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ORIGINAL ARTICLE

Correlation of Obesity and Cardiovascular Diseases Risk Factors in Girls: Tehran Lipid and Glucose Study (TLGS)

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This study aimed at investigating the correlation of obesity with cardiovascular disease risk factors among children and adolescent girls.

Materials and Methods: In this cross sectional study, representative samples of 2061 girls, aged 3–18 years, were selected from among participants of the Tehran Lipid and Glucose Study. Systolic and diastolic blood pressure (BP), weight and height were measured and BMI was calculated. Serum concentrations of triglycerides (TG) and HDL-C were measured and LDL-C was calculated.

Results: Obesity affected 4.7% of the girls. Mean values of BMI, systolic and diastolic BP and TG increased with advancing age. Serum HDL-C, LDL-C and cholesterol levels increased with age up to the age of 12 years and decreased thereafter with advancing age. Compared with non-obese girls, obese girls had greater risks of high TG (OR=1.76, CI=0.48–5.08), high LDL-C (OR=1.3 , CI=0.86–0.95), high cholesterol (OR=2.0,CI=0.06–3.72), low HDL-C (OR=1.46, CI=0.21–5.20), high systolic BP (OR=2.3, CI=0.08-5.22), and high diastolic BP (OR=2.4, CI=1.71–14.48).

Conclusion: Prevalence of cardiovascular risk factors increase in children and adolescent obese girls in Tehran.

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Introduction

Until most recently the importance of obesity and overweight among children had not been emphasized enough. It is estimated that, there are a total of 155 million overweight children and around 30-45 million are classified as obese.[1,2] Much concern is being expressed both about the early consequences and lifetime effects of obesity in both children and adolescents.

Recent surveys have shown alarming prevalence of pediatric obesity in the Middle East countries,[3] including Iran.[4] There has been rapid social development and modernization in the Middle East countries, which has caused large social gaps and socioeconomic inequality within populations. Like most countries that have undergone rapid economic and demographical transition, Iran is in nutrition transition[5] and noncommunicable diseases, especially cardiovascular disease, are at present the major cause of morbidity and morality.

It is most likely that pediatric obesity has similar adverse health consequences that will

manifest in adulthood, because significant correlations between obesity and cardiovascular disease (CVD) risk factors in pediatric populations, similar to those found in adults have been reported.[6] Moreover, obesity tracks from childhood into early adulthood.[7,8] In a population-based sample, approximately 60 percent of severely overweight children, aged 5 to 10 years, had at least one CVD risk factor, such as elevated total cholesterol, triglycerides, insulin, or blood pressure, while 25 percent had two or more CVD risk factors.[9]

It is the objective of this study to assess the correlation between obesity and cardiovascular disease risk factors among children and adolescents girls in Tehran.

Materials and Methods

This cross-sectional study is a part of large cohort of the Tehran Lipid and Glucose Study (TLGS), which is a large scale community based prospective study performed on a representative sample of residents of district-13 of Tehran, the capital of Iran; Tehran city covers an area of 1500 sq. kms and consists of 22 districts with a total population of over 13 million people; the TLGS, first established in 1999, is a cross-sectional study that aims at determining the prevalence of non-communicable disease (NCD) risk factors. Rationales and design of the TLGS have been published elsewhere in detail.[10]

All girls aged 3-18 years, participants in the TLGS were selected for this study, and 2061 subjects were enrolled. A trained physician measured systolic and diastolic blood pressure twice after a period of rest (approximately 15 minutes) while participants were in a seated position using a standard mercury sphygmomanometer calibrated by the Iranian Institute of Standards and Industrial Research.

Participants removed their shoes and wore light clothing for anthropometric measurements. Height was measured by using a tape meter stadiometer and weight was measured by using an electronic scale (Seca, 707; range 0.1-150 kg). Body mass index (BMI) was then calculated ($BMI=W/H^2$ in which W is weight in kilograms and H is height in meters).

The serum samples of the all participants, were taken after an overnight fast. Serum total cholesterol (enzymatic method), high density lipoprotein-cholesterol (HDL-C enzymatic method after precipitation with phosphotungistic acid), and triglycerides (enzymatic method with glycerol phosphate oxidize) were determined, using a Selectra 2 autoanalyzer. The LDL-C concentration was calculated (Friedwald's formula) if triglyceride concentration was ≤400 mg/dL.[11]

Definitions

In children and adolescents, overweight is defined as BMI at or above the 85th percentile for age and sex but less than 95th percentile, and obesity above 95th percentile. Hypertension is defined as blood pressure at or slightly above the 95th percentile for age and sex.[12] Dyslipoproteinemia among the children and adolescents was defined as total cholesterol, LDL-C or triglycerides equal to or greater than the 95th percentile, or when HDL-C was equal to or less than the 5th percentile for age and sex.[13]

Statistical analysis

Both descriptive and statistical analysis methods were applied. Analyses were done using SPSS version 11.5. Data are presented as mean±SD. The χ^2 test was used to compare proportions. When more than 20% of the cells had expected frequencies of less than 5, Fisher exact test was used. To examine the relationship between obesity and the presence of other CVD risk factors, odds ratios were calculated comparing the proportions of obese girls who had high LDL-C, high triglycerides, low HDL-C, and high systolic or diastolic blood pressure compared with normal-weight girls. Logistic regression models were applied to calculate odds ratios (OR) for the presence of CVD risk factors. P value <0.05 was considered statistically significant.

Results

A total of 2061 girls, aged 3–18 years, with a mean age of 11.7±4.3 years were studied.

Prevalence of obesity among the girls was 97 (4.7%). The age-specific distribution of cardiovascular risk factors in girls is shown in Table 1. As expected, mean values of BMI, systolic and diastolic blood pressure and serum triglycerides increased with advancing age.

Table 1. Mean±SD of cardiovascular risk factors in 2061 Tehranian girls: Tehran Lipid and Glucose Study

Age groups (years)	N	BMI (kg/m^2)	Blood Pressure (mmHg)		Triglycerides (mg/dL)	Cholesterol (mg/dL)	LDL–C (mg/dL)	HDL-C (mg/dL)
			Diastolic	Systolic				
3-5.99	264	15±2	97±13	66±11	88±36	171±28	109±24	44±10
6-12	774	17±4	102±11	70±10	107±51	176±34	109±31	45±11
>12-18	1023	21±4	105±11	72±9	111±58	169±30	104±27	43±10
All	2061	19±4	103±11	70±10	106±49	172±30	107±27	44±10

In obese girls, age–specific prevalence of hypercholesterolemia, hypertriglyceridemia, systolic hypertension (except in the 12-18 year age group) and LDL-C hyperlipoproteinemia increased and HDL-C decreased with advancing age.

Table 2 shows odds ratio of having risk factors in obese girls. In girls, aged 3-6 years, high diastolic blood pressure, in those aged >6-12 years, high triglycerides and low HDL-C and in those aged >12-18 years, high systolic and diastolic blood pressure, cholesterol and LDL-C had significant odds ratio in obese, as compared to normal weight girls.

Table 2. Odds ratios for cardiovascular risk categories in obese girls by age groups: Tehran Lipid and Glucose Study

Age groups (years)	Blood Pressure (BP>95th)		LDL-C ≥95th	Triglycerides ≥90th	Cholesterol ≥95th	HDL-C ≤5th
	Systolic	Diastolic				
3-5.99	0.7*	5.0†	0	1.56	0.5	0.9
6-12	2.2	1.0	1.3	2.3†	0.5	2.0
>12-18	6.0†	5.0†	2.1	1.4	2.8†	1.0

* Numbers are odds ratios, † Statistically significant

In general, obesity was associated with significantly elevated risks of systolic and diastolic hypertension (OR=2.3, CI= 0.08-5.22 and OR=2.4, CI=1.71–14.48), LDL-C hyperlipoproteinemia (OR=1.3, CI=0.86–0.95), hypertriglyceridemia (OR=1.76, CI=0.48–5.08), hypercholesterolemia (OR=2.0, CI=0.06–3.72) and low HDL-C (OR=1.46, CI=0.21–5.20), all $p<0.05$.

Table 3 shows frequency of girls with zero to six factors; 49.9, 63.5 and 50.4% of girls in age groups of 3-5.99, 6-12 and 12-18 years respectively, had at least one risk factor

Table 3. Frequency of one to six risk factors in Tehranian girls: Tehran Lipid and Glucose Study

Age groups (years)	Frequency						
	0	1	2	3	4	5	6
3-5.99	176 (50.1)*	104 (29.6)	52 (14.8)	15 (4.3)	3 (0.9)	1 (0.3)	0
6-12	299 (36.5)	292 (35.7)	134 (16.4)	65 (7.9)	25 (3.1)	3 (0.4)	1 (0.1)
12-18	527 (49.6)	368 (34.6)	94 (8.8)	59 (5.6)	13 (1.2)	2 (0.2)	0
Total	1002 (44.9)	764 (34.2)	280 (12.5)	139 (6.2)	41 (1.8)	6 (0.3)	1 (0.01)

* Percent

Discussion

This study, performed in a large number of Tehranian girls, shows a high prevalence of cardiovasular risk factors in Tehranian girls with advancing age.

The 4.7% prevalence of obesity in the present study is much less than those reported in other studies. Prevalence of obesity among 965 children and adolescents, aged 10-18 years, from northern Mexico (51.7% female), was 27.7%.[14] Overweight in Korean girls aged 10–18 years was 10.9% in 2001.[15] Prevalence of obesity among Japanese schoolgirls, aged between 7 and 12 years, was 27 %.[16]

Mean values of BMI, systolic and diastolic blood pressure and HDL-C were lower and serum LDL-C and triglycerides were higher than results from previous studies,[16-18] which probably result from the low prevalence of obesity in girls in the TLGS. Analyses of data from multiple Bogalusa surveys conducted between 1978 and 1996, using BMI instead of waist circumference, showed that the clustered presence in childhood of top-quartile values for BMI, blood pressure, insulin, and triglycerides or low HDL-C levels predicted their clustered presence in young adulthood, 11 years later.[19]

The odds ratio of CVD risk factors in obese girls is in accordance with previous findings, including girls in Korea,[15] Taiwan,[20] the Bogalusa Heart Study,[21] the Ten Town Heart Health study[22] and a study by Sorof et al.[23]

It is well known that sex hormones affect lipid metabolism. Pubertal maturation has been associated with lipids changes.[24,25] If puberty explains some of the variation in non-healthy lipid levels, above and beyond those due to age, puberty may impact the estimated association of lipids with overweight. The pubertal period, a time when body fat is rapidly deposited, may be a vulnerable period during which risk for overweight becomes more pronounced.[12,26] The rapid increase in overweight between the ages of 9-12 years suggests that this pubertal period may be an especially important time for clinical and public health interventions to prevent overweight.[27] Pubertal development is associated with increases in BMI, but transient decreases in lipid levels.[28] Compared to other studies, the overweight girls in our study might be more sexually mature and, therefore, have slightly lower lipid concentrations.[17]

The age-related evolution of CVD variables is mainly driven by rapid physical changes during childhood and adolescence, whereas it may be affected to a greater extent by variations in environment and lifestyle during adulthood.[25]

It is concluded that CVD risk factors are frequently seen in obese girls and increase with advancing age. Periodic universal obesity monitoring in schools may be a valuable component of community-based obesity prevention efforts for these population groups.

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