vitamins and minerals and then mean adequacy ratio (MAR) was calculated as the average of the NARs of vitamins and minerals.

In this study, the body image of adolescents was evaluated by completing the Littleton BIC (LBIC) questionnaire; which is a reliable and suitable method for examining the body shape concerns, designed by Lithton *et al*. in 2005 and is useful in clinical environments and research (Littleton *et al.*, 2005). In Iran, Bassak Nejad *et al*.reported its validity based on internal consistency by Cronbach's alpha of 0.73 after translating and matching this questionnaire (Bassak Nejad, 2007). Also, Ghadakzadeh *et al*. reviewed the validity and reliability of the Persian version of this questionnaire and reported its credit of 85% and Cronbach's alpha of 0.9 (Ghadakzadeh *et al.*, 2011). This questionnaire contains 19 questions about personal feelings about body shape, which in each case gives a score from zero (never) to 5 (ever). For analyzing the total score of each person, scores between 52-38 indicated a little concern about body image, scores between 69-53 showed moderate BIC, and those more than 70 demonstrated high BIC.

Ethical considerations: This study was approved by the Medical Research and Ethics Committee of Shiraz University of Medical Science (IR.SUMS.REC.1396.S1017).

Data analysis: Data were analyzed using SPSS software (version 22). Data normality was checked using Kolmogrove-Smirnove test. Variables were compared between three subgroups of BIC inventory (BICI) score (without, low, and medium) using ANOVA for normally distributed variables and Kruskal Wallis for the skewed data. Paired comparisons were also done using Bonefroni adjustment and MannWithney U test for normal and skewed variables, respectively. Logistic regression analysis was used to determine the main determinants of BIC. The Significance level was considered P-value< 0.05.

Results

The mean z-score of the BMI for age was 0.34±1.19, and the mean z-score of the height for age was -0.02±0.85. Baseline characteristics of the participants are presented in **Table 1**. The mean score of BIC was 37.77±11.97; 121 of the participants (55.8%) had no BIC, 70 (32.3%) had little BIC, and 26 (12.0%) had medium BIC.

Table 1. Baseline characteristics of the participants.

Variables	**Mean**±SD
Age (year)	14.05±0,82
Menarche age (year)	9.83±5.04
Weight (kg)	54.30±11.57
Height (cm)	159.38±6.33
Waist circumference (cm)	71.18±7.51
Wrist (cm)	15.52±1.18
Height for age centile	49.43±25.99
Height for age z-score	-0.02±0.85
BMI (kg/m^2)	21.32±3.86
BMI for age centile	62.66±61.12
BMI for age z-score	0.34±1.19
Physical activity (met.hr)	40.51±11.81
BIC score	37.77±11.97

BMI: Body Mass Index, BIC: Body image concern.

Data on anthropometric indices and physical activity in three BIC subgroups are shown in **Table 2**. Mean weight was significantly different between BIC subgroups (*P*=0.03). In the post hoc analysis, those with medium concern had significantly higher weight than those with no concern (*P*=0.008).

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Table 2. Anthropometric indices and physical activity level based on BIC status.

Variables	Without	Little	Medium	P-value
Weight (kg)	52.82 ± 10.66a	54.86 ± 10.07a,b	60.01 ± 12.81b	0.03[a]
Height (cm)	158.55 ± 6.42a	161.14 ± 5.43b	159.09 ± 6.86 a,b	0.01[a]
Waist circumference (cm)	70.65 ± 6.96	71.04 ± 8.17	74.08 ± 7.96	0.15 [a]
Height for age (centile)	45.52 ± 26.75a	56.14 ± 22.63b	51.90 ± 26.77a,b	0.02 [a]
Height for age (z-score)	-.14 ± 0.90a	0.18 ± 0.69b	0.04 ± 0.86a,b	0.02 [a]
Body mass index (kg/m^2)	20.95 ± 3.55a	21.09 ± 3.97a	23.63 ± 4.39b	0.008 [a]
Body mass index for age (centile)	57.62 ± 30.78a	66.75 ± 99.55a	75.52 ± 24.34b	0.02 [a]
Body mass index for age (z-score)	0.26 ± 1.13a	.23 ± 1.27a	1.03 ± 1.05b	0.009[b]
Physical activity (met.hr)	39.20 ± 9.15	42.00 ± 14.81	42.46 ± 13.57	0.22 [a]

[a]: Kruskal Wallis test; [b]: ANOVA; Different letters show significant difference in post hoc analysis.

Mean values of BMI, BMI for age centile, and z-scores of it were significantly different between BIC subgroups (*P*=0.008, 0.02, and 0.009 for BMI, BMI for age centile, and z-score, respectively). In post hoc analysis, those with medium concern had significantly higher BMI, BMI for age centile, and z-score compared to those with no concern (*P*=0.002, 0.006, and 0.01 for BMI, BMI for age centile, and z-score, respectively) and those with low concern (0.007, 0.01 and 0.01 for BMI, BMI for age centile, and z-score, respectively).

Mean scores of height, height for age centile, and z-scores of it were significantly different between BIC subgroups (*P*=0.01, 0.02, and 0.02 for height, height for age centile, and z-score, respectively). In post hoc analysis, those with low concern had significantly higher height, height for age centile, and z-score than those with no concern (*P*=0.004, 0.006, and 0.009 for height, height for age centile, and z-score, respectively).

According to the results of logistic regression, BIC risk increased by 77%, with 1 unit increase in z-score of height for age. Moreover, 1 kcal increase in daily energy intake led to 1% decrease in BIC risk (**Table 3**).

Table 3. Predictors of BIC using logistic regression modeling.

Variables	Regression coefficient	95% CI	P-value
Age (year)	1.107	0.75 - 1.62	0.606
Menarche age	1.009	0.94 - 1.08	0.809
Waist circumference (cm)	0.958	0.88 - 1.03	0.272
Physical activity (met.hr)	1.028	0.99 - 1.05	0.069
Energy intake (kcal/day)	0.999	0.99 - 1.00	0.007
Height for age (z-score)	1.772	1.15 - 2.71	0.009
Body mass index for age (z-score)	1.247	0.78 - 1.99	0.354

Table 4 shows data on the adequacy of macronutrient and micronutrient intakes in three groups. Mean calorie intake was significantly different between BICI subgroups (*P*=0.03). In post hoc analysis, those with no concern had significantly higher calorie intake compared to those with medium concern (*P*=0.02).

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Table 4. Dietary intakes and mean adequacy ratios based on body image.

Variables	Without	Little	Medium	P-value[a]
Energy intake (kcal)	1688.79 ± 623.06a	1509.86 ± 521.43a,b	1401.14 ± 433.20b	0.03
NAR for protein (%)	97.48 ± 8.05	94.69 ± 11.78	97.76 ± 5.97	0.09
NAR for carbohydrate (%)	99.05 ± 5.07	97.81 ± 11.22	97.80 ± 5.29	0.07
NAR for total fiber (%)	49.87 ± 26.77	46.08 ± 24.34	47.60 ± 27.70	0.69
MAR for vitamins (%)	74.37 ± 13.85	74.96 ± 12.79	76.42 ± 12.35	0.78
MAR for minerals (%)	76.81 ± 16.16	74.97 ± 15.66	73.56 ± 16.55	0.56
Sugar (g)	72.26 ± 40.20	71.50 ± 52.71	59.80 ± 27.80	0.43
Sucrose (g)	17.24 ± 14.20	18.50 ± 18.00	12.44 ± 8.76	0.31
Caffeine (mg)	9.39 ± 16.96	12.65 ± 23.28	10.54 ± 24.30	0.29

NAR: Nutrient Adequacy Ratio; MAR: Mean Adequacy Ratio; [a]: Kruskal Wallis test; Different letters show significant differences in post hoc analysis.

Discussion

In this cross-sectional study, the association between BIC with anthropometric indices and dietary intakes in adolescent girls was assessed. Almost half of the adolescent girls had some degree of BIC. Higher weight and BMI was associated with higher BIC, and higher height led to increased risk of concern. Regarding dietary intakes, those with higher concerns had lower calorie intakes. There was no association between BIC and macro- and micronutrient intakes and physical activity patterns.

In the present study, it was found that 44.3% of adolescent girls had BIC. The results could be different from other studies due to different populations and ethnicities. In CASPIAN-IV study (Childhood Adolescent Surveillance and Prevention of Adult Non communicable disease) conducted on 13486 Iranian adolescents, they reported the prevalence of body weight dissatisfaction of about 53.5% in their study population (Wood-Barcalow *et al.*, 2010). Latiff *et al.* studied 776 students aged 11 and 12 years and randomly selected them from 7 primary schools. They stated that 60.1% of students had body image dissatisfaction, which is statistically significant (Latiff *et al.*, 2018). Another cross-sectional study that evaluated 500 Iranian women with mean age of 26.62 years, showed a high prevalence of body image dissatisfaction (Nikniaz *et al.*, 2016). The present study showed a significant rate of body image dissatisfaction, especially at early adolescence. Given the great importance of this issue, it is necessary to identify related factors as quickly as possible and take the necessary actions in this regard.

In the current study, those with higher weight and height had higher BIC. Almost all other studies confirmed that increased BMI was associated with decreased body image satisfaction (Casarrubias-Jaimez *et al.*, 2020, Xanthopoulos *et al.*, 2011). de Castro et al. (2016) reported that overweight and obese adolescents aged 10-18 years were seven times more susceptible to body image dissatisfaction than adolescents who had normal weight or lower weight (de Castro *et al.*, 2016). High BMI could affect the feeling of body image dissatisfaction in a variety of ways, such as destroying a person's mental image of body shape, that is a direct effect, or moving away from the ideal image that is constantly raised in ads and media, which is an indirect effect (Jones and Crawford, 2005).

It has been reported that there is also a high prevalence of body image dissatisfaction among people with a high BMI. It could be due to the fact that BMI is an indicator calculating an indicator from actual height and weight, while the BIC is subjective and mental feeling of each person about the body size and other parts of the body regardless of actual weight and height (Cash and Fleming, 2002).

In the present study, higher calorie intake decreased the risk of BIC. However, there was no association between BIC and macro- and micronutrient intakes and physical activity

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patterns. Lower calorie intake in those with higher BIC might be due to the efforts to compensate their undesired body image. Although their previous food intake was not evaluated, their incorrect eating habits could probably lead to BIC. A cross-sectional study was conducted on 1496 adolescents about the relationship between dietary patterns and body image dissatisfaction. They found that participants who had mild to moderate body image dissatisfaction compared to those without body image dissatisfaction, had less adherence to western dietary patterns and more compliance with the restrictive dietary patterns (Ribeiro-Silva *et al.*, 2018). The incidence of this adaptation in adolescent eating habits and following very restricted diets on some occasions can be a concerning issue and may cause nutrient inadequacies (Chang *et al.*, 2011). Other studies have also shown that in order to lose weight, students reduced their sugar and sweet snacks consumption, but if they had a weight gain goal, they would increase the consumption of these foods (del Mar Bibiloni *et al.*, 2012). There were also some studies asserting that healthy eating habits are more likely to be seen in people who are satisfied with their body image (Contento *et al.*, 2003, Kargarnovin *et al.*, 2013). There is a direct relationship between unhealthy food behaviors and body image dissatisfaction (Oliveira *et al.*, 2020); it is also logical to observe such results and can be related to the time before the emergence of adaptive behaviors.

In the present study, there was no association between BIC and physical activity. High levels of body image dissatisfaction and anxiety can act as a barrier and a deterrent against higher levels of physical activity (Kopcakova *et al.*, 2014, Storch *et al.*, 2007). Gomes *et al.* also believed that having enough physical activity can play a protective role against body image dissatisfaction, especially in adolescents, and appropriate measures should be taken in this regard (Gomes *et al.*, 2021). However, some studies concluded that moderate to mild levels of body image dissatisfaction can be considered as a stimulant and encouraging factor for higher levels of physical activity (Heinberg *et al.*, 2001) and can be compensatory efforts to achieve the ideal weight and body shape.

This study had some limitations and strengths. There was a limited sample size and cross-sectional design that cannot prove the causality relationship, since the precedence of the cause and effect is not clear, and further studies are needed in different aspects to better elucidate the exact relationships. One of the strengths of the study was that all the questionnaires and measurements were completely valid and performed by skilled and experienced people, which made the results more reliable. This study investigated one of the most important and increasing concerns, especially among adolescents, and evaluated its relationship with various factors such as BMI, physical activity, and dietary intake. This comprehensiveness can be the most important strength of this study. The population included adolescent girls, one of the most important at-risk groups.

Conclusion

Almost half of the adolescent girls had some degree of BIC. BIC was associated with lower calorie intake and higher z-score of height for age in adolescent girls.

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Conflicts of interest

There is any conflicts of interest.

Authors' Contributions

Kohansal A and Rafiepour A contributed to data collection and writing the first draft. Leilami K, Nouri M and Hafezi M contributed to all data and statistical analysis, and interpretation of data. Sohrabi Z and Akbarzade M contributed to the research concept, supervised the work and revised the manuscript. All authors read and approved the final manuscript.

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