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Cardiovascular disease risk factors among children of different socioeconomic status in Istanbul, Turkey: Directions for public health and nutrition policy

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Abstract

Objectives: The aim of the current study was to examine the influence of socioeconomic status (SES) on physiological (lipid profile, obesity indices) and behavioral (dietary habits, physical activity) cardiovascular disease (CVD) risk factors among primary schoolchildren in Istanbul.

Design: Cross sectional study.

Setting: One private school and two public schools from different SES districts in Istanbul.

Participants: 510 randomly selected children aged 12 and 13 years old (257 boys, 253 girls).

Results: The prevalence of overweight (15.2%) and the energy intake ($p < 0.001$ and $p < 0.05$ for boys and girls respectively) were found to be higher for the middle/ high SES group for both genders. Regarding biochemical indices, middle/ high SES children had higher values of High Density Lipoprotein-cholesterol (HDL-C) ($p < 0.001$ and $p < 0.05$ for boys and girls respectively) and lower values of TC/HDL-C ratio and LDL-C/HDL-C ratio ($p < 0.05$ and $p < 0.001$ for boys and girls respectively). This could be attributed to the higher physical activity levels observed for middle/ high SES children ($p < 0.001$).

Conclusion: The findings of the current study revealed a coexistence of both overweight and higher energy intake in middle/ high SES children, as well as a coexistence of underweight and lower physical activity levels in low SES children. These observations should guide the public health policy in developing appropriate intervention strategies to efficiently tackle these health and social issues early in life.

Introduction

Cardiovascular disease (CVD) is the primary cause of mortality in developed countries and generates a major burden of morbidity throughout life [1,2]. Additionally, CVD emergencies have become the leading cause of death in developing countries as well [3,4]. Prospective and retrospective studies have shown that CVD risk factors, namely obesity, the lipid profile, unhealthy diets and sedentary lifestyle, have their roots in childhood and tend to track into adulthood [5-8]. Therefore, early identification and understanding of behavioral and physiological variables related to CVD are essential, so that appropriate interventions can be targeted to children, minimizing the risk of developing the disease later in life.

The continuing modernization and technological advancement of the developing world has brought about rapid lifestyle changes (e.g. fast-food culture, caloric dense diets, sedentary lifestyle), which are known to have a major impact on the development of CVD and other chronic diseases [8,9]. Many recent reports have identified socioeconomic status (SES) differences, as another important parameter that appears to influence the accelerating prevalence of CVD risk factors in both developed and developing world [10-12]. More specifically, the existing epidemiological evidence indicates that SES is inversely associated with CVD morbidity and mortality in developed countries [11,13], while in developing countries, existing data on SES and the prevalence of CVD are inconsistent [14-16].

As far as Turkey is concerned, the available data on the possible effect of SES on the clustering of CVD risk factors among children are limited and to the best of our knowledge, even more scarce data exist for Istanbul. Istanbul, which has experienced rapid urbanization and industrialization in the past few decades, is an overpopulated city, located in the European part of the Turkish territory. The purpose of the present study was to examine the influence of SES on CVD risk factors, specifically the lipid profile and behavioral indices, among children of Istanbul, as well as to expand our knowledge and understanding on the interrelationship of all these parameters to the development of CVD.

Methods

Sampling

This cross-sectional study was carried out from November 2001 until May 2002. The study population consisted of primary schoolchildren aged 12 and 13 years old, living in Istanbul. Out of totally 650 6th grade primary school children registered in the selected schools, 510 pupils (78.5%) were finally studied (257 males, 253 females). Inclusion of subjects was on a voluntary basis; prior to acceptance, children's parents or guardians were fully informed about the objectives and methods of the study and signed a consent form.

The study population was selected from one private and two public schools using the multi-stage sampling method. All children in the same class were invited to participate in the study to avoid ethical problems.

Approval to conduct this survey was granted by the Ethical Committee of Marmara University and the Turkish Ministry of Education.

Data collection

Baseline data was collected during face-to-face interviews with children by a team of trained personnel. The data collected from the children consisted of physiological indices, such as biochemical, anthropometrical and cardiorespiratory fitness measurement and behavioral indices, such as dietary habits, estimation of energy and nutrient intake and physical activity assessment. These data are presented in more detail below.

SES assessment

From the data provided by the Ministry of National Education and the National Statistical Centre of Turkey three districts within the metropolitan area of Istanbul were identified. These three districts are inhabited by citizens with distinguished SES and consequently this is reflected on the SES of the pupils attending the schools within the respected school zones. From the high SES district a private school was selected randomly among all the private schools located in that zone, while for the middle and low SES districts one public school, from each one of these areas, among the public schools located in these two zones respectively was selected.

Hence for the needs of the present study the SES grouping of the pupils was based on the SES of the district their schools were located, while middle and high SES group children were grouped as one group.

Anthropometrical measurements

Body weight was measured using a digital scale (Seca) with an accuracy of ± 100 g. Subjects were weighed without shoes, in the minimum clothing possible, i.e. underwear. Standing height was measured without shoes to the nearest 0.5 cm with the use of a commercial stadiometer, with the shoulders in relaxed position and arms hanging freely [17]. Body Mass Index (BMI) was calculated by dividing weight (kg) by height squared (m^2). Left triceps, biceps, subscapular and suprailiac skinfold thickness, were measured with a Lange skinfold calliper. The sum of these four skinfolds was then estimated.

Definition of underweight and overweight

Based on the US NHANES I data, in the current study the 5th percentile for BMI was used as a cut-off point for defining childhood underweight [18]. This method is recommended by the Centre of Diseases Control (CDC), as well as for international use for adolescents aged 10–19 years by a WHO expert committee [19].

Regarding classification of the under study population in overweight and obese, the age- and sex-specific BMI cut-off points proposed by the Childhood Obesity Working Group of the International Obesity Task Force (IOTF) have been adopted in the current study [20]. These cut-off points are based on the reference values of Cole et al (2000) and they are widely used in many studies with children and adolescents [21-23]. Due to the relatively low prevalence of obesity in the current population, for further examination of health indices associated with obesity per se, apart from the initial estimation of prevalence rate, in all other data analysis both overweight and obese subjects were grouped together as overweight [22].

Biochemical indices

Early morning venous blood samples were obtained from each child for biochemical screening tests, following a 12-h overnight fast. Professional staff performed venipuncture, using vacutainers to obtain 10 ml of whole blood. When blood collection was completed all samples were stored at 3–4°C and sent to Marmara University, Faculty of Health Education where the actual biochemical analysis took place.

One of these aliquots was used for the determination of several biochemical parameters. Total cholesterol (TC) was determined using Allain's method [23], while Fossati's method was used for triglycerides (TG) determination [24]. High Density Lipoprotein-cholesterol (HDL-C) was measured by the heparin-manganese precipitation method. Low Density Lipoprotein-cholesterol (LDL-C) was calculated as follows: LDL-C = TC - (HDL-C + TG/5) [25].

Dietary assessment

Food consumption of children was assessed by the 24-hour recall technique on three consecutive days. Dietary data was collected from children during a face-to-face interview with a trained dietician. Dieticians were trained as a group to minimize inter-observer variation. During the interview, food models and photos of common Turkish dishes of various portions, as well as household cups and measures were used to define amounts, in order to obtain as accurate information as possible, regarding the type and amount of food and beverages consumed during the previous day. Macronutrient and micronutrient intake were calculated using the food database available in Marmara University, Faculty of Health Education. This database contains Turkish food composition tables for all food, including cooked Turkish dishes. Information on processed foods was obtained from food companies and national as well as international fast food chains.

Physical activity assessment

Physical activity during school hours and leisure time was assessed using a standardized physical activity diary completed by the children for two consecutive weekdays and one weekend day. A member of the research team cross-checked diary information during daily interviews. The diary was constructed for searching various physical activities ranging from mild to vigorous [24], while the time spent for each type of activity was recorded in hours.

Activities were classified into two groups, namely Sedentary and Light Activities (< 4 METs) and Moderate to Vigorous Physical Activities (MVPA) (> 4 METs). Typical activities in the Sedentary and Light category were watching TV, board and computer games, studying and extra curricular classes (e.g. music, language), etc. The MVPA category included activities such as walking, bicycling, rhythmic-gymnastics, dancing, basketball, soccer, athletics, tennis, swimming, running up and down, jumping rope and general participation in active outdoors games. Given the age group, MVPA was defined as continuous vigorous activity causing sweating and heavy breathing for periods longer than 15 minutes, but with occasional breaks in intensity, rather than the strict aerobic definition of 20 continuous minutes appropriate for adults.

Cardiorespiratory fitness assessment

Cardiorespiratory fitness was estimated indirectly according to children's performance on the Endurance 20 m shuttle Run Test (ERT). The ERT is a field test included in the European battery of physical fitness tests and is recommended by the Committee of Experts on Sports Research for the assessment of cardiorespiratory fitness in school children [25]. During this test, subjects start running at a speed of 8.5 Km/h and speed is increased at various stages. The subjects move between two lines at a distance of 20 m apart, reversing direction and continuing backwards and forwards in accordance with a pace dictated by a sound signal on an audio tape, which gets progressively faster (0,5 Km/h every minute). Each stage of the test is made up of several shuttle runs, but the actual score of the subject is the last half stage fully completed before they drop out (the stages are 0.0, 0.5, 1.0, 1.5, 2.0 etc). In our study, the number of shuttle runs that each child completed was estimated and referred as ERT score. The higher the ERT score the better the cardiovascular function. The ERT is recommended for large groups of children since it is reliable, valid, non-invasive and requires limited facilities [26].

Statistical analysis

Descriptive statistics of continuous variables are expressed as the mean ± Standard Deviation (SD). At first, univariate linear regression analysis was performed in order to determine variables related to BMI. Only variables with

Table 1: Characteristics of the study population. Data are the mean ± SD.

	Boys (n = 257)	Girls (n = 253)
Age (years)	12,6 ± 0,5	12,5 ± 0,5
Height (cm)	151,1 ± 9,0	151,2 ± 7,8
Weight (kg)	41,1 ± 9,9	42,5 ± 9,7
BMI (kg/m^2)[a]	17,8 ± 3,0	18,4 ± 3,1
Sum of skinfolds (mm)	34,8 ± 19,8	42,1 ± 20,2

[a]Parameter was log transformed.

Table 2: Percentage of children in middle/ high and low SES groups by USA percentiles and Cole cut-off points

	Boys				Girls				Total			
	Middle/ High SES (n = 144)		Low SES (n = 113)		Middle/ High SES (n = 132)		Low SES (n = 121)		Middle/ High SES (n = 276)		Low SES (n = 234)	
	n	%	n	%	n	%	n	%	n	%	n	%
Underweight	20	13,9*	29	25,7	12	9,1	15	12,4	32	11,6*	44	18,8
Normal	104	72,2	76	67,3	98	74,2	94	77,7	202	73,2	170	72,6
Overweight	20	13,9	8	7,1	22	16,7	12	9,9	42	15,2*	20	8,5

* $p < 0.05$ vs. corresponding proportion in Low SES group. Underweight = all children with BMI-for-age < 5th percentile according to CDC BMI-for-age gender specific charts for US children. Normal = all children with BMI-for-age between the 5th percentile and the reference values of Cole et al equivalent to an adult BMI of 25. Overweight = all children with BMI-for-age above the reference values of Cole et al equivalent to an adult BMI of 25.

significant association were used to subsequent analysis. All variables followed a normal distribution with the exception of BMI, HDL-C, LDL-C, TG, energy and fat intake, which were transformed using the natural logarithm before further analysis.

The chi-square test was used to compare prevalence and percentages between SES groups for both sexes. Differences between low and middle/ high SES children in relation to physiological and behavioral indices were determined using the Independent Sample T-test. All analyses were conducted using the SPSS 10.0 statistical software package for Windows. In all analyses a 5% significance level was used.

Results

The descriptive characteristics of the sample are summarized in Table 1. In Table 2 it can be seen that the prevalence of underweight, normal weight and overweight in the total sample was 11.6%, 73.2%, 15.2% for middle/ high SES children and 18.8%, 72.6%, 8.5% for low SES children respectively. The prevalence of underweight was significantly higher and the prevalence of overweight was significantly lower in the low SES group compared to the middle/ high SES group ($p < 0.05$).

Table 3 summarizes the results derived comparing anthropometrical and biochemical indices between low SES and middle/ high SES children. For both sexes, all anthropometrical indices were found to be significantly lower for the low SES group, compared to the middle/high SES group. Regarding biochemical indices, middle/ high SES children had significantly higher values of HDL-C ($p < 0.001$ and $p < 0.05$ for boys and girls respectively) and lower values of TC/HDL-C ratio and LDL-C/HDL-C ratio ($p < 0.05$ and $p < 0.001$ for boys and girls respectively) than their low SES counterparts. Additionally, TC ($p < 0.05$) and LDL-C ($p < 0.01$) were found to be lower for middle/ high SES girls. As far as TG levels are concerned, no significant differences were observed among middle/ high SES and low SES children.

Behavioral indices of the under study population are presented in Table 4 and Table 5. In Table 4 it can be seen that middle/ high SES children reported higher energy intake ($p < 0.001$ and $p < 0.05$ for boys and girls respectively) compared to their low SES counterparts. Furthermore, protein and fat intakes were found to be higher in the middle/ high SES boys compared to their low SES peers ($p < 0.05$). The same tendency was observed for girls, although it did not reach a significant level. As far as carbohydrate intake is concerned, no differences were observed for both sexes.

Table 3: Anthropometric data (mean ± SD) and plasma lipid levels (mean mg/dl ± SD) according to gender and SES

	Boys		Girls	
	Middle/ High SES	Low SES	Middle/ High SES	Low SES
Anthropometrical data				
Height (cm)	152.7 ± 8.6***	149.1 ± 9.1	152.5 ± 7.8**	149.8 ± 7.6
Weight (kg)	43.3 ± 10.0***	38.4 ± 9.1	44.2 ± 9.6***	40.6 ± 9.6
BMI (kg/m^2)[a]	18.4 ± 3.2***	17.1 ± 2.6	18.9 ± 3.1**	17.9 ± 3.00
Sum of Skinfolds (mm)	40.0 ± 23.5***	28.1 ± 10.5	49.7 ± 23.7***	33.8 ± 10.6
Biochemical data				
TC (mg/dl)	157.6 ± 29.9	155.3 ± 27.9	159.5 ± 32.0*	168.8 ± 29.9
HDL-C (mg/dl)[a]	60.4 ± 13.3***	54.7 ± 11.9	59.9 ± 12.3*	56.1 ± 13.3
LDL-C (mg/dl)[a]	80.4 ± 29.0	82.5 ± 23.9	82.2 ± 32.1**	91.6 ± 29.3
TG (mg/dl)[a]	86.4 ± 44.0	88.6 ± 50.0	90.9 ± 57.4	99.6 ± 44.7
TC/HDL-C	2.8 ± 0.9*	3.0 ± 0.8	2.8 ± 0.8***	3.1 ± 0.8
LDL-C/HDL-C[a]	1.4 ± 0.7*	1.6 ± 0.6	1.5 ± 0.7***	1.7 ± 0.7

*p < 0.05; **p < 0.01; ***p < 0.001 vs. corresponding mean values in Low SES group. [a]Parameter was log transformed.

Table 4: Energy and macronutrient intakes (mean ± SD) according to gender and SES

	Boys		Girls	
	Middle/ High SES	Low SES	Middle/ High SES	Low SES
Energy Intake[a] (kcal/day)	2,094 ± 600,5***	1,878 ± 549,3	1,919 ± 488,2*	1,796 ± 555.9
Protein Intake[a] (g/day)	71.7 ± 23.0*	65.8 ± 22.3	64.7 ± 22.4	62.2 ± 23.7
Fat Intake[a] (g/day)	73.7 ± 28.0*	66.4 ± 27.9	70.5 ± 25.6	65.6 ± 28.0
CHO Intake (g/day)	211.4 ± 76.7	210.1 ± 70.7	179.5 ± 59.0	183.7 ± 63.5

* p < 0.05; ** p < 0.01; *** p < 0.001 vs. corresponding mean values in Low SES group.[a]Parameter was log transformed.

Table 5: Physical activity and fitness indices (mean ± SD) according to gender and SES.

	Boys		Girls	
	Middle/ High SES	Low SES	Middle/ High SES	Low SES
Physical activity				
Sedentary Activities (hours/week)	156.4 ± 6.5***	163.6 ± 4.4	160.9 ± 5.3***	166.1 ± 2.5
MVPA (hours/week)	8.2 ± 6.1***	3.8 ± 4.2	3.6 ± 4.6***	1.0 ± 2.1
Physical fitness				
ERT score	36.5 ± 15.0	34.3 ± 13.3	25.1 ± 9.7	24.0 ± 8.5

*p < 0.05; **p < 0.01; ***p < 0.001 vs. corresponding mean values in low SES group.

Physical activity and fitness indices are presented in Table 5. For both genders, the weekly time devoted into MVPA activities was higher in the middle/ high SES group compared to the low SES group ($p < 0.001$), while the opposite was detected for the time devoted to sedentary activities ($p < 0.001$). Finally, no significant differences were observed for the performance in ERT among middle/ high SES and low SES children.

Discussion

The current study aimed at recording CVD risk factors among children of different SES in Istanbul. A coexistence of both underweight and overweight in the current population was revealed, which reflects the impeding nutrition transition occurring in Istanbul. The prevalence of overweight was found to be higher in middle/ high SES children compared to their low SES counterparts. Despite the use of different SES indices, the results of the present study are in agreement with many other studies, indicating that overweight is more prevalent among children of higher SES in developing countries [20,27,28]. However, the opposite trend is observed in the developed world [16,27,29].

Additionally, the present study showed that middle/ high SES children had higher values in anthropometrical indices namely, height, weight, BMI and sum of skinfolds, similarly to the results of another study conducted on children in Turkey by Mahley et al (2001) [30].

As shown in Table 3, most of the biochemical indices were found to be in favour of middle/ high SES children. In the previous mentioned study above conducted in Turkey, it was demonstrated that HDL-C and TC levels were higher in upper SES children [30]. These findings are in accordance to the current study, only as far as HDL-C is concerned. Additionally, another interesting finding of the current study is the coexistence of higher overweight indices with lower values of atherogenic indices (i.e. TC/HDL-C, LDL-C/ HDL-C) in the middle/ high SES children. This is in contrast with the available literature, where higher overweight and obesity indices are accompanied with more unfavourable atherogenic indices [31,32].

In order to further proceed with the understanding of the higher prevalence of overweight and the more favorable lipid profile among middle/ high SES children, the present study aimed at elucidating differences regarding dietary practices and physical activity patterns among children of different SES backgrounds. In terms of dietary intake, middle/ high SES children reported a higher intake for energy, while higher protein and fat intake in middle/ high SES groups reached a significant difference for boys. These findings are similar to the findings of Mahley et al (2001), in which total energy, protein and fat intake were higher for upper SES children, for both genders [30].

Regarding physical activity, the coexistence of higher prevalence of overweight and increased levels of physical activity in middle/ high SES groups is in inconsistency with the findings of other studies conducted on children in the developing world [20,33]. Regarding ERT scores, no differences were observed between the two SES groups, although middle/ high SES children were found to devote more time per week on MVPA than low SES children did. This could be explained by the higher values in weight and BMI observed in subjects with middle/ high SES versus those with low SES, since existing scientific evidence supports that both higher weight and BMI values negatively affect ERT score and therefore, fitness performance [34].

Taking into consideration all data presented above, it could be suggested that the higher values of overweight indices observed in children with middle/ high SES may be attributed to higher energy intake. Although the middle/ high SES subjects were more physically active than the low SES subjects, one might argue that the increased levels of physical activity do not counteract the increased energy intake in the middle/ high SES groups in both genders, leading to higher proportions of overweight among participants in higher socioeconomic position. On the other hand, the increased levels of physical activity in the middle/ high SES groups could possibly explain the more favorable profile of these subjects, predominantly HDL-C, as well as TC/ HDL-C and LDL-C/ HDL-C ratios. Supportive to this hypothesis are the findings of previously conducted surveys in children indicating that higher levels of physical activity are associated with higher values of HDL-C and with more favorable lipid profiles in general [35-37].

In conclusion, the results of the current study provide support to the existing scientific evidence suggesting that the prevalence of obesity is higher among upper SES children in developing countries. Additionally, the recorded prevalence of overweight, coupled with the coexisted undernutrition reflects the impeding nutrition transition occurring in Turkey, a pattern that has a SES dimension. These observations point out the emergent need for different measures to be implemented in order to counteract these health and social problems. Consequently, the outcomes of the current study should guide the public health policy in developing appropriate intervention strategies to efficiently tackle these issues early in life.

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