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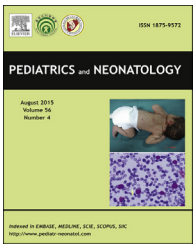

ORIGINAL ARTICLE

Prevalence of Growth Disorders in a Nationally Representative Sample of Iranian Adolescents According to Socioeconomic Status: The CASPIAN-III Study

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Key Words
adolescents;
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underweight

Background: This study aims to assess the prevalence of growth disorders among a nationally representative sample of Iranian adolescents according to the socioeconomic status (SES) of their living area.
Methods: This nationwide cross-sectional survey was conducted among a representative sample of 5624 adolescents aged 10–18 years. They were selected by multistage cluster sampling from 27 provinces of Iran. Subnational classification of the country was based on geography and social class of each region. Analysis of variance and Chi-square tests were used to compare the prevalence of growth disorders according to sex and SES of the living regions.

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Results: The mean and standard deviation for body mass index was 19.42 (4.09) kg/m^2, with a significant trend from the Southeast region with lowest SES to the Central part with highest SES ($p_{trend} < 0.001$). The prevalence of obesity, combined overweight and obesity, as well as abdominal adiposity increased with a significant trend from low to high SES (all $p_{trend} < 0.001$, except for girls' height, $p_{trend} = 0.003$). The opposite direction was documented for the prevalence of underweight and short stature, with the highest frequencies in the Southeast (lowest SES) and the lowest in Central part (highest SES).
Conclusion: Excess weight was more prevalent in high SES regions, whereas underweight and short stature were more prevalent in low SES regions. These findings underscore the necessity of implementing evidence-based health promotion programs and preventive strategies according to SES.
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1. Introduction

Growth is one of the most fundamental phenomena in the pediatric age group. It is influenced by genetic background and a complex interaction between hormonal, nutritional, psychosocial, socioeconomic, and lifestyle habits of individuals.[1] Growth disorders are manifested by different patterns such as short stature, underweight, overweight, and obesity. The prevalence of such disorders has large variations in different communities. Growth disorders in childhood might increase the risk of different associated comorbidities in later life; they can have long-term impact—for instance, longitudinal studies have shown that even after 55 years of follow-up, weight status in childhood had independent association with that of adulthood.[2,3]

Previous studies for the period between the 1980s and 1990s show the prevalence of overweight and obesity in children increased dramatically by 2- to 5-folds in developed countries (e.g., from 11% to >30% in boys in Canada), and up to almost four times in developing countries (e.g., from 4% to 14% in Brazil).[4]

Increased urbanization along with rapid socioeconomic changes and nutrition transition might be considered as the main determinants of the high prevalence of growth disorders in developing communities.[5–7] Although in developed countries overweight and obesity are more prevalent than underweight, the prevalence of overweight and underweight is estimated to be the same in developing societies such as Iran.[8–10] Previous nationwide studies in Iran have indicated high frequency of such disorders, including 8.8% overweight, 4.5% obesity, and 13.9% underweight.[11] This pattern is also reported from South and West Asian populations with high prevalence of underweight in children and adolescents.[12,13]

The association between socioeconomic status (SES) and obesity has been documented among adults; however, results are conflicting in the pediatric age group.[14–16]

Childhood and adolescence are considered critical periods of rapid growth during the life span of human beings; therefore, screening, identification, and treatment of growth failure deserve ample attention in developing countries. A recent systematic review and meta-analysis conducted in Iran revealed that, although the trend in the prevalence of obesity among Iranian children is not remarkably high, the increasing trend of overweight among young children is at an alarming rate and should be considered by providers of interventional preventive programs at national and regional levels.[17] Previous results based on national data have also shown a double burden of nutritional disorders in Iran[8,11]; however, this condition is not reported according to subnational SES classification of the country. The present study aims to determine the prevalence of growth disorders in a nationally representative sample of Iranian adolescents according to the SES of their living area.

2. Methods

This nationwide survey was performed in 2011–2012 as the third phase of a national school-based surveillance program entitled Childhood Adolescence Surveillance and Prevention of Adult Non-communicable disease (CASPIAN) study.[18] Details of the current survey are published elsewhere.[19] It is based on the World Health Organization Global School-based Student Health Survey, with additional information gathered from parents. This study aims to assess the risky behaviors and risk factors among students to help the design and implementation of health initiatives in an action-oriented manner. The study participants consisted of 5624 students selected from urban and rural areas of 27 provinces in Iran. They were selected by stratified multistage random sampling. After complete clarification of the study, written informed consent was obtained from parents and oral assent from students. Anthropometric indices used for these analyses included body weight, height, and waist circumference (WC), measured by trained health professionals. Body mass index (BMI) was then calculated via the ratio of weight (kg) to height squared (m^2). Weight was recorded with the individual wearing only light clothing to the nearest 0.1 kg, and height was measured without shoes to the nearest 0.1 cm, using a portable stadiometer. WC was measured using a nonelastic tape to the nearest 0.1 cm over skin, midway between the iliac crest and the lowest rib in standing position. The definition of weight status disorders was based on the World Health Organization standard growth curves.[20] Abdominal obesity was determined using the equation WC divided by height ratio greater than 0.5.[20]

For comparison of regions with different SES, the classification of Iran into four subnational regions was based on a previous study. The subnational regions were defined based on the combined criteria of geography and SES using principal component analysis. SES was an index consisting of variables from Iranian national census including literacy, family permanent income (family assets), and employment rate. According to this classification, Iranian regions were ranked from lowest to highest SES as follows: Southeast, North-Northeast, West, and the Central regions.[21]

2.1. Statistical analysis

To analyze the data, the SPSS software (version 16.0; SPSS, Chicago, IL, USA) was used. Mean and standard deviations (SD) were calculated for continuous variables. Analysis of variance and Chi-square tests were used to compare the prevalence of growth disorders between regions. The level of significance was set as $p < 0.05$.

3. Results

This cross-sectional nationwide survey was performed among 5624 students with mean age of 14.7 years (49.79% girls, 69.37% urban). More than 90% of the study participants were from public schools. The mean (SD) for BMI was 19.42 (4.09) kg/m^2, showing a significant trend with lowest amount in Southeast (with lowest SES) and highest in the Central part (with highest SES) of Iran ($p_{trend} < 0.001$). The corresponding values for WC were 68.72 (20.67) with no significant trend between different regions of the country. Table 1 demonstrates the mean values of continuous variables according to subnational classification of the country from the lowest (Southeast) to the highest (Central) SES. It shows a significant rising trend between regions from the lowest to the highest SES in the mean (SD) of anthropometric indices including weight, height, and BMI (all $p_{trend} < 0.001$, except for girls' height, $p_{trend} = 0.003$). WC and waist/height ratio (WHtR) showed the aforementioned trend only for female students (0.001 for WC and 0.019 for WHtR). Among boys, the maximum value of mean (SD) for WC observed in Southeastern area, whereas its lowest level was seen in North-Northeast, with no significant trend between regions ($p_{trend} = 0.42$). A marginally significant trend was found between regions regarding mean (SD) of WHtR of male students with the highest level in the Southeast and minimum values in the North-Northeast of Iran ($p_{trend} = 0.08$).

Table 2 shows the prevalence of growth disorders among girls and boys in different regions of Iran, and p for trend from lowest to the highest SES. Obesity was documented in 8.9% of adolescents. Overall, significant regional disparities were observed in the prevalence of obesity from the highest level in the Central part of Iran (with the highest SES), to its lowest level in the Southeastern area (with the lowest SES) ($p_{trend} < 0.001$). The same trend was found for the prevalence of overweight and obesity ($p_{trend} < 0.001$). When we combined overweight and obese individuals in the analysis, we observed the highest frequency (21.1%) for the Central region (ranked as the highest SES), whereas the lowest prevalence (11.3%) was found in the Southeast area (lowest SES).

In total, 2.6% of study participants had short stature. It had lowest frequency of 1.5% in the Central part (with the highest SES) and the highest frequency of 3.9% for Southeast area (with the lowest SES).

The overall prevalence of underweight was documented in 17.5% of the study population. Its highest prevalence was present in 25.4% of adolescent population living in Southeast

Table 1 Mean and standard deviation of continuous variables according to subnational classification of Iran: the CASPIAN III Study.

	Southeast (Lowest SES)	North-Northeast (Second low SES)	West (Second high SES)	Central (Highest SES)	National	p_{trend}*
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	
Weight (kg)						
Boys	42.61 (13.47)	46.31 (13.50)	45.31 (12.59)	47.65 (13.65)	45.89 (13.23)	<0.001
Girls	44.60 (15.30)	48.54 (16.96)	47.93 (16.10)	50.07 (17.12)	48.73 (16.57)	<0.001
Height (cm)						
Boys	149.01 (12.27)	151.77 (11.86)	151.58 (11.16)	153.10 (11.76)	151.79 (11.63)	<0.001
Girls	154.41 (16.65)	156.10 (14.95)	156.50 (15.91)	157.55 (15.18)	156.54 (15.60)	0.003
BMI (kg/m^2)						
Boys	18.78 (4.10)	19.80 (4.28)	19.40 (3.86)	20.08 (4.31)	19.61 (4.12)	<0.001
Girls	18.12 (3.46)	19.38 (4.16)	19.11 (3.93)	19.65 (4.28)	19.23 (4.06)	<0.001
Waist circumference (cm)						
Boys	70.13 (45.18)	66.46 (9.50)	67.52 (23.34)	67.57 (11.39)	67.59 (22.16)	0.425
Girls	67.14 (10.76)	70.03 (27.54)	69.04 (19.36)	71.72 (12.88)	69.86 (18.99)	0.001
WHtR						
Boys	0.46 (0.27)	0.43 (0.05)	0.44 (0.15)	0.44 (0.06)	0.44 (0.14)	0.087
Girls	0.43 (0.05)	0.44 (0.17)	0.44 (0.12)	0.45 (0.06)	0.44 (0.12)	0.019

BMI = body mass index; CASPIAN III Study = Childhood Adolescence Surveillance and Prevention of Adult Non-communicable Disease III Study; SD = standard deviation; WHtR = waist/height ratio.

* Between regions using analysis of variance (ANOVA).

Table 2 Prevalence of growth disorders among Iranian students in a subnational classification: the CASPIAN III Study.

	Southeast (Lowest SES)	North-Northeast (Second low SES)	West (Second high SES)	Central (Highest SES)	National	p_{trend}*
	N (%)	*N* (%)	*N* (%)	*N* (%)	*N* (%)	
Underweight						
Boys	73 (25.8)	90 (16.7)	218 (18.1)	117 (14.6)	498 (17.6)	0.001
Girls	69 (25.1)	82 (15.4)	186 (16.4)	149 (17.4)	486 (17.4)	0.097
Overall	142 (25.4)	172 (16)	404 (17.3)	266 (16.1)	984 (17.5)	<0.001
Short stature						
Boys	11 (3.9)	25 (4.6)	37 (3.1)	16 (2)	89 (3.1)	0.013
Girls	11 (4)	9 (1.7)	26 (2.3)	9 (1.1)	55 (2)	0.012
Overall	22 (3.9)	34 (3.2)	63 (2.7)	25 (1.5)	144 (2.6)	<0.001
Obesity						
Boys	29 (10.2)	61 (11.3)	87 (7.2)	109 (13.6)	286 (10.1)	0.162
Girls	8 (2.9)	46 (8.6)	73 (6.4)	88 (10.3)	215 (7.7)	0.001
Overall	37 (6.6)	107 (10)	160 (6.8)	197 (11.9)	501 (8.9)	<0.001
Overweight and obesity						
Boys	41 (14.5)	122 (22.6)	201 (16.7)	187 (23.4)	551 (19.5)	<0.001
Girls	22 (8)	85 (15.9)	132 (11.6)	162 (18.9)	401 (14.3)	<0.001
Overall	63 (11.3)	207 (19.3)	333 (14.2)	349 (21.1)	952 (16.9)	<0.001
Abdominal obesity						
Boys	47 (16.5)	61 (11.3)	170 (14.1)	137 (17.1)	415 (14.7)	0.128
Girls	34 (12.3)	88 (16.4)	148 (13)	203 (23.7)	473 (16.9)	<0.001
Overall	81 (14.5)	149 (13.9)	318 (13.6)	340 (20.5)	888 (15.8)	<0.001

CASPIAN III Study = Childhood Adolescence Surveillance and Prevention of Adult Non-communicable Disease III Study.
* Between regions comparison using Chi-square test.

districts, whereas the lowest frequency of underweight (16%) was observed among residents of North-Northeast regions, which was ranked as the second low SES level. The trend between different socioeconomic parts of Iran for underweight prevalence was significant ($p_{trend} < 0.001$).

Among the study populations, abdominal adiposity was observed in 15.8% of adolescents. A higher abdominal obesity rate was found in the Central part (with the highest SES), whereas its lowest level was attributed to populations living in the West part (with the second highest SES) of the country. The significant regional disparities between different SES levels were also documented for abdominal obesity ($p_{trend} < 0.001$).

4. Discussion

This study is the first of its kind to compare the prevalence of growth disorders among Iranian adolescents at the subnational classification of SES. It revealed regional disparities in the prevalence of growth disorders in Iranian adolescents. Overweight, generalized and abdominal obesity had higher prevalence in high SES than in low SES regions, whereas short stature was more prevalent in low SES than in high SES regions.

It is well documented that rapid growth during childhood is influenced by multiple parameters including environment and sociodemographic factors. Unfavorable growth pattern will emerge as malnutrition including underweight- and/or obesity-associated complications later in adult life.[22] Recent research has focused on SES as an important determinant of overall health status. Results from adult populations revealed the association between SES and obesity; however, this relationship is not clearly observed in the pediatric age group.[23]

Overall, we found that the prevalence of growth disorders is remarkably different across the country, showing the impact of SES development level. According to these findings, obesity and abdominal adiposity were the prevailing disorders in more affluent districts, whereas underweight and short stature, as indicators of malnutrition, were mostly seen among adolescents living in less developed regions. This finding is in line with a previous report from Pakistan indicating higher risk of stunting and thinness among children living in low-income neighbors. Food insecurity, lower access to healthy foods, and inadequate education might play a role in the higher prevalence of short stature and underweight among residents of low SES areas.[24] Moreover, urbanization along with rapid epidemiologic and nutrition transition could be possibly considered as an important factor contributing to the emergence of epidemics of underweight and excess weight in developing countries.[25]

In the present study, the double burden of nutritional disorders, in terms of coexistence of both thinness (17.5%) and excess weight (16.9%), was observed. One explanation for the higher percentage of undernutrition in the Southeast area might be the low SES level of the living area and the family. In the current study, overweight and obesity had lower prevalence in regions with low SES, whereas in some middle- and high-income regions, lower SES is associated with a higher frequency of obesity.[24]

Similar patterns of growth disorders have been explored in some developing countries (e.g., China, Egypt) and

among Iranian children at entry to elementary school.[9,26–28] Findings of the current study on the positive relationship between SES and BMI are consistent with some previous studies from India, Ghana, and Indonesia.[29,30] By contrast, in the United States, higher risk of obesity was found in low SES groups, whereas in Russia, a transitional community, both low and high SES levels were associated with an increased risk of obesity compared to the middle income population.[23,31] These variations might be because of the different impacts of SES on lifestyle-related factors, such as dietary habits and physical activity levels, in developed and developing societies. As an example, affluent urban Chinese people have better access to energy-dense, animal products and more developed transportation system than poorer inhabitants, reflecting unhealthy diets and sedentary behaviors, whereas in the United States, more vegetables and fruits are consumed by the higher SES group than their lower SES counterparts.[26]

It is important to mention that because of the cross-sectional nature of the current study, we cannot imply the cause–effect relationships. Considering the large representative sample of Iranian adolescents as a nationwide study enabled us to extrapolate the current results to rural and urban school students.

Results of the current national survey are alarming and confirm that both excess weight and growth failure are health priorities for the pediatric age group. There is an urgent need for screening, monitoring, and designing intervention programs to prevent health consequences of the emerging growth disorders at the subnational level by considering the SES.

Conflicts of interest

None to declare.

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