Evaluation of Secondary Dyslipidemia in Obese Children

Obez Çocuklarda Sekonder Dislipidemi Sıklığının Araştırılması

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ABSTRACT

Objective: This study was conducted to determine the frequency of dyslipidemia secondary to childhood obesity, a recently emerging clinical entity, and to compare serum lipid profiles in obese and non-obese children.

Material and Methods: After screening children with an obese appearance, a group of 119 obese children aged between 2 to 16 years with a body mass index above the 95th percentile and a control group of 124 children in a similar age range were compared in terms of serum lipid profile.

Results: An abnormal lipid profile was determined in 62.6% of obese children, and serum levels of total cholesterol and triglycerides were higher in this group. It was found that Childhood obesity was associated with higher levels of total cholesterol (44.5%), triglycerides (48.7%), LDL (38.7%), and lower levels of HDL (23.5%).

Conclusion: Obese children have a higher risk of secondary dyslipidemia and associated comorbidities. In order to prevent childhood obesity and its dangerous consequences, effective measures must be implemented in terms of screening, early diagnosis and appropriate treatment.

Key Words: Childhood, Dyslipidemia, Obesity

ÖZ

Amaç: Bu çalışma, çocukluk çağı obezitesine sekonder gelişen dislipideminin sıklığını belirlemek ve obez çocuklarla obez olmayan çocukların lipid profillerini karşılaştırmak amacıyla yapılmıştır.

Gereç ve Yöntemler: Obez görünümlü çocuklar taranarak saptanan, yaş aralığı 2-16 arasında ve vücut kitle indeksi 95. persentil eğrisi üzerinde olan 119 obez olgudan oluşan grup ve benzer yaş aralığındaki 124 olgudan oluşan kontrol grubu, serum lipid profili bakımından karşılaştırılmıştır.

Bulgular: Bulgularımıza göre anormal lipid profili obez çocuklarda %62.6 oranında saptandı ve total kolesterol ile trigliserid düzeyleri kontrol grubuna göre daha yüksekti. Çocuklarda obezite, total kolesterol yüksekliği (%44.5), trigliserid yüksekliği (%48.7), LDL yüksekliği (%38.7) ve HDL düşüklüğü (%23.5) ile ilişkili bulundu.

Sonuç: Obez çocuklar sekonder dislipidemi ve ilişkili hastalıklar açısından risk altındadır. Obezite ve dislipideminin komplikasyonlarını önlemek amacıyla çocukluk çağı obezitesine yönelik tarama, erken teşhis ve uygun tedavinin başlanması önem taşımaktadır.

Anahtar Sözcükler: Çocukluk çağı, Dislipidemi, Obezite

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Contribution of the Authors / Yazarların katkısı*: *ÇAKMAKCI S: Constructing the hypothesis or idea of research and/or article, Planning methodology to reach the conclusions, Taking responsibility in patient follow-up, collection of relevant biological materials, data management and reporting, execution of the experiments, Taking responsibility in logical interpretation and conclusion of the results, Taking responsibility in necessary literature review for the study, Taking responsibility in the writing of the whole or important parts of the study, Reviewing the article before submission scientifically besides spelling and grammar. ***YILDIZ F:*** Constructing the hypothesis or idea of research and/or article, Planning methodology to reach the conclusions, Organizing, supervising the course of progress and taking the responsibility of the research/study, Taking responsibility in logical interpretation and conclusion of the results, Reviewing the article before submission scientifically besides spelling and grammar.

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INTRODUCTION

The increasing frequency of pediatric obesity is an increasing public health problem, and is gradually becoming more explicit due to the decreasing engagement of children in physical activity, the changes in life circumstances and the lack of knowledge of the need to address obesity by both families and physicians (1).

The diagnosis of childhood obesity is based on body mass index (BMI, calculated as weight (kg)/height (m^2)). BMI percentile curves prepared based on age and sex identify those between 85th and 95th percentile as overweight, and those above the 95th percentile as obese. Associations have been reported between obesity and cardiovascular system diseases, hypertension, degenerative arthritis and type-2 diabetes in all age groups. Furthermore, obesity in adulthood has been associated with the individual's childhood status, and the mean lifetime in such people is shorter. It is important to screen for the degree of obesity, for comorbidities associated with family history and for other risk factors (2).

A study conducted in the United States reported that the prevalence of obesity in children and adolescents was 16% (2). The prevalence of childhood obesity in Türkiye has increased two-fold and three-fold in children aged 6–11 years and 12–17 years, respectively, since 1980 (2). Obesity, has become a significant health problem in Türkiye, especially among children residing in urban areas. The prevalence of obesity among children aged 6–11 year of parents with a high socioeconomic level was reported to be 30.2% in a study conducted in Istanbul between 2006 and 2007 (2). Factors such as age, sex, race, family history, nutritional habits, decreased physical activity and daily calorie intake play a role in the emergence of obesity (3).

Duration of childhood obesity has been linked to the development of heart disease (4). In childhood obesity associated with an inactive lifestyle and malnutrition, deterioration in the blood lipid profile can often be observed. The condition can manifest in childhood, and if ignored as a disease and not treated, can facilitate the emergence of many health problems, especially cardiovascular diseases, later in life.

The aim of this study was to determine the frequency, type and prevalence of dyslipidemia due to childhood obesity.

MATERIALS and METHODS

This cross-sectional study was carried out at the Istanbul Zeynep Kamil Women and Children Diseases Training and Research Hospital Paediatrics Clinic, after the approval of the local ethics committee (19 October 2010–15647) and written consent was obtained from the parents. The study group was established after screening comprising 119 children aged 2–16 years with a BMI at the 95th percentile and above with an obese appearance who presented to the outpatient pediatric clinic of pediatrics of the hospital. The weight and height of the children were measured and the BMI was calculated and compared with a control group of 124 children selected from non-obese children in the same age group. Obesity was defined as at the 95th percentile or above in a curve created based on sex and age according to BMI in male and female Turkish children (2). Cases with a history of drug use that may lead to obesity or primary liver disease that may cause fatty liver were excluded from the study.

Early morning venous blood samples were obtained from the participants after 8–12 hours of fasting. Total cholesterol, total triglyceride, low-density lipoprotein (LDL) and high-density lipoprotein (HDL) levels were measured in the Biochemistry Laboratory of the Istanbul Zeynep Kamil Women and Children Diseases Training and Research Hospital from the serumprepared from these samples using the method developed by Skelton and Rudolph (5). The total cholesterol, total triglyceride, LDL and HDL assays were performed using a COBAS Integra® 800 device (Roche Diagnostics International AG, Rotkreuz, Switzerland) whit appropriate kits to determine the serum lipid profile.

The comparisons of the patient and control groups were made based on total cholesterol ≥170 mg/dl, LDL cholesterol ≥110 mg/dl and HDL cholesterol 35 mg/dl cut-off levels. The cut-off value for triglyceride was accepted as ≥100 mg/dl for those aged 2–15 years and ≥125 mg/dl for those aged ≥15 years.

The patients were divided into five categories for the evaluation:

- Category 1: normolipidemia
- Category 2: elevated LDL alone
- Category 3: elevated triglyceride and decreased HDL
- Category 4: elevated triglyceride and LDL
- Category 5: elevated triglyceride and LDL with decreased HDL (or increased LDL and decreased HDL)

The data were analyzed using IBM Statistical Package for the Social Sciences, version 16.0 (SPSS Inc., Armonk, NY, IBM Corp., USA). Descriptive statistics were performed in order to calculate the frequency, percentage, mean, standart deviation, and median values. To compare the data of two groups, a Chi-square test was used for the categorical variables and a Mann-Whitney U test was used for the continuous numeric values. Data were analyzed with 95% confidence intervals; $p<0.050$ was considered significant.

RESULTS

A total of 243 children aged 2–16 years were participated in the study, of whom 119 (50 males, 42% and 69 females, 58%) were

Table I: Comparison of case and control groups according to lipid profile

	Case group*	Control group*	Chi-square	p
Normolipidaemia	34 (37.4)	82 (75.9)	30.209	<0.001
Lipid profile abnormality	57 (62.6)	26 (24.1)		

**: n(%)*

Table II: Comparative analysis of age, BMI and serum lipid profile findings in case and control groups

	Case group			Control group			p
	Mean	SD	Median	Mean	SD	Median	
Age	8.96	3.65	9.30	9.31	3.82	9.00	0.714
Body mass index	25.33	4.06	24.50	17.74	2.54	16.95	<0.001
Total cholesterol	166.76	43.06	161.00	140.40	22.76	140.00	<0.001
Triglyceride	108.37	56.87	100.00	83.08	15.69	80.50	<0.001
LDL cholesterol	102.78	38.38	101.00	95.30	20.71	90.50	0.167
HDL cholesterol	47.17	15.00	46.00	47.60	8.47	46.00	0.308
Atherogenic index	3.82	1.35	3.60	3.07	0.86	2.98	<0.001

HDL: *High density lipoprotein,* ***LDL:*** *Low density lipoprotein,* ***SD:*** *Standard deviation*

Table III: Comparison of case and control groups in terms of abnormal serum cholesterol (total, LDL and HDL) and triglyceride levels

	Case group*	Control group*	Chi-square	p
High total cholesterol				
Yes	53 (44.5)	12 (9.7)	37.662	<0.001
No	66 (55.5)	112 (90.3)		
High triglycerides				
Yes	58 (48.7)	10 (8.1)	49.852	<0.001
No	61 (51.3)	114 (91.9)		
High LDL cholesterol				
Yes	46 (38.7)	26 (21)	9.112	0.003
No	73 (61.3)	98 (79)		
High HDL cholesterol				
Yes	28 (23.5)	7 (5.6)	15.754	<0.001
No	91 (76.5)	117 (94.4)		

: *n (%)*

assigned to the obese patient group based on a BMI of 95th percentile and above, while 124 children (56 males, 45.2% and 68 females, 54.8%) were assigned to the control group. The mean ages of the patient and control groups were 8.96±3.65 and 9.31±3.82 years, respectively. There was no difference in terms of gender between the patients and the control group (p=0.621).

Lipid profile abnormality was significantly higher in the case group than in the control group (p<0.001) (Table I). The BMI (p<0.001), total cholesterol (p<0.001), triglyceride (p<0.001) and atherogenic index (p<0.001) values were found to be significantly higher in the study group than in the control group, as seen in Table II. The difference in total cholesterol levels was due to significantly higher triglyceride levels in the case group compared to the control group. There was no difference in the age (p=0.714), LDL cholesterol (p=0.167) and HDL cholesterol (p=0.308) levels of the two groups.

A comparison of the two groups revealed that the number of patients with high total cholesterol (p<0.001), triglyceride (p<0.001), LDL cholesterol (p=0.003) and HDL cholesterol (p<0.001) levels were significantly higher in the study group than in the control group (Table III).

Table IV. Distribution of case and control groups according to lipid profiles

Category	Case group*			Control group*		
	Male	Female	Total	Male	Female	Total
1	18 (47.4)	16 (30.2)	34 (37.4)	35 (70)	47 (81.0)	82 (75.9)
2	7 (18.4)	12 (22.6)	19 (20.9)	14 (28)	11 (19.0)	25 (23.2)
3	4 (10.5)	8 (15.1)	12 (13.2)	0	0	0
4	5 (13.2)	11 (20.8)	16 (17.6)	1 (2)	0	1 (0.9)
5	4 (10.5)	6 (11.3)	10 (11.0)	0	0	0

: *n(%)*

In study group no significant differences were determined in the age (p=0.331), total cholesterol (p=0.976), LDL cholesterol (p=0.633), HDL cholesterol (p=0.536) and triglyceride (p=0.586) levels of the male and female participants. Similarly, no significant differences were identified in the elevated total cholesterol (p=0.692) and LDL cholesterol (p=0.908), decreased HDL cholesterol (p=0.641) and increased triglyceride (p=0.291) levels of the male and female participants in control group.

When the case group is evaluated according to five lipid profiles, normolipidemia in 37.4%, only high cholesterol in 20.9%, high triglyceride and low HDL cholesterol in 13.2%, high LDL cholesterol and triglyceride in 17.6%, and low HDL cholesterol along with high LDL cholesterol-triglyceride levels were detected in 11% of the patients. In the control group, normolipidemia was 75.9%, LDL elevation alone was 23.1%, and LDL cholesterol and triglyceride elevation was 0.9% (Table IV).

DISCUSSION

Although obesity can be seen at any age, childhood obesity is particularly important since it affects the later periods of life and provides a basis for many adult diseases (6–8). The majority of research studies on the prevalence of obesity and its risk factors focus on adulthood, despite the importance of childhood obesity and its recently increasing frequency. A prevalence of

obesity of 16.3% was reported among children aged 2–17 years in a study conducted in the United States between 2003 and 2006, while a ratio of 9.7% was reported among school children in Venezuela (9,10). In Turkey, ratios varying between 1.6% and 12.5% have been reported in studies evaluating the prevalence of childhood obesity (11,12). The study revealed that the prevalence of the obesity in boys was slightly higher than in girls, but the difference was not significant (13–15). This lack of any significant difference between the childhood obesity rates of males and females may be due to the absence of such factors that increase the risk of obesity as pregnancy and menopause in childhood. Obesity was found to be slightly more common among female children (50.4%) than male children (47.2%) in our study compared to previous studies, although no significant difference was found between them, which concur with the findings in literature.

The findings of this present study support earlier studies reporting increased dyslipidemia in obese children, with mean total cholesterol and triglyceride levels significantly higher in the obese patients than in the control group. Childhood obesity has shown to be significantly associated with increased total cholesterol (44.5%), triglyceride (48.7%) and LDL (38.7%) levels, and decreased HDL (23.5%), suggesting an association between obesity and dyslipidemia, and highlighting the need to monitor the lipid profiles of people with obesity in the early phases and the application of proactive measures.

While BMI is used as a standard method in the diagnosis of obesity in adulthood, it is not used as a standard for childhood obesity because BMI assessment differs according to age in children (16). Although BMI is often used to define obesity, the association between BMI and lipid profile was not evaluated in the present study because the sample included children of different ages. Furthermore, the presence of characteristics that could contribute to obesity, such as familial factors, nutritional habits, physical activity and sedentary lifestyle, and their effects on obesity, were not analyzed given the cross-sectional study design.

Prospective and multicenter studies involving larger series are required to evaluate the cause-and-effect relationships between obesity and dyslipidemia, as the fact that parents may be deluded into thinking their child is not obese may lead them to be unwilling to allow them to be tested. This may be a reason for the small number of people participating in this study. The lack of awareness among physicians, in addition to the attitudes of families and the changing life circumstances have all contributed to obesity becoming a common public health problem, and it is clear that childhood obesity will continue to be a significant public health problem in the future.

Obesity and dyslipidemia in adulthood are conditions that require early diagnosis using appropriate screening methods and timely medical interventions due to the potential complications and socioeconomic outcomes. An efficient screening protocol in childhood may contribute to the better determination, prevention and treatment of risk factors associated with childhood obesity and accompanying dyslipidemia, and quality of life would be improved through the prevention of complications and comorbidities. The prevalence of the obesity-related chronic diseases among young adults would be significantly increased later in life without the implementation of the required precautions and an efficient treatment strategy for children related to obesity (17). In this context, the measurement of the lipid profile can be considered vital, along with the launch of a medical intervention program in support of obese children. In addition, screening for obesity in larger groups and studies evaluating the risk factors for the diagnosis of metabolic syndrome, diabetes mellitus and hypertension, are required, as well as programs to measure dyslipidemia, triglyceride, HDL and LDL levels, fasting blood glucose, insulin resistance and blood pressure values in obese children.

A multidisciplinary approach to obese children is needed to guide, for example, weight loss programs, the regulation of physical activity, changes to sedentary lifestyles and behavioral changes. Treatments targeting a decrease in lipid levels should be applied to obese patients, and physicians should explain the factors promoting the development and consequences of obesity when providing information on infant and child nutrition to the family during healthy child follow-up visits (18–20). Educating school-age children on appropriate nutrition and the prevention of obesity, and ensuring access to healthy nutrition school canteens are also important. As a further approach, school administrators should schedule regular gym classes, support students in participating in such classes and promote sporting activities. Reducing the screen time of children by regulating their use of television and computers would support the efforts to reverse a sedentary lifestyle. Efficient strategies targeting society as a whole should also be implemented in addition to those applied by the family and school administrations. Sports facilities from which all children can benefit should be created, and children and young people should be encouraged to take part in athletic activities as a communal duty. Advertisements in the media should be strictly audited when promoting high-calorie and hazardous food.

CONCLUSION

In conclusion, awareness of childhood obesity and dyslipidemia should be increased, and efficient screening, diagnostic and treatment strategies should be developed not only for physicians and healthcare personnel, but also for families, schools and society, as a combined measure against obesity and dyslipidemia, and throughout such a process, obesity should be regarded as a significant and preventable public health problem.

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