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Original Article

Association of Socioeconomic Status with Anthropometric Measures and Blood Pressure in a Representative Sample of Iranian Children and Adolescents: The CASPIAN-IV Study

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Abstract

Background: The aim of this study was to evaluate the association of Socioeconomic Status (SES) with anthropometric measures and BP in Iranian children and adolescents.

Methods: This nationwide study was conducted in 2011-2012 among 14,880 students, aged 6-18 years, selected by multistage, cluster-sampling method from rural and urban areas of 30 provinces of Iran. Anthropometric indexes and BP were measured by standard protocols and with calibrated instruments. SES was estimated based on family assets and parents' job and education using principle component analysis method. SES was considered as "low", "intermediate" and "high" in the statistical analysis.

Results: Overall**,** 13486 children and adolescents out of 14,880 invited students (response rate 90.6%) participated in this study. They consisted of 50.8% boys, 75.6% urban residents, with a mean age of 12.47 ±3.36 years. The prevalence of overweight, obesity and abdominal obesity and also mean of all anthropometric measures increased linearly with increasing SES. Inversely, underweight decreased linearly with increasing SES. Association of BP measures with SES was not statistically significant. After adjustment for potential confounders, association of anthropometric measures and BP with SES did not change significantly.

Conclusion: We found that obesity, overweight and abdominal obesity was prevalent in high SES group and underweight in low SES group. Our findings serve as confirmatory evidence that contrary to developed countries, in developing countries childhood obesity is more prevalent in families with higher SES.

Keywords: Anthropometric measures, Blood pressure, Socio-economic status, Children and adolescents, Iran

Introduction

Obesity is a global health problem and a major risk factor for many health disorders, affecting around 1.4 billion people worldwide (1, 2). Obesity epidemics have reached low and middle-income countries as the Middle-eastern and North African (MENA) countries. However; while the major concern is overweight and obesity is industrialized countries, developing countries as that of MENA with socioeconomic disparities are facing a double burden of malnutrition in terms of underweight and overweight (3-6). Iran, as a country in the MENA region, with a developing economy has the same situation. Previous nationwide studies have shown that Iran is facing a problem with both underweight and "overweight and obesity" with a prevalence of 17.4 and 17.7 percent respectively showing a clear double burden of malnutrition in the nation concomitant with an increasing trend in prevalence of obesity and overweight among children and adolescents (4, 7, 8). It is mostly thought that a disproportionate rapid growth in economy may be the main determinant this double burden (3, 4).

Many risk factors have been concretely associated with obesity and underweight; these include but are not limited to: dietary habits, physical activity, age, genetic predisposition, and gender. Some others have been proposed as possible factors. Of note in this latter group is socioeconomic status (SES) including educational levels, rural versus urban residence, income, and social class, which are potentially modifiable (9, 10).

Effects of SES on anthropometric variables of children and young adolescents are insufficiently studied. To our knowledge, the impact of SES on anthropometric measures has not been studied in the MENA region. The aim of this study was to investigate the association of SES with anthropometric indexes and blood pressure (BP) in a representative sample of Iranian children and adolescents.

Materials and Methods

This national study was conducted in Iran, based on the protocol of the World Health Organization- Global School-based Student Health Survey (WHO-GSHS). It was conducted as the fourth survey of a school-based surveillance system entitled "Childhood and Adolescence Surveillance and Prevention of Adult Non-communicable Disease" (CASPIAN-IV) study (2011-2012). The details of aim and methods of mentioned study is described previously (11), and here we report it in brief.

The study population consisted of 14,880 school students, aged 6-18 years. They were selected through multistage, cluster sampling method from rural and urban areas of different cities in 30 provinces of Iran. A trained team of health care providers conducted all processes of examinations under standard protocols and with calibrated instruments. The information was recorded in the checklists and validated questionnaires were completed for all participants. The quality assurance of study process was controlled by Data and Safety Monitoring Board (DSMB) of the project (1).

Physical examination

Anthropometric measures

Height (Ht) and weight (Wt) were measured according to standard protocols, without shoes and with light clothing to the nearest 0.1 unit of measure (cm for height and kg for weight). As a measure of obesity, body mass index (BMI) was calculated from weight and height [BMI = Wt (kg) /Ht (m2)] (12, 13). Waist circumference (WC) was measured over skin, midway between the lower border of the rib margin and the iliac crest at the end of normal expiration, to the nearest 0.1 cm (14-16). Waist to height ratio (WHtR) was calculated from WC and Ht [WHtR = WC (cm) /Ht (cm)]. Hip circumference (HC) was measured at the widest part of the hip at the level of the greater trochanter to the nearest 0.1 cm. Waist to hip ratio (WHR) was calculated as WHR = WC (cm) /HC (cm). Wrist circumference was measured to the nearest 0.1 cm on the dominant arm using a tape meter. Subjects were asked to hold their arm on a flat surface such as a table. The superior bor-

der of the tape measure was placed just distal to the prominences of radial and ulnar bones.

Blood pressure

Systolic and diastolic BP (SBP/DBP) were measured, using calibrated mercury sphygmomanometers, with a suitable cuff size for each participant, on the right arm after 5-minutes of rest in a sitting position. The first and fifth Korotkoff sounds were respectively recorded as SBP and DBP. BP was measured two times at five-minute intervals, and the average was considered as the actual value (11, 14).

Demographic information

Demographic information, including family history of chronic diseases (hypertension, dyslipidemia, diabetes, and obesity, premature cardiovascular diseases), parental level of education, possessing a family private car and type of home, dietary behaviors, physical activity,, and sedentary lifestyle, was collected by trained interviewers.

Definition of terms

Anthropometric and BP measures

The World Health Organization (WHO) growth curves were used to define BMI categories. Underweight, overweight and obesity were defined as BMI<5^{th} percentile, BMI 85^{th} - 95^{th} percentile and BMI > 95^{th} percentile for age and sex respectively**.** Abdominal obesity was considered as WHtR more than 0.5 [14-16]. 'Elevated BP' was defined for BP values ≥95th gender, age, and height-specific percentile (15, 16).

Socioeconomic status (SES)

The method and variables, which was used for calculating SES was approved previously in the Progress in the International Reading Literacy Study (PIRLS) (17). Using principle component analysis variables including parents' education, parents' occupation, possessing private car, school type (public/private), type of home (private/rented) and having personal computer in home were summarized in one main component. This main component was categorized into tertiles. The first tertile was defined as a "low SES", second tertile as a "moderate SES" and third tertile as a "high SES".

Screen time (ST)

The ST behavior of the participants was assessed through a questionnaire that asked them to report the average number of hours per day they spent watching, personal computer, or electronic games. For the analysis ST according to the international recommendations was categorized into two groups; less than 2 hours per day (low), and 2 hours per day or more (high) (18).

Physical activity (PA)

The information of past week was collected. Participants reported the weekly frequency of their leisure time PA outside the school. The duration of at least 30 minutes per day was considered as the main component of leisure time PA definition. For statistical analysis, each weekly frequency received a name (0-2 days per week (Mild), 3-5 days per week (Moderate), 6-7 days (Severe)) (11, 18).

Ethical consideration

The study was reviewed and approved by ethical committees and other relevant national regulatory organizations. Participation in the present study was voluntarily. Sampling and examinations were begun after complete introducing of project and explanation of the study's protocols for students and their parents. The written informed consent and verbal assent obtained from all of the parents and students.

Statistical analyses

Quantitative variables are expressed as mean and 95% confidence interval (CI), and qualitative variables as percentages and 95% CI. Comparisons of means were investigated by *t*-test and for categorized variables; the Pearson Chi-square test used to compare the percentages.

In this study, SES was determined using principal component analysis (PCA) method. Logistic and linear regression analyses were used to evaluate the association of SES categories with anthropometric indices and BP in different models for adjust-

ing potential confounders. Model I was a crude model (without adjusted). In Model II the association was adjusted for age, sex and living place and in Model III, family size, PA, ST activity, family history of chronic diseases and junk food consumption additionally were adjusted in the model. Model IV is adjusted additionally for BMI in HTN, DBP and SBP. All statistical measures were estimated using survey data analysis methods. Data was analyzed by using STATA package ver. 11.0 (Stata Statistical Software: Release 11.College Station, TX: Stata Corp LP. Package). *P*-value< 0.05 was considered as statistically significant.

Results

The population of this survey consisted of 13486 children and adolescents out of 14880 invited subjects (participation rate of 90.6%) and one of their parents. They were 6640 (49.2%) girls and 6846 (50.8%) boys; 75.6% of students were from urban and 24.4% from rural areas. The mean age of participants was 12.47±3.36 years. Table1 shows the sex stratified anthropometric data and other characteristics of the study population. Overall boys had higher height and weight but lower BMI. In addition, both obesity and underweight were slightly higher in boys than in girls.

Table 1: Characteristics of participants according to gender: the CASPIAN-IV Study

	Boys % (95% CI)	Girls % (95% CI)	Total % (95% CI)	*P*- value
Age (Yr)[1]	12.36 (12.12- 12.60)	12.58 (12.34-12.82)	12.47189 (12.29-12.64)	<0.001
Height (cm)[1]	148.17 (146.83-149.51)	145.77 (144.69-146.85)	146.99 (146.10- 147.88)	<0.001
Weight (Kg)[1]	43.07 (41.92-44.21)	41.71 (40.77-42.65)	42.40 (41.64-43.15)	<0.001
BMI (Kg/m2)[1]	18.73 (18.53-18.94)	18.97 (18.76-19.17)	18.85 (18.70-18.99)	<0.001
WC (cm)[1]	67.83 (67.15-68.51)	66.19 (65.62-66.76)	67.02 (66.57-67.48)	<0.001
WHtR [1]	0.458 (0.456-0 . 461)	0.454 (0.452-0.457)	0.456 (0.455-0.458)	<0.001
Wrist (cm)[1]	15.01 (14.89-15.13)	14.51 (14.42-14.60)	14.76 (14.68- 14.84)	<0.001
Hip (cm)[1]	80.05 (79.21- 80.90)	81.52 (80.65-82.40)	80.78 (80.16-81.40)	<0.001
WHR[1]	. 1908 (. 1890-. 1925)	. 1815 (. 1798-. 1832)	18.62 (18.49- 18.74)	<0.001
SBP[1]	102.79 (102.03- 103.54)	100.21 (99.59-100.82)	101.52 (101.02-102.02)	<0.001
DBP[1]	65.58 (64.96-66.19)	64.15 (63.57-64.73)	64.87 (64.45-65.30)	0.001
HTN				
Yes	4.53 (3.79-5.41)	2.93 (2.33-3.74)	3.75 (3.27-4.28)	0.007
No	95.47 (94.59-96.21)	97.07 (96.26-97.74)	96.25 (95.72-96.73)	
Abdominal obesity				
Yes	20.41 (19.09-21.79)	17.79 (16.56-19.09)	19.12 (18.22-20.06)	0.006
No	79.59 (78.21-80.91)	82.21 (80.91-8344)	80.88 (79.94-81.78)	
BMI categories				
Underweight	13.03 (12.06-14.08)	11.28 (10.38-12.23)	12.17 (11.50-12.87)	<0.001
Normal	64.11 (62.78-65.42)	68.52 (67.14-69.87)	66.28 (65.31-67.24)	
Overweight	9.28 (8.56-10.05)	10.06 (9.30-10.86)	9.66 (9.14-10.21)	
Obesity	13.58 (12.59-1463)	10.15 (9.28-11.09)	11.89 (11.22-12.59)	
Family size				
≥4	. 5017 (. 4843,. 5191)	. 4764 (. 4583,. 4945)	. 4892 (. 4776,. 5007)	0.0653
<4	. 4983 (. 4809,. 5157)	. 5236 (. 5055,. 5417)	. 5108 (. 4993,. 5224)	
Screen time (%)				
≤4h	7807 (. 766,. 7947)	. 8478 (. 836,. 8588)	8138 (. 8043,. 8229)	<0.001
>4h	. 2193 (. 2053,. 234)	. 1522 (. 1412,. 164)	. 1862 (. 1771,. 1957)	
Physical activity (%)				
Mild	. 2875 (. 2686,. 3072)	. 3961 (. 3754,. 4172)	. 3411 (. 3266,. 3558)	<0.001
Moderate	. 3562 (. 3411,. 3717)	. 3797 (. 3636,. 3961)	. 3678 (. 3566,. 3792)	
Severe	. 3562 (. 3366,. 3763)	. 2242 (. 2082,. 241)	. 2911 (. 2779,. 3047)	
Family History (%)				
Obesity	. 4334 (. 4185,. 4484)	. 4766 (. 4607,. 4926)	. 4547 (. 4438,. 4657)	<0.001
DM	. 3653 (. 3514,. 3793)	. 38 (. 3659,. 3943)	. 3726 (. 3632,. 3821)	0.16
HTN	. 524 (. 5097,. 5382)	. 5492 (. 5338,. 5645)	. 5364 (. 5262,. 5467)	0.02
Dyslipidemia	. 4351 (. 4209,. 4493)	. 4464 (. 4322,. 4606)	. 4407 (. 4308,. 4505)	0.28
Junk food consumption				
Seldom	. 3143 (. 2988,. 3302)	. 3551 (. 3393,. 3712)	. 3345 (. 3233,. 3458)	<0.001
Weekly	. 3233 (. 3108,. 3361)	. 3346 (. 3226,. 3467)	. 3289 (. 3201,. 3378)	
Daily	. 3624 (. 3454,. 3797)	. 3104 (. 295,. 3261)	. 3367 (. 325,. 3485)	
SES (%)				
Low	. 3318 (. 3114,. 3529)	. 3377 (. 3173,. 3587)	. 3347 (. 3204,. 3494)	0.57
Moderate	. 3267 (. 3113,. 3424)	. 3352 (. 3203,. 3506)	. 3309 (. 3201,. 3419)	
High	. 3415 (. 3181,. 3657)	. 3271 (. 3045,. 3504)	. 3344 (. 3182,. 3509)	

BMI: body mass index; WC: waist circumference, WHtR: waist to height ratio, WHR: waist to hip ratio, SBP: systolic blood pressure, DBP: diastolic blood pressure, HTN: hypertension, SES: socio economic status, DM: diabetes mellitus, [1] Data are mean (95% of mean)

Mean values of the anthropometrics of the study population across SES categories are depicted in Table2.Prevalence of obesity, overweight, abdominal obesity and also mean of all anthropometric measures (such as height, wrist circumference, WC, weight to height ratio, waist to hip ratio and BMI) increased linearly with increasing SES (*P* for trend <0.001), while prevalence of underweight linearly decreased with increasing SES (*P* for trend <0.001). No significant difference in HTN either diastolic or systolic was noted among different SES groups. Odds ratios of the anthropometric and BP measures across SES categories in different logistic models are shown in Table 3.

Table 2: Anthropometrics and BP measures across SES categories: the CASPIAN-IV Study

	SES categories				
	Low	Moderate	High	*P*-Value[2]	*P* for trend[3]
Height (cm)[1]	144.19 (143.01-145.37)	146.87 (145.78-147.96)	149.50 (148.25-150.74)	<0.001	<0.001
Weight (Kg)[1]	39.00 (38.06-39.94)	42.20 (41.25-43.15)	45.63 (44.50-46.76)	<0.001	<0.001
BMI (Kg/m2)[1]	18.05 (17.86-18.25)	18.78 (18.59-18.97)	19.65 (19.43- 19.87)	<0.001	<0.001
WC (cm)[1]	64.64 (64.06-65.22)	67.08 (66.49-67.68)	69.23 (68.54-69.91)	<0.001	<0.001
WHtR[1]	. 4495 (. 4470-. 4519)	. 4574 (. 4549-. 4598)	. 4637 (. 4609-. 4665)	<0.001	<0.001
Wrist (cm)[1]	14.52 (14.41-14.62)	14.76 (14.76- 14.86)	14.97 (14.86- 15.09)	<0.001	<0.001
Hip (cm)[1]	78.21 (77.32-79.09)	80.54 (79.78- 81.29)	83.39 (82.46-84.32	<0.001	<0.001
WHR[1]	0.1891 (0.187-0.1907)	0.186 (0.185-0.188)	0.182 (0.181-0.184)	<0.001	<0.001
SBP	100.19 (99.48- 100.89)	101.71 (101.07-102.34)	102.38 (101.62-103.14)	<0.001	<0.001
DBP	64.57 (63.95-65.19)	64.98 (64.44- 65.52)	64.93 (64.31- 65.54)	<0.001	0.390
Abdominal obesity (%)	14.25 (13.05-15.55)	19.35 (18.02-20.74)	24.1 (22.5-25.78)	<0.001	<0.001
Underweight (%)	15.09 (13.82-16.44)	12.0 (10.95-13.13)	9.45 (8.54-10.45)	<0.001	<0.001
Overweight (%)	6.96 (6.19-7.81)	9.22 (8.36-10.16)	1269 (11.66-13.81)	<0.001	<0.001
General obesity (%)	7.52 (6.66-8.48)	11.9 (10.92-12.96)	15.81 (14.55-17.16)	<0.001	<0.001
High SBP (%)	0.73 (0.5-1.06)	1.08 (0.78-1.49)	0.9 (0.6-1.35)	0.27	0.43
High DBP (%)	3.45 (2.74-4.35)	3.15 (2.56-3.87)	2.65 (2.1-3.35)	0.18	0.10
HTN (%)	4.06 (3.29-5.00)	3.86 (3.2-4.65)	3.31 (2.67-409)	0.27	0.16

BMI: body mass index; WC: waist circumference, WHtR: waist to height ratio, WHR: waist to hip ratio, SBP: systolic blood pressure, DBP: diastolic blood pressure, HTN: hypertension, SES: socio economic status, DM: diabetes mellitus, /[1]All values are means (95%CI of mean),/ [2]*P*-values are resulted from analysis of variance (ANOVA) or Chi square/[3]*P*-values for trend analysis

Table 3: Odds ratios (95% CI) for anthropometric and BP measures across SES categories: : the CASPIAN-IV Study

SES	Low	Moderate	High	*P*-trend
Obesity				
Model I[1]	1	1.66 (1.42-1.93)*	2.31 (1.96-2.71)*	<. 001
Model II[2]	1	1.54 (1.31- 1.80)*	2.05 (1.73-2.42)*	<. 001
Model III[3]	1	1.38 (1.17- 1.63)*	1.74 (1.46-2.09)*	<. 001
Underweight				
Model I[1]	1	0.76 (0.66-0.88)*	0.58 (0.50-0.68)*	<. 001
Model II[2]	1	0.79 (0.69-0.92)*	0.62 (0.53-0.73)*	<. 001
Model III[3]	1	0.83 (0.72-0.96)*	0.68 (0.58-0.80)*	<. 001
Overweight				
Model I[1]	1	1.35 (1.15-1.59)*	1.94 (1.65- 2.27)*	<. 001
Model II[2]	1	1.25 (1.07-1.47)*	1.70 (1.44-2.01)*	<. 001
Model III[3]	1	1.24 (1.05-1.47)*	1.64 (1.38- 1.95)*	<. 001
Abdominal obesity				
Model I[1]	1	1.44 (1.27- 1.62)*	1.91 (1.67- 2.18)*	<. 001
Model II[2]	1	1.31 (1.16-1.48)*	1.64 (1.43-1.88)*	<. 001
Model III[3]	1	1.21 (1.06-1.38)*	1.48 (1.27- 1.71)*	<. 001
HTN				
Model I[1]	1	0.95 (0.74- 1.21)	0.80 (0.57-1.12)	0.21
Model II[2]	1	0.95 (0.74- 1.21)	0.77 (0.56- 1.07)	0.12
Model III[3]	1	0.96 (0.74- 1.24)	0.82 (0.60-1.14)	0.24
Model IV[4]	1	1.18 (0.82-1.69)	1.27 (0.69-2.33)	0.10
DBP				
Model I[1]	1	0.90 (0.69-1.18)	0.76 (0.52-1.10)	0.15
Model II[2]	1	0.93 (0.71- 1.21)	0.76 (0.53- 1.09)	0.13
Model III[3]	1	0.94 (0.71-1.24)	0.80 (0.55-1.14)	0.22
Model IV[4]	1	1.25 (0.84-1.87)	1.47 (0.76- 2.85)	0.11
SBP				
Model I[1]	1	1.48 (0.95-2.31)	1.23 (0.72- 2.10)	0.43
Model II[2]	1	1.29 (0.82- 2.02)	0.95 (0.56-1.63)	0.78
Model III[3]	1	1.24 (0.73-2.10)	0.95 (0.51- 1.76)	0.77
Model IV[4]	1	0.95 (0.45-2.01)	0.59 (0.18-1.98)	0.44

SBP: systolic blood pressure, DBP: diastolic blood pressure, HTN: hypertension, SES: socio economic status /[1]Without adjusted (crude models)/ [2]Adjusted for age, sex and living place/[3]Additionally adjusted for family size, physical activity, screen time activity, family history of chronic diseases and junk food consumption /[4] Additionally adjusted for BMI in HTN, DBP and SBP

As seen in this table, higher SES groups have higher risk of general and abdominal obesity and overweight while lower SES groups have higher risk of underweight in all models. Fully adjusted multivariate model (model-III) shows obesity is 1.7 times higher in high SES group compared to low SES group (95% CI: 1.46-2.09), while underweight was shown to be 0.68 times in the high SES group compared to the low SES group (95%CI: 0.58-0.80). Results of linear regression models are depicted in Table 4.Results of model-III show that weight is on average 3.8 Kg more in high SES category compared to the low SES group (95% CI :3.2- 4.4), while the moderate SES group stands in the middle between high and low (Beta co-efficient: 2.2, 95% CI: 1.7-2.7). The same linear trend is observed for Ht, BMI, WHtR, wrist HC and WC; however, WHR decreased linearly with increasing SES categories (*P* for trend <0.001) (*P* for trend <0.001).

Table 4: β-coefficients (CI 95%) for anthropometric and BP measures across SES categories: the CASPIAN-IV Study

	SES categories		
	Moderate/ Low	**High/Low**	***P*-trend**
Weight (cm)			
Model I[1]	3.20 (2.26-4.14)	6.63 (5.29-7.97)	<0.001
ModelII[2]	2.72 (2.23-3.20)	4.67 (4.10-5.24)	<0.001
Model III[3]	2.24 (1.75-2.72)	3.83 (3.25- 4.41)	<0.001
Height (cm)			
Model I[1]	2.68 (1.57- 3.78)	5.30 (3.75-6.85)	<0.001
Model II[2]	2.28 (1.84-2.72)	2.72 (2.69- 3.78)	<0.001
Model III[3]	2.07 (1.61-2.53)	2.90 (2.35-3.45)	<0.001
BMI			
Model I[1]	0.72 (0.51-0.93)	1.59 (1.32- 1.86)	<0.001
Model II[2]	0.60 (0.44-0.77)	1.22 (1.03-1.41)	<0.001
Model III[3]	0.44 (0.27-0.61)	0.94 (0.74-1.14)	<0.001
WC (cm)			
Model I[1]	2.44 (1.82-3.06)	4.58 (3.75-5.41)	<0.001
Model II[2]	1.96 (1.52-2.41)	3.21 (2.65-3.76)	<0.001
Model III[3]	1.57 (1.11-2.03)	2.63 (2.07-3.19)	<0.001
WHtR			
Model I[1]	0.008 (0.005-0.01)	0.014 (0.01-0.017)	<0.001
Model II[2]	0.006 (0.003-0.009)	0.011 (0.008-0.015)	<0.001
Model III[3]	0.004 (0.001-0.007)	0.008 (0.004-0.012)	<0.001
Wrist (cm)			
Model I[1]	0.24 (0.14-0.35)	0.45 (0.31-0.60)	<0.001
Model II[2]	0.21 (0.14-0.27)	0.28 (0.20-0.37)	<0.001
Model III[3]	. 18 (0.11-0.25)	0.23 (0.14-0.32)	<0.001
Hip (cm)			
Model I[1]	2.32 (1.44-3.20)	5.18 (3.98-6.38)	<0.001
Model II[2]	1.74 (1.19- 2.29)	3.42 (2.74-4.10)	<0.001
Model III[3]	1.42 (0.88-1.96)	2.93 (2.20-3.66)	<0.001
WHR			
Model I[1]	-0.002 (-0.003, -0.0007)	-0.006 (-0.008, -0.004)	<0.001
Model II[2]	-0.004 (-0.002,-0.0004)	-0.0038 (-0.005, -0.002)	<0.001
Model III[3]	-0.0008 (-0.0023,0.0005)	-0.0036 (-0.005, -0.002)	<0.001
SBP (mmHg)			
Model I[1]	1.51 (0.77-2.26)	2.18 (1.20- 3.17)	<0.001
Model II[2]	1.07 (0.42- 1.72)	0.95 (0.13-1.78)	0.025
Model III[3]	0.96 (0.29- 1.63)	1.63 (-0.07-1.60)	0.079
Model IV[4]	0.70 (0.03-1.36)	0.19 (-0.64-1.03)	0.674
DBP (mmHg)			
Model I[1]	0.41 (-0.22-1.05)	0.35 (-0.49-1.20)	0.41
Model II[2]	0.11 (-0.48-0.71)	-0.42 (-1.19- 0.33)	0.26
Model III[3]	0.056 (-0.55-0.66)	-0.49 (-1.27- 0.27)	0.20
Model IV[4]	-0.10 (-0.70-0.49)	-0.86 (-1.63- -0.095)	0.02

Discussion

This study found a strong linear correlation between SES and weight disorders among a nation-wide sample of Iranian children and adolescents. This study confirms the existence a double burden of nutritional disorders in Iranian population, and

finds SES as an independent predictor for both obesity-overweight and underweight.

Results of the present study are congruent with existing data (19). Previous studies have demonstrated similar double burden of malnutrition in other developing countries (20-24). These studies have correlated some aspects of SES; for example one study reported underweight to be two times higher in public school children than in private school children (21), other studies reported an increase in obesity and underweight in urban and rural communities respectively (20,22). One study showed that lower educational level of the caregivers is associated with underweight and stunting (21). One possible explanation for the observed double burden of malnutrition might be the change in social classes, which comes with economic improvement. It might be that once a country begins to thrive economically; some classes grow faster than others, resulting in a disproportionate economic growth and SES disparity. Thus higher social classes with an urban, industrial lifestyle would suffer more from the incommunicable diseases and its risk factors such as obesity, while lower, less industrialized classes suffer the same old diseases associated with under nutrition like underweight, stunting etc. It seems to be a universal transitional phenomenon in underdeveloped nations beginning rapid growth (23, 24). As a country with a fast developing economy and social disparity, China is a good comparable model. Previous studies have reported a disparity in SES and health care in China, as well as a correlation between obesity and SES in school- aged children (25-27).

None of the abovementioned studies had approached our population size, which makes this study more generalizable than the others. Another advantage of the present study is the inclusiveness of socio-economic factors that were taken into consideration, which were summarized using the factor analysis procedure.

Although a wide range of factors, both genetic and environmental, are associated with the occurrence and extent of obesity (28-33), it is logical to consider that economic growth and SES of individuals are not correlated with their genetic background, and so with economic development and industrialization and resulting elimination of hunger and under nutrition, individuals with the genetic background of obesity become obese. Thus, when an under developed country is planning economic growth it should take into consideration the trade-off between under nutrition on one hand, and obesity and overweight on the other, and take preventive measures.

Study limitations and strengths

This study is a cross-sectional study, which makes causal inference of this data incredible. In addition, other possible factors influencing anthropometric measures as puberty and possible genetic difference of different regions of the country are not considered. In present study for estimating SES, from family asset variables only type of home, possessing private car and personal computer was available which may reduce the precision of the estimate.

Conclusion

This study shows a double burden of weight disorders in Iranian children and adolescents. We also found that obesity, overweight and abdominal obesity was prevalent in high SES group and underweight in low SES group. Our findings serve as confirmatory evidence that contrary to developed countries, in developing countries childhood obesity is more prevalent in families with higher SES.

Ethical considerations

Ethical issues (Including plagiarism, Informed Consent, misconduct, and/or falsification, double publication) have been considered carefully.

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